CRE Redevelopment Options and the Use of Mortgage Financing*

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Abstract

A significant share of commercial real estate (CRE) investment properties—about half by our estimates—are purchased without a mortgage. Using comprehensive microdata on transactions in the U.S. CRE market, we analyze which types of properties are purchased without a mortgage, highlighting the important role of renovation or redevelopment options. We show that properties that are financed by a mortgage are less likely to be subsequently redeveloped, and that owners anticipate these redevelopment frictions and avoid mortgage financing for properties with greater redevelopment options. These effects were even stronger during the COVID-19 pandemic, when uncertainty increased the redevelopment option value.

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1. INTRODUCTION

There is substantial evidence that collateral plays an important role in mitigating financial frictions (Hart and Moore, 1994). Real estate is especially well suited as collateral for loans, given it depreciates slowly (Rajan and Winton, 1995), and is relatively redeployable (Benmelech et al., 2005). Indeed, the commercial real estate (CRE) industry is generally known for operating with high leverage (Glancy et al., 2022). However, the use of collateral varies drastically across properties; about half of commercial real estate transactions have no mortgages associated with them, well above the share of residential real estate (RRE) transactions without a mortgage (Han and Hong, 2020). CRE is also a less levered asset in aggregate, with CRE-secured debt estimated to be about 15 percent of the value of CRE assets (compared to 28 percent for RRE).[1]

Why do so many CRE investors purchase properties without a mortgage? One potential reason is to maintain flexibility with regards to property operations and investment. The presence of debt associated with a property can inhibit investment for several reasons. Perhaps most importantly, loan contracts frequently prohibit borrowers from engaging in material alterations without the lender's consent and prohibit borrowers from taking out additional loans to cover the costs of alterations (Mann, 1997). Additionally, debt overhang considerations may discourage investors from engaging in costly investments whose benefits would partially accrue to debt holders (Correa et al., 2022; DeFusco et al., 2023), and debt service costs may introduce financial constraints that prevent property owners from undertaking profitable investments (Seltzer, 2021). Understanding investor renovation and redevelopment decisions is especially relevant today, as transitioning office properties to alternative uses could alleviate strains due to oversupply in that market (Gupta et al., 2023).

In this paper, we study how financing decisions affect redevelopment options using comprehensive microdata on U.S. CRE transactions. We provide theoretical and empirical evidence that an

[1] Estimates from 2023:Q3 Financial Accounts of the U.S. data. See Figure A1 in the appendix for time series versions of these measures, and for details on the data construction.

important motivation for leaving a property unencumbered is to maintain the value of the redevelopment option on the property. To guide our empirical analysis, we establish a simple theoretical framework where aging properties have the option to be redeveloped at a cost. Property owners choose whether to finance a property with a mortgage, trading off the benefit of secured financing against the higher cost to renovation that the mortgage creates. The model shows that older and less productive properties have more valuable redevelopment options and are thus (1) more likely to be purchased for immediate redevelopment, and (2) less likely to be mortgage-financed.

Guided by our theoretical framework, we construct estimates of redevelopment option values for the properties in our sample. We show empirically that older, less-productive properties are more likely to be purchased for redevelopment or renovation. The fitted values from this analysis, namely the estimated probability of alteration, map directly into option values for properties that are not purchased for immediate redevelopment. These estimated redevelopment options based on property age and quality form the foundation for our analysis for how such options affect financing decisions.

Using our property-level redevelopment option value estimates, we show that owners indeed strategically decide whether to use mortgage financing for property purchases with the renovation option in mind. We identify this effect using a difference-in-differences style approach, estimating whether buyers use mortgage financing based on the estimated redevelopment option and the purchaser's experience in renovation or construction activity (reflecting a specific owner's competency at undertaking a renovation project). Buyers without development experience serve as a control for property-specific factors affecting the availability of debt (e.g., lenders being hesitant to lend against questionable collateral), and the inclusion of buyer fixed effects accounts for cross-borrower differences in financing needs or broad credit availability. Consequently, the effect we identify should capture the extent to which a borrower's desire to preserve the renovation option value affects financing decisions.

Finally, we present two pieces of additional evidence in favor of redevelopment options affecting

financing choices. First, we show directly that when properties are not mortgage financed, they are more likely to be subsequently renovated or improved. Second, we show that we get similar findings when we use the COVID-19 pandemic as an alternative source of variation in redevelopment options. By virtue of producing significant uncertainty and inducing a flight to higher-quality properties, the pandemic plausibly increased the share of property values attributable to redevelopment options, particularly for office properties. Consistent with this idea, we show that buyers reduced their usage of mortgage financing for offices and for older/lower quality properties during the pandemic.

The most closely related paper to our own is that of Loewenstein et al. (2021) who show that mortgaged properties are less likely to be redeployed to a new use. We add to this work in two ways. First, we demonstrate that the presence of mortgage debt not only inhibits redeployment across property types, it also affects smaller renovations and property improvements as well. Second, we analyze how frictions to renovation affect investors' ex-ante financing decisions.

In addition, we make contributions to three strains of the literature. First, we provide a broad summary of patterns regarding the characteristics of properties that are and are not mortgage financed. While there is much work analyzing "all cash" purchases in the residential real estate market (see, for example, Han and Hong (2020) and Reher and Valkanov (Forthcoming)), there is significantly less work on this topic with regard to commercial properties. Conklin et al. (2018) also use transaction level data to study buyers' decision to take out a mortgage; however, their sample is comprised entirely of real estate investment trust (REITs), who we show differ markedly from other buyers in terms of their usage of mortgage-financing.[2] Consequently, we provide a more comprehensive overview of patterns with respect to mortgage usage across different types of CRE-owning entities.

Second, we contribute to a broad literature on the benefits of collateral. The existing work demon-

[2]REITs are about half as likely as other borrowers to purchase properties with mortgage debt. This difference could reflect a greater availability of other funding sources or the need for greater financial flexibility in light of their limited ability to retain net income.

strates that pledging collateral (or higher quality collateral) can reduce borrowing costs (Luck and Santos, 2023; Benmelech et al., 2022), alleviate credit rationing (Stiglitz and Weiss, 1981), mitigate information asymmetries (Boot et al., 1991), and increase borrowing capacity (Benmelech et al., 2005; Cerqueiro et al., 2016). Nonetheless, the usage of secured debt has been declining over time (Benmelech et al., Forthcoming), arguably due in part to borrowers' desire to maintain flexibility in the usage of their assets. By maintaining unencumbered CRE assets, property investors are able to maintain a source of liquidity through potential asset sales or future secured borrowing (Conklin et al., 2018; Campello et al., 2022). We provide evidence for an additional benefit of unsecured financing: avoiding restrictions to repositioning the collateral securing the loan.

Third, we contribute to the literature on CRE redevelopment. Munneke and Womack (2020) and Buchler et al. (2023) use information on the likelihood of redevelopment to estimate the value of redevelopment options. In a similar spirit, we use information on the likelihood of financing a purchase with a mortgage for properties with different redevelopment options to infer the extent to which secured financing hinders the value of the redevelopment option. Understanding these frictions to redevelopment are especially salient now, given that shifts in real estate markets prompted by the pandemic have likely dramatically changed the best use of space (Gupta et al., 2023).

The remainder of the paper proceeds as follows: in Section 2, we describe the data and provides descriptive statistics regarding which transactions are mortgage financed. In Section 3, we present a simple model of how redevelopment options affect financing decisions. In Section 4, we describe our empirical approach and primary findings. In Section 5, we conclude.

2. DATA AND DESCRIPTIVE ANALYSIS

2.1. Data

Our primary data source comes from MSCI Real Capital Analytics (RCA). The database provides information on property and loan characteristics for CRE transactions since 2001 for properties above $2.5 million in value.

A few features make this data particularly well suited to the current study. First, RCA identifies the "true buyer" in the transaction, thus allowing us to know the actual entity acquiring a property rather than the subsidiary. This allows us to better analyze whether the acquiring company had experience engaging in renovation or redevelopment projects. Second, the data includes a quality score (Q-Score), reflecting the price per square foot of a property relative to peer properties. A low quality score indicates a lower value relative to what could likely be achieved after renovation, and thus is indicative that more of the value of the property comes from the redevelopment option.[3]

Third, the data links properties over time. Consequently, we can observe the characteristics of properties and loans that are associated with future renovation and redevelopment decisions. This information allows us to understand the property-level factors that influence the likelihood of redevelopment and study how the existence of property level debt complicates that redevelopment.

