The Appraisal Mechanism: Spillover Effects of All-Cash Buyers on Local Housing Markets*

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Abstract

All-cash transactions have become increasingly prevalent in U.S. housing markets, yet their impact on local house price formation and the underlying mechanisms remain poorly understood. In this paper, I propose and identify an appraisal channel through which cash purchases exert downward pressure on nearby mortgage-financed property sales. I assemble a comprehensive micro-level housing dataset spanning 2018–2022 and implement a ring-based identification strategy to exploit hyper-local variation in the incidence of cash purchases, allowing me to estimate their causal influence on neighboring properties. For a focal property, I find that a one-standard-deviation increase in the share of nearby cash purchases leads to a $3,194 reduction in its appraised value and, consequently, a $3,487 decline in its transaction price. A stylized housing choice model incorporating appraisal constraints highlights the context-dependent welfare implications of cash purchase spillovers: in distressed markets, price declines driven by cash transactions and appraisal feedback reduce welfare by excluding mortgage-dependent buyers and limiting wealth accumulation through homeownership. In contrast, in high-demand areas, the same spillovers may have less detrimental effects and can even enhance affordability by lowering entry prices for prospective buyers.

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Introduction

In the past two decades, the share of all-cash home purchases in the U.S. has increased substantially—from approximately 12% to over 30% (Figure 1). While institutional and professional buyers[1] have consistently relied heavily on cash, individual buyers—who historically account for over 90% of all housing transactions—have also steadily increased their use of cash over time (Appendix Figure 5). Despite this notable rise, the underlying drivers and economic implications of growing cash activity remain relatively underexplored.

A growing literature has documented an average price differential of approximately 11% between mortgage-financed and all-cash home purchases, commonly referred to as the "cash-mortgage discount" (Reher and Valkanov, 2024; Han and Hong, 2024). In contrast to the frictionless benchmark assumption in Modigliani and Miller (1958), the housing market is rife with transaction frictions. Sellers often prefer cash offers—even at a discount—due to the reduced risk of financing contingencies, delays, and appraisal-related uncertainty. Empirical evidence further suggests that this discount is more pronounced for lower-priced, distressed, foreclosed, or poor-quality properties, particularly in small or struggling markets and during downturns (Chia and Ambrose, 2024; Seo et al., 2021; Asabere et al., 2015; Aroul and Hansz, 2023).

In this paper, I examine the *economic consequences* of a rising local cash purchase share. I conceptually develop and empirically test an *appraisal mechanism* through which the local prevalence of cash buyers can *depress* house prices, even after accounting for property-level selection and unobserved local market trends (e.g., housing demand).

Institutionally, mortgage lenders typically hire an external appraiser to assess the fair market value of a home before approving a loan. By regulatory and professional standards, appraisers are not allowed to consider the buyer's financing method when assigning value. Crucially, they rely primarily on recent comparable sales ("comps") to determine the appraisal value. I describe these institutional details in Section 1.

This appraisal process introduces a potential channel through which cash buyers influence prices. First, a higher local