We identify transactions that are not mortgage financed (colloquially referred to as "cash purchases") as those without any loan or lender information. This approach would misclassify some mortgaged purchases as cash transactions if RCA was not able to obtain any information on the mortgage loan or lender, or if they were unable to provide that information in their data. However, we believe that this source of misidentification is small for two reasons. First, mortgages are public records, so while information about some loan terms or property characteristics might be unavailable, whether or not there is a mortgage associated with a property should be reliably available. Second, we verify the share of cash transactions is consistent with other data. Specifically, we compare the share of cash transactions by property type to property-level data from the National Council of Real Estate Investment Fiduciaries (NCREIF), which provides more uniform reporting of property-level debt. These data are not as valuable as the RCA data for analysis pertaining to redevelopment values as, by its nature, NCREIF only covers properties owned by institutional investors, which tend to be of higher quality and not likely to be substantially redeveloped. However,

[3]See Cvijanovic et al. (2022) for a more detailed description of RCA's Q-score measure as well as a validation of RCA's coverage and identification of true buyers based on REIT disclosures.

it is useful for validating the cash measure in RCA. Appendix Figure A2 shows that institutional investors in RCA have similar cash shares across property types as in the NCREIF data, which gives us confidence in RCA's coverage of loan and lender information.[4]

Our main sample is limited to non-portfolio purchase transactions from 2005-2022, as we are less confident in the lender and loan information in RCA prior to 2005.[5] In Figure A3, we plot the share of cash purchases over time by buyer type, objective, and property type. The cash shares prior to 2005 are relatively uniform and higher than the subsequent levels, indicating that the loan and lender information is relatively less complete in these early years.

2.2. Descriptive Statistics

Figure 1 shows what share of purchase transactions (by number) occur without any associated property-level debt (i.e., the cash share of purchases), split by buyer objective, buyer type, and property type. Regarding buyer objectives, cash purchases are most common for redevelopment projects at 75 percent. Cash purchases are also on the higher end at 59 percent for purchases by intended occupiers, consistent with highly firm-specific assets being more likely to be owned than rented (Smith Jr and Wakeman, 1985) and less suited for usage as collateral (Benmelech et al., 2005). Properties purchased for investment have cash shares around 46 percent, while cash shares for condo conversions and renovations are lower at 34 and 31 percent, respectively.[6]

Regarding buyer type, cash purchases are highest for public buyers (i.e., REITs) at 79 percent and lowest for private buyers at 44 percent. Regarding property type, cash shares are highest for development sites at 80 percent, lowest for apartment buildings at 32 percent, and between 39 and

[4]The large differences in the shares of purchases that are all cash across property types also indicates that reporting errors are small. We find that cash purchases are most common for private buyers and least common for public ones. If misclassifications were common, we would expect to see the opposite pattern, as there is less information about private buyers, so there would be a greater risk of mistakenly classifying those purchases as all cash due to missing mortgage data.

[5]We exclude portfolio transactions since it is less feasible to making financing decisions based on the redevelopment potential of individual properties.

[6]These patterns are broadly similar when shares are weighted by property value (see Figure A4); on a weighted basis, cash purchases are around 70 percent of purchases for occupancy or redevelopment, compared to about 43 percent of purchases for investment.

56 percent for non-residential property types.

These differences provide some hints at motivations for deciding against using mortgage financing to fund purchases. First, differences in credit availability appear to affect capital structure decisions; public buyers, which likely have greater access to unsecured financing, are much less likely to use mortgage financing than private borrowers. Additionally, mortgage usage is highest for apartment buildings, perhaps reflecting greater credit availability given the involvement of the government sponsored enterprises in the secondary market. We will account for differences in credit availability along these dimensions in the empirical results by employing buyer and property type fixed effects.

Second, the results are consistent with the hypothesis that buyers use cash financing to maintain operational flexibility to engage in redevelopment projects. Namely, cash usage is particularly high for redevelopment projects or development sites. In the next two sections, we will further develop and more formally test this hypothesis by analyzing differences in financing behavior based on properties' redevelopment options and buyers' redevelopment experience.

Table 1 provides some summary statistics for the full sample of property sales, and for samples broken out by whether or not there is a mortgage associated with the transaction. Since we are interested in how financing decisions affect redevelopment *options* rather than how renovation and redevelopment projects are funded, this sample includes only purchase transaction for the sake of investment (as opposed to the other objectives listed in the top of Figure 1). The last column presents the difference in means for cash- and mortgage-financed purchases.

Unconditionally, properties that are cash financed have modestly higher Q-scores on average, but are 1 percentage point more likely to have a Q-score in the bottom quartile ("Low Q-Score"= 1). Cash purchases also are used for younger properties, with lower average valuations and prices per square foot, and for transactions with shorter average hold periods.

Regarding buyer characteristics, cash purchases are more likely to be used by buyers with devel-

opment experience. Cash purchases are 0.65 percentage points more likely to be by developers, which we define as a buyer for which at least 25 percent of transactions are flagged as involving renovation, redevelopment or construction. Consistent with this, cash buyers have a 1 percentage point higher development share of transactions. However, the summary statistics indicate that cash purchases are over 1 percent less likely on average to actually be redeveloped in the near future. Of course, these summary statistics are subject to composition effects, so we will require more formal analysis to understand these patterns better.

3. MODEL OF REDEVELOPMENT OPTIONS AND FINANCING DECISIONS

In this section, we present a simple model of how redevelopment options affect financing decisions. In the first subsection, we present a model where CRE investors optimally choose when to redevelop properties. The model establishes the framework we use for estimating cross-sectional differences in the value of redevelopment options. In the second subsection, we extend the model to include leverage and derive how frictions to redeveloping mortgaged properties affect option values and financing decisions.

3.1. Model

Suppose that a newly renovated property yields a net cash flow that we normalize to 1. Over time, this cash flow depreciates at rate δ. If property investors discount the future at rate r, then the value of a property after t years will satisfy the pricing equation:

$$rV(t) = e^{-\delta t} + V'(t). \tag{1}$$

Suppose that owners are able to renovate at cost c to return the property to the cash flow of a

newly-built one. In Appendix B, we show that (1) in this situation can be solved as

$$V(t) = \underbrace{\frac{e^{-\delta t}}{r+\delta}}_{\substack{\text{Value Without} \\ \text{Renovation Option}}} \left(1 + \underbrace{\frac{\delta}{r} e^{-(r+\delta)(t^*(c)-t)}}_{\equiv \rho(t,c)} \right), \tag{2}$$

where $t^*(c)$ is the optimal time of renovation, which we show to be monotonically increasing in c.[7] This expression says that the increase in the value of the property due to the renovation option—defined above as $\rho(t,c)$—is decreasing in the time until renovation $(t^*(c)-t)$. Higher costs of renovation cause owners to wait longer to renovate and reduce the value of the option. We can thus derive the first hypothesis we test in the data.

Hypothesis 1. *Older (higher t) properties are more likely to be immediately redeveloped.*

This hypothesis follows directly from the fact that $\rho(t,c)$ is decreasing in the time until renovation. A purchaser i would acquire a property j for immediate redevelopment if $t^*_{i,j} - t_j < 0$. If we assume t_j is observable and $t^*_{i,j}$ is distributed according to the CDF F, then the probability that a purchase occurs for immediate redevelopment is $F(t_j)$. This probability is increasing in time since renovation (t_j) and decreasing property productivity (since income relative to newly renovated properties, $e^{-\delta t_j}$, is a decreasing function of time).

In practice, t_j is typically not directly observed, so, when we estimate the value of redevelopment options, we will instead estimate a probit based on a flexible function of a building's age (the time it has had to depreciate) and Q-score (a direct measure of the property's relative productivity) to capture the renovation potential of a property. Specifically, we parameterize $t_j - t^*_{i,j}$, reflecting the value of the renovation option, as $t_j - t^*_{i,j} = X_j'\beta + \sigma\varepsilon_{i,j}$, where X_j is a set of variables measuring the property's age and quality, and $\varepsilon_{i,j}$ follows a standard normal distribution. We then estimate Pr(Renovation)$= \Phi(\frac{X_j'\beta}{\sigma})$, which provides an estimate of the value of the renovation option (up to a scale parameter). In measuring the value of the renovation option for the empirical findings, we

[7] $t^*(c)$ is defined implicitly by the value-matching condition that $V(t^*) = V(0) - c$.

work with the fitted probability that a property was purchased for renovation rather than estimates of $\mathbb{E}(\rho \mid X_j)$. However, as both are monotonically increasing functions of $X_j'\hat{\beta}$, results are similar with other measures.

3.2. Model with Leverage

We now introduce leverage following a standard trade-off theory approach, though we make some simplifying assumptions on the functional forms of the cost and benefit of debt for ease of exposition.

Assume the presence of a mortgage raises the cost of renovation such that the optimal renovation time increases from t^* to $t^* + \Delta$. Borrowers trade this benefit off against a benefit to debt that is proportional to the renovation-option-free value of the property. Denoting this benefit b, purchasers then use cash to finance a property if

$$V(t;t^*) > V(t;t^* + \Delta) + b\frac{e^{-\delta t}}{r+\delta}. \tag{3}$$

We can then derive our second hypothesis.

Hypothesis 2. *Investors use cash to purchase properties with greater redevelopment options*

We can derive this hypothesis by combining (2) and (3) to show that buyers use cash if

$$b < \rho(t,c)\left(1 - e^{-(r+\delta)\Delta}\right). \tag{4}$$

This expression says that borrowers use cash if the benefit to secured financing, b, is smaller than the decline in the value of the renovation option, the expression on the right. The marginal effect of increasing the optimal renovation time t^*, is greater when the renovation option is more valuable i.e., when ρ is higher.

Summarizing the results, buyers will do the following when purchasing a property:

$$\text{Investment Strategy} = \begin{cases} \text{Immediately Renovate} & \text{if } t^*_{i,j} - t_j < 0 \\ \text{Invest with Cash Financing} & \text{if } 0 < t^*_{i,j} - t_j < \max\{\gamma, 0\} \\ \text{Invest with Mortgage Financing} & \text{if } t^*_{i,j} - t_j > \max\{\gamma, 0\}, \end{cases}$$

where $\gamma = \frac{1}{r+\delta} \ln\left(\frac{\delta(1-e^{-(r+\delta)\Delta})}{br}\right)$ is the threshold time to renovation below which buyers choose to use cash rather than mortgage financing based on equation (4).[8]

The buy-to-renovate/buy-to-operate-with-cash/buy-to-operate-with-mortgage decision could be estimated by ordered probit since those outcomes depend on the same latent variable $t^* - t$ but with different thresholds (0 and γ). However, such an estimation strategy would impose that that cash purchases are used for properties with a greater renovation option rather than test for this fact. Consequently, when we test this proposition in the data in the next section, we instead use a probit model predicting whether a property is purchased for immediate development to estimate the likely value of the redevelopment option. We then test whether properties with a greater redevelopment option are more likely to be cash financed.

4. METHODOLOGY AND EMPIRICAL FINDINGS

In this section, we test the two hypotheses from the model and provide some additional analysis regarding the relationship between mortgage financing and redevelopment options. In the first subsection, we estimate the likelihood of redevelopment based on property age and quality in order to construct our measure of redevelopment potential. In the second subsection, we show that investors use cash purchases for properties with greater redevelopment potential. In the third subsection, we show that cash-financed properties are more likely to be redeveloped or improved. In the fourth subsection, we study the increase in redevelopment option values during the COVID-

[8] If $\gamma < 0$, the cost to having secured debt is small enough that $V(t;t^*) < V(t;t^*+\Delta) + b\frac{e^{-\delta t}}{r+\delta}\ \forall t^* > t$, meaning that all purchases are mortgage financed.

19 pandemic.

4.1. Older or less productive properties are more likely to be redeveloped

Our simple theoretical framework indicates that older, less-productive properties are more likely to be redeveloped. At first blush, this appears to be true in our data. In Figure 2, we present binscatter regressions of an indicator of whether a property was purchased for redevelopment on our main measure of building quality (Q-Score) in the left panel and building age in the right panel. We define redevelopment broadly to include both renovation and redevelopment. The binscatter regressions also control for the natural log of the acreage of the land parcel and include year, property type, and buyer fixed effects. The plot by Q-Score also controls for building age and vice versa.

The rate at which properties are purchased for redevelopment falls sharply in quality for properties in the lowest quintile and then levels off at higher Q-scores (before jumping again for properties in the top decile). Effects of age are more linear; the probability of redevelopment rises from about 2 percent for a 10 year old property to about 8 percent for a 50 year old property, and over 10 percent for an 80 year old property.

To more formally test how Q-Score and building age are related to redevelopment, we run the following regression:

$$\Pr(\text{Redevelopment or Renovation}_{i,j,t}) = f(\text{Building Age}_j) + g(\text{Q-Score}_j) + \zeta_{p(j,t)} + \eta_t + \varepsilon_{i,j,t},$$

where the dependent variable is an indicator for whether the buyer i's objective in purchasing a property is either renovation or redevelopment (as opposed to investment), $f(\text{Building Age}_j)$ is a function of building j's age in years, and $g(\text{Q-Score}_j)$ is a function of building j's Q-Score. We also include property-type fixed effects ($\zeta_{p(j,t)}$) and year fixed effects (η_t). We cluster the standard errors by buyer.

We use two separate specifications. First, we simply include building age and the Q-Score as dependent variables. Second, we estimate linear splines for the dependent variables of interest in order to capture the non-linearities demonstrated in Figure 2. For building age, the knots of the spline are at 5, 25, 50, and 75 years old. For the Q-Score, we place knots at the 25th, 50th and 75th percentiles.

We estimate Equation 4.1 using two models, first with OLS and second with a probit. The results are presented in Table 2. Columns (1) and (2) include the OLS results, with building age and Q-Score entering linearly in column (1) and with the linear splines in column (2). Columns (3) and (4) include parallel results using a probit model.

The signs of the coefficients are as expected. The coefficient on building age in Column (1) indicates that, on average, a property that is one year older has a 0.15 percentage point higher likelihood of redevelopment or renovation, while a property with a Q-Score of 1 is almost 2 percentage points less likely to be redeveloped or renovated than one with a Q-score of 0. The results for the linear spline in Column (2) indicate that these effects vary across the building age and Q-Score distribution. As indicated by Figure 2, age fairly consistently increases the likelihood of redevelopment, with sizable effects starting at age 5 up until effects level off around after 75. For Q-score, higher quality reduces the likelihood of redevelopment sharply in the first quartile, but has modest effects at higher quartiles.

The coefficients for the probit model in columns (3) and (4) are harder to interpret in terms of magnitude but generally retain similar signs, significance levels, and relative magnitudes. As discussed in Section 3.1, we use the probit model to construct the fitted probability of redevelopment for properties purchased for investment. This gives us a continuous measure of redevelopment potential that combines the effect of building age and Q-Score; this will be our main measure of the value of the redevelopment option in the remaining analysis.

4.2. Properties with greater redevelopment options are less likely to be mortgage-financed

The summary statistics provide some suggestive evidence for several potential reasons for purchases made without a mortgage: high availability of unsecured funding (e.g., for REITs), avoiding transaction costs for projects with shorter investment horizons, funding properties with a higher asset-specificity (e.g., for owner-occupiers). Here, we focus on the role of investors maintaining their redevelopment option, as predicted in the theory.

To quantify such an effect, we need to control for buyer or property characteristics that may influence financing decisions. We do this with a difference-in-differences type approach, testing whether properties that are more likely to benefit from redevelopment are more likely to be cash-financed when purchased by a buyer with development experience.[9]

Namely, we estimate the specification:

$$\begin{aligned}\text{Cash purchase}_{i,j,t} = \beta_1 \text{Developer}_i \times \text{Redevelopment Probability}_{j,t} \\ + \eta' X_{i,j,t} + \gamma_j + \zeta_{p(j,t)} + \eta_t + \varepsilon_{i,j,t},\end{aligned} \tag{5}$$

where $\text{Cash purchase}_{i,j,t}$ is an indicator for whether the purchase of property j by buyer i at time t was made without associated property-level debt. Developer_i is an indicator for whether more than a quarter of the buyer's transactions involve some type of development purpose (renovation, redevelopment or construction). $\text{Redevelopment Probability}_{j,t}$ is the fitted probability that the property would be redeveloped as estimated in Section 4.1. $X_{i,j,t}$ is a set of controls including the uninteracted property redevelopment probability. γ_i, $\zeta_{p(j,t)}$, and η_t are buyer, property-type and transaction year fixed effects, respectively.

The idea behind this approach is that the buyer fixed effects control for differences in credit availability across buyers, and the property controls account for differences in the availability of mort-

[9] In this section, we use our estimated redevelopment probability created in Section 4.1. In the appendix, we run a similar specification using the two main components of redevelopment potential directly: the Q-Score and building age.

gage credit across properties. The difference in the effect of redevelopment potential on cash financing for developers relative to non-developers therefore plausibly reflects the additional motivation of borrowers to fund properties with cash (or unsecured financing) to preserve the value of their redevelopment option. We also consider specifications that include buyer type fixed effects instead of buyer fixed effects, which control for broad differences in availability of credit to different buyer types without the same loss of degrees of freedom and observations that result when using buyer fixed effects.

The vector $X_{i,j,t}$ includes a set of controls meant to capture various other factors that could affect a buyer's decision to purchase a property without a mortgage. The inclusion of these variables serves both to account for potential confounding variables in our estimates of how financing decisions affect a property's redevelopment value, while also providing some information on other considerations that affect financing decisions. We include an indicator for whether the building was built in the last two years as it takes time for new buildings to become stabilized and they are less likely to have a mortgage during the lease-up period. We also include the log of the land area of the parcel in acres.

The estimates for the primary specification are presented in Table 3. Columns (1)–(2) present estimates excluding the buyer or buyer type fixed effects, with the interaction with the buyer's development experience added in the second column; columns (3)–(4) present the same specifications but include buyer type fixed effects; and columns (5)–(6) again present the same specifications but include buyer fixed effects.

The estimates in column (1), which excludes the interaction terms, imply that a property with a 10 percentage point higher redevelopment probability is about 2.5 percentage points more likely to be cash financed. The sign on the indicator for buildings that have been recently built is also as expected: new buildings are over 11 percent less likely to be purchased with a mortgage. We also find that larger parcels are less likely to be cash financed.

In column (2), we add in the interaction of the redevelopment probability with whether the buyer

is a developer. The coefficient on the interaction term is statistically significant and positive, as expected. It indicates that when developers buy a property, their financing decisions are over twice as sensitive to redevelopment options as those for non-developers; a 10 percentage point increase in redevelopment probability raises the use of cash purchases by 4.3 percentage points for developers, compared to 1.9 percentage points for non-developers.

Columns (3) and (4) repeat the same specifications, but include buyer type fixed effects to account for differences in access to alternative financing options across buyer types. The inclusion of these buyer typed fixed effects strengthens the relationship between redevelopment options and cash usage overall, but does not materially affect the coefficient on the interaction term. REITs have have high cash purchase shares despite tending to buy higher-quality properties, so not controlling for buyer type tends to weaken the estimates.

We include buyer fixed effects in columns (5) and (6), which controls for any buyer-specific access to or preference over various funding sources. The results are again broadly similar, with the coefficient on redevelopment probability increasing yet again but the interaction term remaining in the same range as in other specifications with less granular fixed effects. Across the specifications, a 10 percentage point increase in redevelopment probability is found to raise the likelihood of cash financing by a bit over 2 percent more for buyers with development experience compared to buyers without it.

Figure 3 presents similar estimates from binscatter regressions, thus allowing the relationship between cash purchases and redevelopment potential to be non-linear. The regression is separately estimated for developers and non-developers, including the same fixed effects as in Equation (5). The results confirm that developers are relatively more likely use cash financing when purchasing properties with high redevelopment potential. The usage of cash financing is fairly similar across these types of buyers for properties with a redevelopment probability under 5 percent, but the differences increases (about linearly) for properties with greater redevelopment potential.

4.3. Cash Financing and Redevelopment Outcomes

How well do financing decisions by developers relate to actual redevelopment activity? If developers use cash financing to ease frictions on subsequent renovations or redevelopment, we would expect cash purchases to be predictive of whether properties are actually altered after purchase. Answering this question is complicated by the fact that the RCA data reports the purpose of the acquisition in terms of whether the buyer intends to renovate or redevelop a property but generally does not report whether the buyer eventually goes on to undertake such activities after buying.

To try to get at such activities, we generate two proxies for whether properties are improved based on reporting in subsequent transactions (if available). First, we impute that a property is renovated if any of the following occur: the next transaction has a purpose listed as renovation, redevelopment, construction, or condo conversion; the next purchase updates the year built or year renovated field to indicate that rebuilding or renovation occurred since the last transaction; or the property type changes to indicate the building was repurposed. Second, we impute improvements based on the change to the Q-score, since property improvements would increase the value of the property for the next transaction. We flag a property as improved if the Q-score rises by 0.2 between transactions. We then run regressions identical in construct to Equation (5) but with indicators of renovation or improvement as the dependent variables and replacing the redevelopment probability variable with a Cash purchase indicator. Estimates predicting these improvement variables are displayed in Table 4.

Overall, the results indicate that cash purchases by developers do predict future renovations and improvements. Columns (1)–(3) indicate that purchases by developers are almost 6 percent more likely to be renovated in the future and that cash purchases by developers are an additional 2 percentage points more likely to be renovated. The coefficient on the interaction between the cash purchase and developer indicators stays fairly stable across specifications with buyer type and buyer fixed effects.

Columns (4)–(6) indicate that cash purchases are on average between 3 and 4.3 percentage points more likely to be improved in the future. In the specifications without buyer fixed effects, cash purchases by developers are another 4 percentage points more likely to be improved in the future, but the difference for developers and non-developers when including buyer fixed effects in not statistically different from zero. One explanation for this result is that the developer indicator is constructed based on a measure of the frequency with which the buyer is flagged as buying with the intention to renovate or redevelop, thus the measure may struggle to capture the tendency to make improvements of the type that are not directly reported by RCA.

4.4. Redevelopment Option Values Increased during the COVID-19 Pandemic

The COVID-19 pandemic provides another source of variation in redevelopment options to study. The pandemic likely increased option values for a couple of reasons. First, it increased uncertainty, particularly for the CRE market, thus increasing option values. Second, it prompted a shift in how space was utilized, increasing the need of some space to be redeployed or at least updated. These effects were particularly prominent for office properties, for which there is substantial uncertainty about long-term demand and there has reportedly been a flight-to-quality that may encourage renovation. Given these factors, we would expect the pandemic to raise redevelopment option values and prompt an increase in the share of purchases made with a mortgage.

Of course, identifying causal effects of the COVID-19 pandemic on redevelopment values and property financing decisions is complicated by the fact that lending standards also changed during the pandemic. This change could have affected borrowers' access to mortgage financing, and increased the use of cash purchases for reasons that have nothing to do with redevelopment option values.

To plausibly identify the channel we are interested in, we again use a difference-in-difference specification where we compare properties with different redevelopment probabilities pre- and post-COVID. If the pandemic did affect redevelopment option values, we would expect cash pur-

chases to increase more for properties with greater redevelopment potential.

We run the following regression:

$$\begin{aligned}\text{Cash purchase}_{i,j,t} = \beta_1 \text{COVID-19}_t \times \text{Redevelopment Probability}_{i,t} \\ + \eta' X_{i,j,t} + \gamma_j + \zeta_{p(i,t)} + \eta_t + \varepsilon_{i,j,t},\end{aligned} \tag{6}$$

where COVID-19$_t$ is equal to one for years from 2020-on. The redevelopment probability is the measure constructed Section 4.1 and used to measure redevelopment options in the other results. We include a vector of controls that includes an indicator for newly built properties and the natural log of the size of the land parcel. Last, we include buyer (γ_i), property type ($\zeta_{p(j,t)}$), and year (η_t) fixed effects. Standard errors are clustered by buyer.

Given the dramatic change in work-from-home policies during COVID and their potential impact on the viability of office properties, we also run an additional regression specification where we replace the redevelopment probability with an indicator for office properties. If the redevelopment option value of office properties increased more during the pandemic relative to other properties, we would expect cash purchases of these properties to have also increased.

The results are presented in Table 5. Columns (1)–(3) include the specifications using the redevelopment probability, with each column adding different fixed effects. Columns (4)–(6) report results from parallel regressions but replace the redevelopment probability with an indicator for office properties. The results in Columns (1)–(3) indicate that the relationship between cash financing and redevelopment probability rose during the pandemic. Across specifications, a 10 percentage point increase in redevelopment probability is found to raise the likelihood of cash financing by roughly 2 percent points more during COVID relative to before it. This effect is comparable in magnitude to the increase in cash financing for developers relative to non-developers found in Section 4.2.

Office properties were also more likely to be purchased with cash during the pandemic relative to

other property types. In column (4), the results indicate that there is a almost five percent greater increase in cash purchases for office properties during the pandemic relative to other property types. The estimate is similar when including buyer type fixed effects in column (5) but falls to just under 3 percent when including buyer fixed effects.

5. CONCLUSION

Our results indicate that CRE investors consider a property's redevelopment potential when deciding how to finance a purchase. Mortgages on CRE properties often require the owner to relinquish some control over property management to the lender and can therefore create additional frictions to redevelopment.

We provide evidence that buyers strategically decide whether to take out mortgages with these frictions in mind. Using within-borrower variation to account for differences in financing availability, we show that properties with greater redevelopment potential are more likely to be cash financed, particularly when the buyer has experience undertaking renovation and redevelopment projects. These effects grew in magnitude during the pandemic, consistent with COVID-19 increasing the importance of renovation and redevelopment options. Office properties in particular, had a strong rise in the usage of cash financing during the pandemic. These findings can help to explain the significant number of CRE properties that are purchased without mortgage financing.

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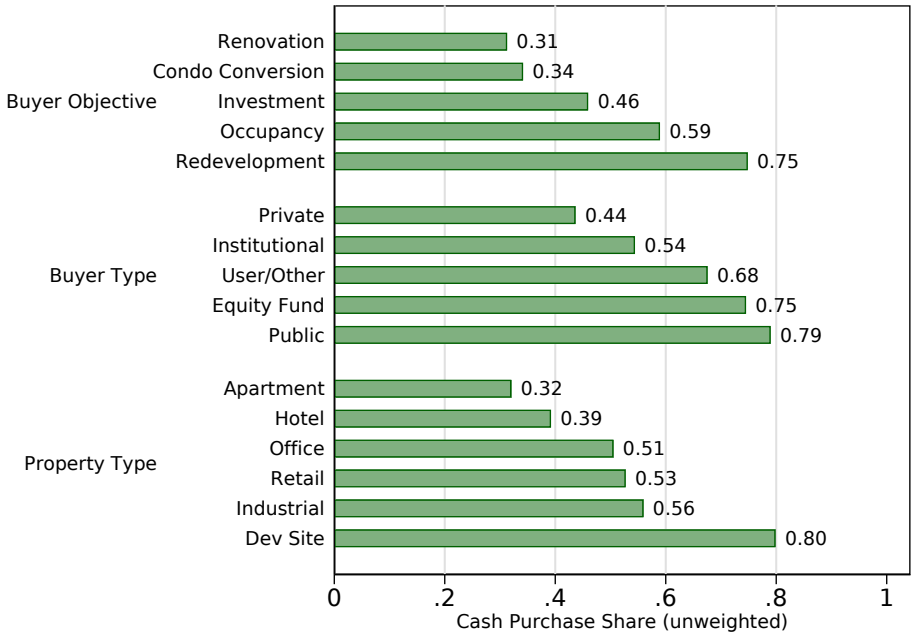
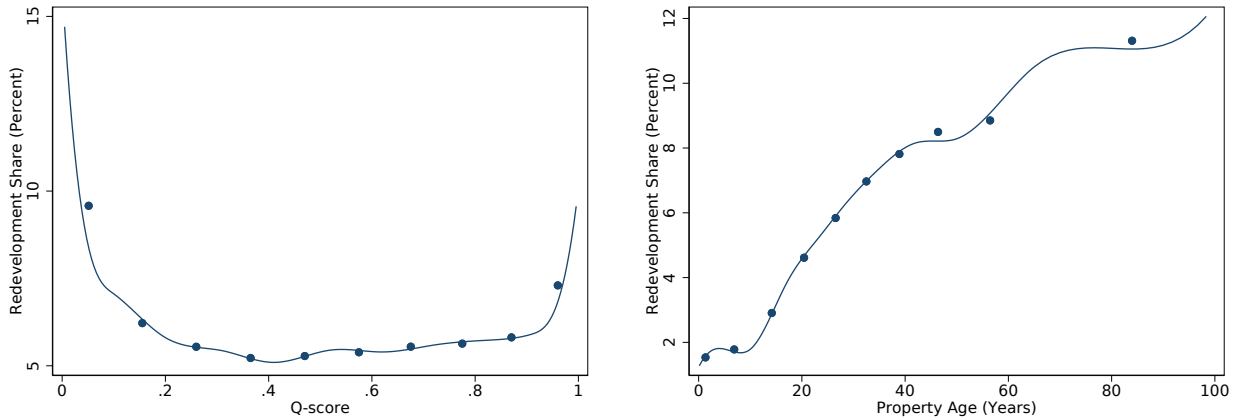
Figure 1: Cash Purchase Shares



Notes: Figure plots the share of CRE purchases that are cash financed (i.e., financed without mortgages) by buyer objective (top), buyer type (middle) and property type (bottom). Shares are unweighted; equivalent value-weighted statistics are shown in Figure A4.

Figure 2: Redevelopment by Q-Score and Age

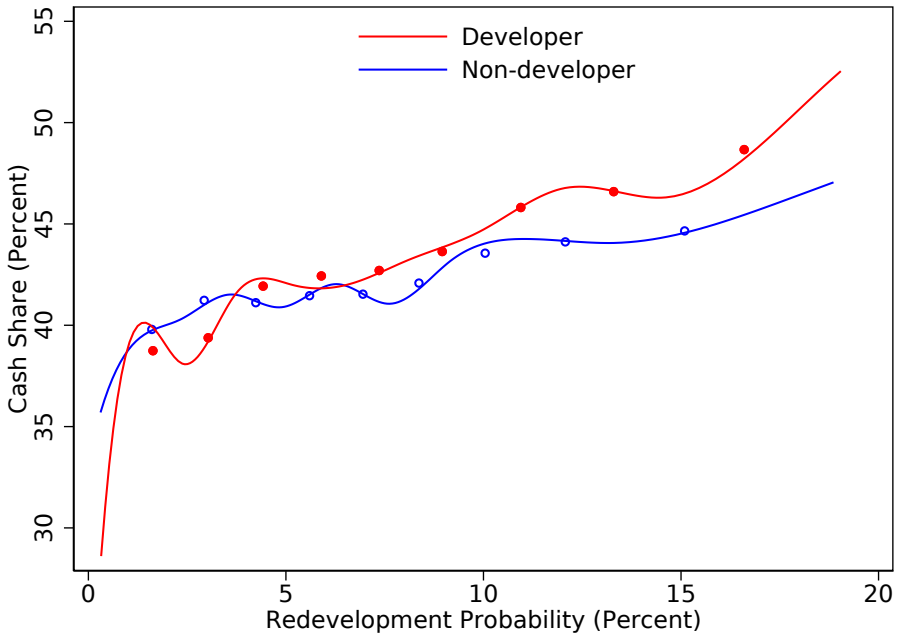


(a) By Property Quality

(b) By Age

Notes: Plots are produced using the Stata command binsreg (Cattaneo et al., 2019). Each binscatter regression includes year and property type fixed effects. Additionally, the property quality plot controls for age and the age plot controls for property quality. A higher Q-Score indicates a higher quality property relative to a peer group. The dependent variable is an indicator for whether the property was purchased for renovation or redevelopment. Dots show estimated redevelopment shares by decile of the independent variable of interest, while lines plot semi-linear regression estimates with a cubic B-spline. *Source:* Authors' calculations using MSCI RCA.

Figure 3: Cash Purchases by Redevelopment Potential



Notes: Plots are produced using the Stata command binsreg (Cattaneo et al., 2019). Each binscatter regression includes year, property type, and buyer fixed effects. Dots show estimated cash purchase shares by decile of renovation probability, while lines plot semi-linear regression estimates with a cubic B-spline. Estimates for developers are in red, and non-developers in blue. *Source:* Authors' calculations using MSCI RCA.

Table 1: Summary Statistics

	Full Sample (1)	Cash Purchases (2)	Mortgage Purchases (3)	Difference (4)
Q-Score	0.51	0.52	0.50	0.02**
	(0.30)	(0.31)	(0.29)	(0.00)
Low Q-Score	0.26	0.27	0.26	0.01**
	(0.44)	(0.44)	(0.44)	(0.00)
Age	34.86	33.35	36.07	-2.71**
	(27.05)	(26.95)	(27.07)	(0.10)
Holding Period	4.97	4.74	5.14	-0.40**
	(3.52)	(3.64)	(3.42)	(0.02)
Value (millions)	14.60	13.49	15.55	-2.06**
	(47.45)	(43.24)	(50.74)	(0.16)
Price Per Sq. Ft.	230.63	234.65	227.12	7.53**
	(235.26)	(250.80)	(220.76)	(0.86)
Redevelopment Probability (%)	9.05	9.28	8.88	0.39**
	(6.37)	(6.72)	(6.08)	(0.03)
Buyer Development Share (%)	15.87	16.41	15.42	0.99**
	(14.05)	(14.26)	(13.85)	(0.05)
Developer (%)	10.93	11.28	10.63	0.65**
	(31.20)	(31.63)	(30.82)	(0.11)
Imminent Redevelopment (%)	13.02	12.23	13.58	-1.35**
	(33.65)	(32.76)	(34.26)	(0.17)

Notes: Columns (1)–(3) present the mean and standard deviation (in parentheses) of various property or transaction characteristics for the full sample of property investments, cash purchases, and mortgage purchases, respectively. Column (4) presents the difference in means and standard error of the difference for cash purchases as compared with mortgage purchases. The full sample is limited to non-portfolio purchase transactions in 2005 or later where the buyer has indicated that their objective is investment. A lower Q-Score indicates higher redevelopment potential. "Low Q-Score" is an indicator for a Q-Score in the bottom quartile of the distribution. "Developer" is defined as a buyer with a development share above 25 percent. "Redevelopment Probability" is the fitted value predicting the probability that a property is purchased for renovation or redevelopment (see Section 4.1). $^{+}$,*,** indicate significance at 10 percent, 5 percent and 1 percent, respectively. *Source:* Authors' calculations using MSCI RCA data.

Table 2: Predictors of Redevelopment/Renovation

	Purchased for Redevelopment/Renovation (in percentage points)			
	OLS		Probit	
	(1)	(2)	(3)	(4)
Building Age (Years)	0.15**		0.01**	
	(0.01)		(0.00)	
Q-Score	-1.90**		-0.44**	
	(0.46)		(0.03)	
Age 0–5		0.05		-0.13**
		(0.04)		(0.01)
Age 5–25		0.35**		0.04**
		(0.01)		(0.00)
Age 25–50		0.17**		0.01**
		(0.02)		(0.00)
Age 50–75		0.12**		0.01**
		(0.03)		(0.00)
Age 75–100		-0.00		-0.00
		(0.03)		(0.00)
Q-Score: Quartile 1		-31.17**		-3.30**
		(2.00)		(0.14)
Q-Score: Quartile 2		4.42**		0.62**
		(1.05)		(0.09)
Q-Score: Quartile 3		3.74**		0.07
		(1.00)		(0.08)
Q-Score: Quartile 4		13.89**		0.79**
		(1.56)		(0.10)
R^2_a	0.040	0.045		
Observations	246,771	237,589	246,771	237,585
$\bar{Y}$	8.52	8.25	8.52	8.25
sd(Y)	27.92	27.52	27.92	27.52
Property Type FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓

Notes: Sample is limited to refinance and sale transactions where the buyer objective is investment, redevelopment or renovation. The dependent variable is an indicator of whether the buyer's objective is redevelopment or renovation multiplied by 100. Columns (2) and (4) fit a linear spline in age and Q-score, coefficient estimates reflect slopes within a particular age or Q-score bin. Mean(Y) and sd(Y) report the mean and standard deviation of the dependent variable in each regression sample. Standards errors, in parentheses, are clustered by buyer. $^{+},^{*},^{**}$ indicate significance at 10 percent, 5 percent and 1 percent, respectively. *Source:* Authors' calculations using MSCI RCA data.

Table 3: Cash Purchases and Redevelopment Options

	Cash Indicator (in percentage points)					
	(1)	(2)	(3)	(4)	(5)	(6)
Redevelopment Probability	25.22**	19.44**	37.86**	32.26**	51.45**	47.15**
	(4.43)	(4.73)	(3.92)	(4.43)	(3.53)	(3.63)
Redevelopment Probability× Developer		23.94**		22.73**		20.02**
		(8.26)		(6.82)		(6.83)
Developer		-1.38		-1.16		
		(1.43)		(1.04)		
Age<2	11.26**	11.28**	8.26**	8.27**	3.99**	4.01**
	(1.05)	(1.04)	(1.10)	(1.09)	(0.78)	(0.78)
ln(Land Area in Acres)	-0.65**	-0.65**	-1.15**	-1.16**	-1.67**	-1.67**
	(0.14)	(0.14)	(0.12)	(0.12)	(0.11)	(0.11)
R^2_a	0.094	0.094	0.136	0.136	0.328	0.328
Observations	129,261	129,261	126,879	126,879	118,994	118,994
$\bar{Y}$	42.24	42.24	41.78	41.78	42.17	42.17
sd(Y)	49.39	49.39	49.32	49.32	49.38	49.38
Property Type FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Buyer Type FE	-	-	✓	✓	-	-
Buyer FE	-	-	-	-	✓	✓

Notes: Sample is limited to purchase transactions in 2005 or later where the buyer has indicated their intention is investment. The dependent variable is an indicator for whether the property is cash-financed, scaled by 100 so estimates can be interpreted in percentage points. The redevelopment probability is calculated as described in Section 4.1. Standards errors, in parentheses, are clustered by buyer. $^{+,*,**}$ indicate significance at 10 percent, 5 percent and 1 percent, respectively. Mean(Y) and sd(Y) report the mean and standard deviation of the dependent variable in each regression sample. *Source:* Authors' calculations using the MSCI RCA data.

Table 4: Cash Purchases as a Predictor of Improvement/Renovation

	Renovation Indicator (in percentage points)			Improvement Indicator (in percentage points)		
	(1)	(2)	(3)	(4)	(5)	(6)
Cash Purchase	-0.84**	-1.00**	-0.77*	3.11**	3.86**	4.28**
	(0.32)	(0.33)	(0.37)	(0.50)	(0.53)	(0.55)
Cash Purchase × Developer	1.78*	2.11**	1.93*	4.33**	3.99**	-0.15
	(0.79)	(0.79)	(0.94)	(1.14)	(1.16)	(1.39)
Developer	5.91**	5.82**		4.12**	4.18**	
	(0.54)	(0.54)		(0.70)	(0.70)	
ln(Land Area in Acres)	1.62**	1.55**	0.81**	-0.66**	-0.51**	-0.41**
	(0.09)	(0.09)	(0.11)	(0.12)	(0.12)	(0.14)
Age<2	-6.23**	-6.24**	-5.07**	-6.68**	-6.38**	-2.72**
	(0.51)	(0.51)	(0.65)	(0.65)	(0.67)	(0.75)
R^2_a	0.032	0.034	0.089	0.032	0.034	0.148
Observations	86,728	85,906	76,773	43,578	43,255	36,501
$\bar{Y}$	14.81	14.84	14.91	14.9	14.92	14.44
sd(Y)	35.52	35.55	35.62	35.6	35.63	35.15
Property Type FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Buyer Type FE	-	✓	-	-	✓	-
Buyer FE	-	-	✓	-	-	✓

Notes: The redevelopment probability is calculated as described in Section 4.1. Mean(Y) and sd(Y) report the mean and standard deviation of the dependent variable in each regression sample. Standards errors, in parentheses, are clustered by buyer. $^{+}$,*,** indicate significance at 10 percent, 5 percent and 1 percent, respectively. *Source:* Authors' calculations using MSCI RCA data.

Table 5: Cash Purchases during the COVID-19 Pandemic

	Cash Indicator (in percentage points)					
	(1)	(2)	(3)	(4)	(5)	(6)
Redevelopment Probability	23.38**	35.54**	49.30**			
	(4.43)	(3.97)	(3.62)			
Redevelopment Probability × COVID-19	15.62^{+}	20.08*	17.90*			
	(9.35)	(8.91)	(7.44)			
Office × COVID-19				4.22**	4.17**	2.18
				(1.25)	(1.21)	(1.50)
Age<2	11.30**	8.31**	4.03**	10.37**	7.22**	3.67**
	(1.05)	(1.10)	(0.78)	(1.01)	(1.07)	(0.66)
ln(Land Area in Acres)	-0.65**	-1.15**	-1.67**	-0.49**	-0.99**	-1.62**
	(0.14)	(0.12)	(0.11)	(0.14)	(0.11)	(0.10)
R^2_a	0.094	0.136	0.328	0.082	0.123	0.306
Observations	129,261	126,879	118,994	157,516	154,134	146,358
$\bar{Y}$	42.24	41.78	42.17	43.23	42.59	43.21
sd(Y)	49.39	49.32	49.38	49.54	49.45	49.54
Property Type FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Buyer Type FE	-	✓	-	-	✓	-
Buyer FE	-	-	✓	-	-	✓

Notes: The COVID-19 Indicator is one for transactions in 2020Q1 or later. The redevelopment probability is calculated as described in Section 4.1. Mean(Y) and sd(Y) report the mean and standard deviation of the dependent variable in each regression sample. Standards errors, in parentheses, are clustered by buyer. $^{+}$,*,** indicate significance at 10 percent, 5 percent and 1 percent, respectively. *Source:* Authors' calculations using MSCI RCA data.

A. DATA APPENDIX

A.1. Details on Appendix Exhibits Referenced in Main Text

Figure A1 shows aggregate leverage in the CRE and RRE markets. The leverage ratios reflect the average LTVs for properties that are mortgage financed as well as the share of properties that have a mortgage. Given real estate is marked to market in the Financial Accounts while debt is kept at book value, price appreciation over time decreases leverage relative to at-origination LTVs, also contributing to low aggregate leverage.

A.2. Alternative Measures of Redevelopment Potential

In Table A1, we run regressions similar to Equation 5 but using different measures of redevelopment potential. Specifically, we replace the redevelopment probability with an indicator for whether the Q-score is in the bottom quartile and an indicator for whether the property is over 25 years of age.

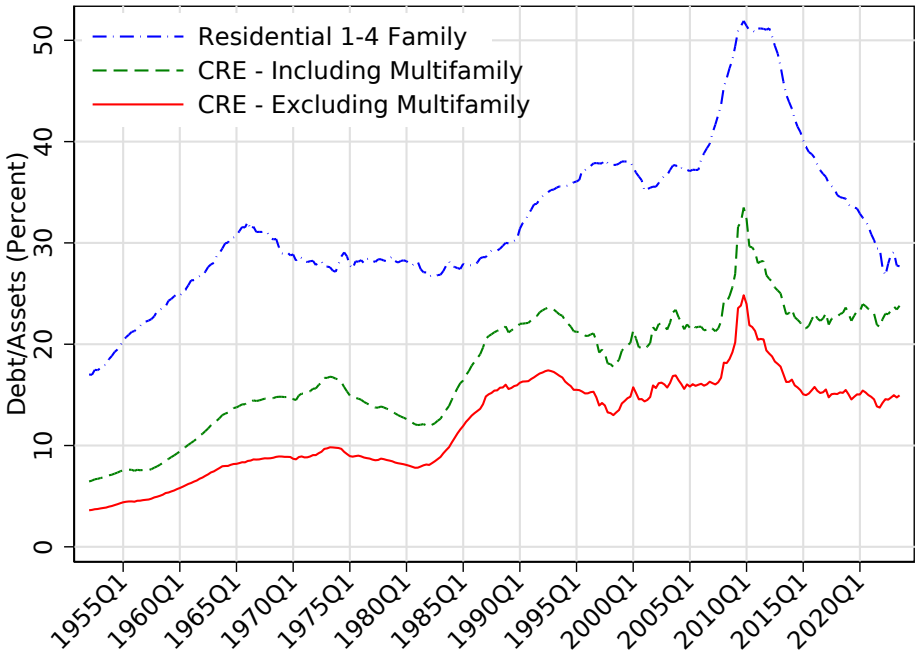
Columns (1)–(3) include estimates excluding the buyer or buyer type fixed effects, layering in the interaction terms related to redevelopment-potential one at a time; Columns (4)–(6) present the same specifications but include buyer type fixed effects; and the last three columns again present the same specifications but include buyer fixed effects.

The findings are qualitatively similar to those shown in Table 3, in which information on age and quality were combined into a single measure of renovation potential. Lower quality properties are more likely to cash financed. Properties with low Q-scores are predicted as having a 4 percentage point lower cash share in specifications without buyer controls (column 1), rising to about a 6 percentage point effect in specifications with buyer type or buyer fixed effects (columns 4 and 7). In contrast to the main results, older properties are predicted as having lower cash purchase shares controlling for property quality, however, the effect goes away when buyer fixed effects are added, indicating that the results are driven by buyer-specific omitted variables.

The results looking at differences across buyers with and without development experience are more uniformly consistent with the primary results. Developers are more likely to use cash financing than other buyers, but only when the property has at least one of the characteristics to indicate that it has redevelopment potential (advanced age or low Q-scores). Focusing on the results in column (9)—the specification where both property characteristics are interacted with the developer indicator and buyer fixed effects are included—we find that having a low Q-score raises the likelihood of cash financing by about 5.8 percentage points for non-developers and 8.7 percentage points for developers. As slightly under half of investment properties are cash financed, this constitutes an over a 10 percent increase in the likelihood that a buyer finances a property with cash, overall, and an over 15 percent increase for buyers with development experience. Advanced age increases the likelihood of using cash financing by about 2 percentage points for developers, while having little effect on other buyers. Differences between developers and non-developers tended to be slightly stronger in the other specifications without buyer fixed effects (columns 3 and 6).

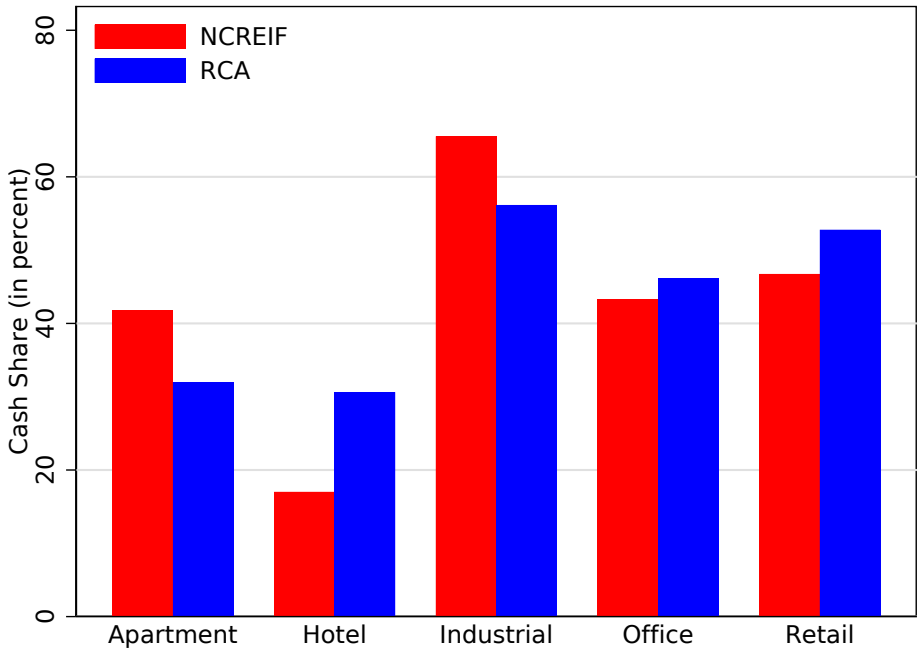
Similar results are shown in Figure A5, which present binscatter regression estimates of the relationship between cash financing and Q-score or age, by the buyer's development experience.

Figure A1: Debt to Assets in the Financial Accounts: Commercial and Residential Real Estate



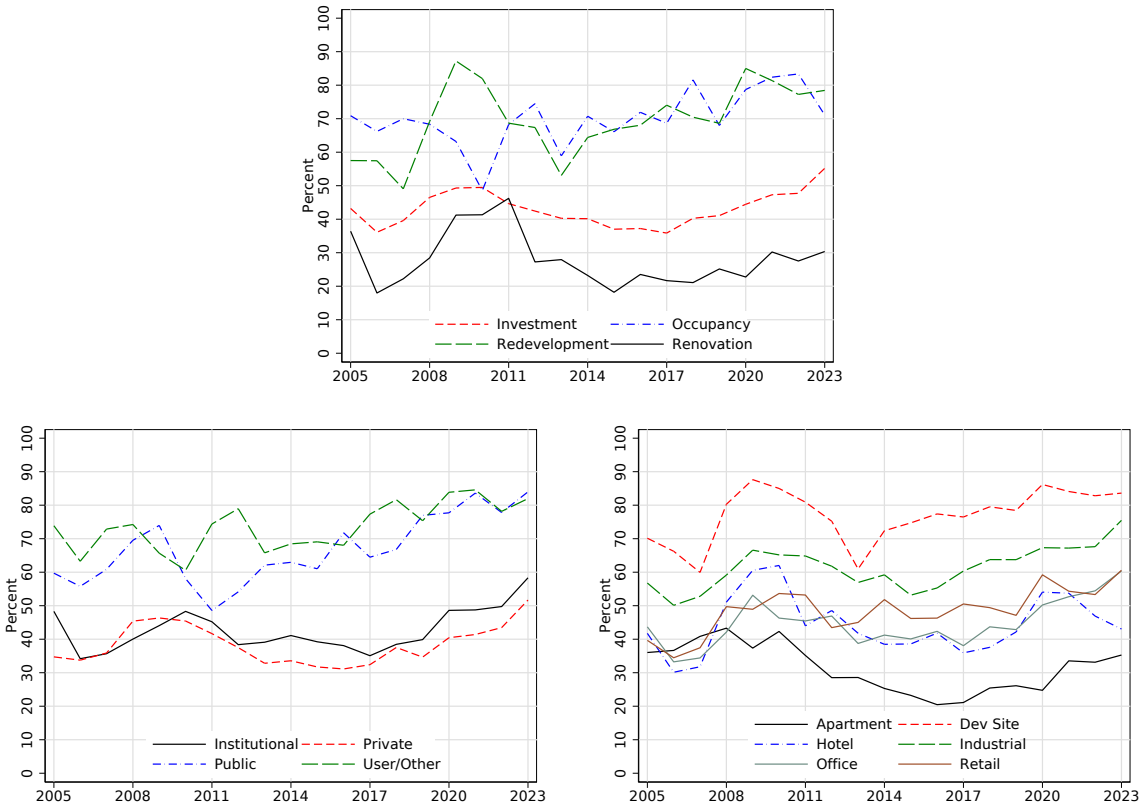
Notes: Figure plots time series of Commercial Real Estate (CRE) and Residential Real Estate (RRE) debt to assets. CRE debt is measured as series "All sectors; commercial mortgages; asset" on Table L.220 (series FL893065505.Q). RRE debt is measures as "All sectors; one-to-four-family residential mortgages; asset" on Table L.214 (series FL893065105.Q). We follow Ghent et al. (2019) in their definition of CRE and RRE assets. CRE assets is measures as the sum of "Nonfinancial noncorporate business; nonresidential real estate at market value" and "Nonfinancial corporate business; real estate at market value" on Tables B.103 and B.104, respectively (series FL105035005.Q and FL115035035.Q, respectively). RRE assets is measured as "Households and nonprofit organizations; real estate at market value" on Table B.101 (series FL155035005.Q). Note that if CRE debt included all multifamily mortgages (series FL893065405.Q), CRE debt to assets would still be lower than RRE debt to assets. *Source:* Z.1 Financial Accounts Release of the Board of Governors of the Federal Reserve System.

Figure A2: Comparison of Cash Purchase Shares between RCA and NCREIF



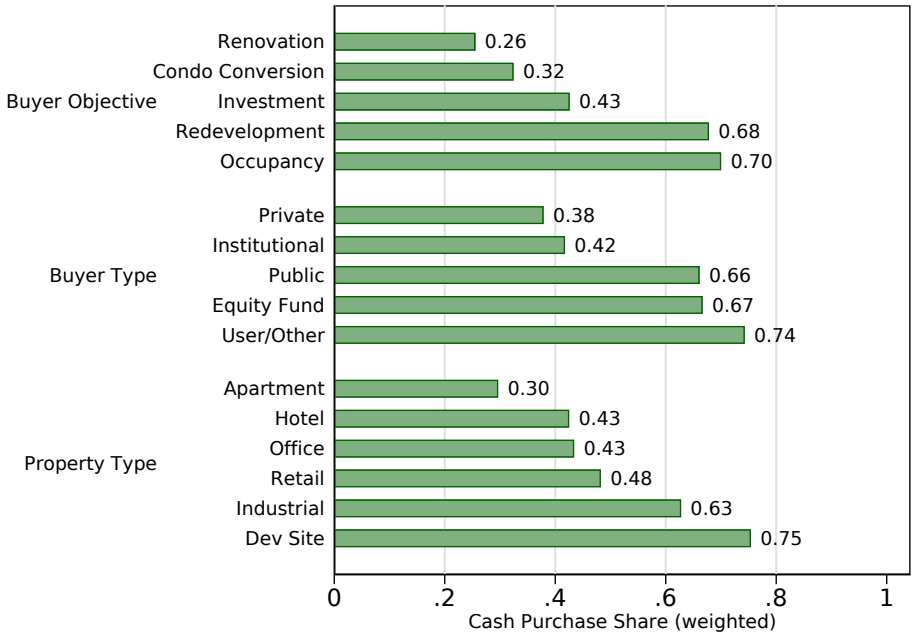
Notes: RCA sample is limited to sale transactions by institutional buyers between 2005 and 2020. NCREIF sample is limited to sale transactions between 2005 and 2020. *Source:* Authors' calculations using transaction-level data from NCREIF and MSCI RCA.

Figure A3: Time Trends by Buyer Type, Objective, and Property Type



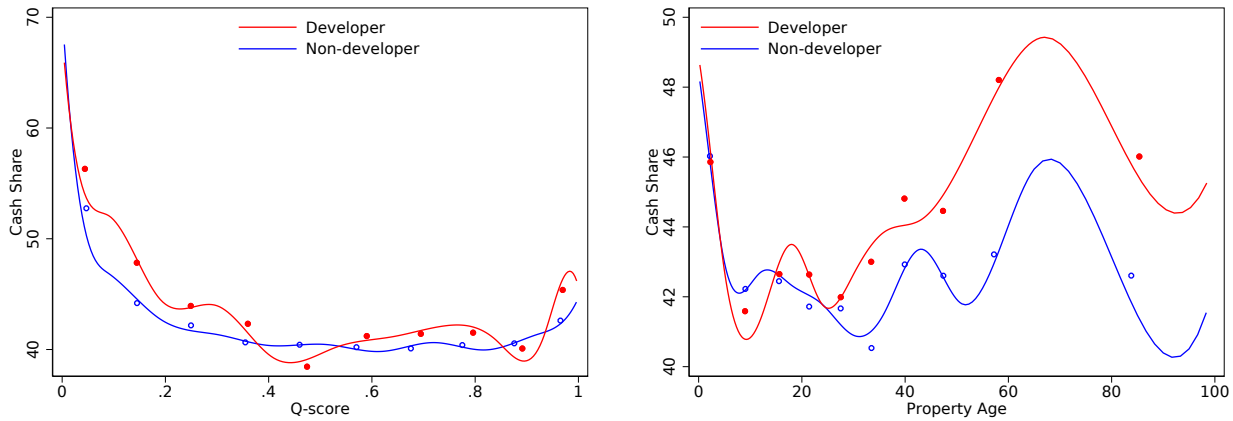
Notes: Figure plots the share of CRE purchases over time that are cash financed by buyer objective (top), buyer type (bottom left) and property type (bottom right). Shares are weighted by the property value. Sample is limited to non-portfolio sale transactions. *Source:* Authors' calculations using MSCI RCA data.

Figure A4: Cash Purchase Shares, weighted



Notes: Figure plots the share of CRE purchases that cash financed (i.e., not financed by a mortgage) by buyer objective (top), buyer type (middle) and property type (bottom). Shares are weighted by the property value. *Source:* Authors' calculations using MSCI RCA data.

Figure A5: Cash Purchase Shares by Development Experience



(a) By Property Quality (b) By Age

Notes: Plots are produced using the Stata command binsreg (Cattaneo et al., 2019). Each binscatter regression includes year, property type, and buyer fixed effects. Dots show estimated cash purchase shares by decile of Q-score (left) or age (right), while lines plot semi-linear regression estimates with a cubic B-spline. Estimates for developers are in red, and non-developers in blue. *Source:* Authors' calculations using MSCI RCA.

Table A1: Cash purchases and Redevelopment Options

	Cash Indicator (in percentage points)								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Low Q-Score	3.90**	2.80**	2.95**	5.53**	4.48**	4.63**	6.30**	5.68**	5.75**
	(0.47)	(0.53)	(0.53)	(0.44)	(0.51)	(0.51)	(0.57)	(0.64)	(0.64)
Age>25	-3.94**	-3.93**	-4.49**	-2.70**	-2.70**	-3.29**	0.02	0.03	-0.41
	(0.49)	(0.48)	(0.56)	(0.45)	(0.44)	(0.52)	(0.47)	(0.47)	(0.54)
Low Q-Score × Developer		5.39**	4.88**		5.10**	4.57**		3.22**	2.92**
		(1.13)	(1.10)		(0.97)	(0.96)		(1.02)	(1.01)
Age> 25× Developer			2.82**			2.94**			2.25*
			(1.08)			(0.96)			(0.92)
Developer		-0.22	-1.74		-0.01	-1.60			
		(1.13)	(1.42)		(0.78)	(1.03)			
Age<2	9.50**	9.47**	9.43**	7.33**	7.29**	7.26**	4.57**	4.55**	4.55**
	(0.98)	(0.98)	(0.98)	(1.06)	(1.06)	(1.05)	(0.73)	(0.72)	(0.72)
ln(Land Area in Acres)	-1.12**	-1.13**	-1.14**	-1.64**	-1.65**	-1.65**	-1.94**	-1.94**	-1.94**
	(0.14)	(0.14)	(0.14)	(0.12)	(0.12)	(0.12)	(0.11)	(0.11)	(0.11)
R^2_a	0.093	0.094	0.094	0.135	0.135	0.135	0.324	0.325	0.325
Observations	133,993	133,993	133,993	131,494	131,494	131,494	123,727	123,727	123,727
$\bar{Y}$	42.05	42.05	42.05	41.6	41.6	41.6	41.95	41.95	41.95
sd(Y)	49.36	49.36	49.36	49.29	49.29	49.29	49.35	49.35	49.35
Property Type FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
Buyer Type FE	-	-	-	✓	✓	✓	-	-	-
Buyer FE	-	-	-	-	-	-	✓	✓	✓

Notes: Sample is limited to purchase transactions in 2005 or later where the buyer has indicated their intention is investment. *Source:* Standards errors, in parentheses, are clustered by buyer. $^{+}$,*,** indicate significance at 10 percent, 5 percent and 1 percent, respectively. Authors' calculations using the MSCI RCA data.

B. THEORY APPENDIX

In this section of the appendix, we provide further details on the solution to the model described in Section 3.

Equation (1) has the solution:

$$V(t) = \frac{e^{-\delta t}}{r+\delta} + Ae^{rt}, \tag{7}$$

where A is a constant determined by the boundary condition and optimality conditions that:

$$V(t^*) = V(0) - c$$
$$V'(t^*) = 0.$$

The first condition is the value matching condition that the value of the property at the time of renovation is the value of a newly renovated property net of construction costs. The second condition is the smooth pasting condition required for t^* to be optimal.

We can use the smooth pasting condition to solve for A as a function of t^*. Differentiating (7) with respect to t, evaluating at t^*, and setting the equation to 0 implies

$$A(r+\delta) = \frac{\delta}{r} e^{-(r+\delta)t^*}.$$

Substituting A into (7) implies:

$$V(t) = \frac{e^{-\delta t}}{r+\delta}\left(1 + \underbrace{\frac{\delta}{r} e^{-(r+\delta)(t^*(c)-t)}}_{\equiv \rho}\right). \tag{8}$$

The optimal renovation threshold, t^*, is defined implicitly by the value matching condition that

$V(t^*) = V(0) - c$. Evaluating (8) at t^* and 0, this expression simplifies to:

$$e^{-\delta t^*}\frac{1}{r} - \frac{1}{r+\delta} - \frac{\delta}{r(r+\delta)}e^{-(r+\delta)t^*} + c \quad = \quad 0.$$

Applying the implicit function theorem thus implies:

$$\frac{\partial t^*}{\partial c} = \left(\frac{\delta}{r}e^{-\delta t^*}(1-e^{-rt^*})\right)^{-1} > 0.$$

This means that t^* increases monotonically in the cost of renovation. To summarize how renovation costs affect property values, When c is zero, $t^* = 0$, and property values are $\frac{1}{r}$. Higher renovation costs then cause renovations to occur later (higher t^*), and property values to decline, reflecting a smaller value of the renovation option (since $\frac{\partial \rho}{\partial t^*} < 0$). In the limit, t^* goes to ∞ as c goes to ∞, and the value of the renovation option goes to 0.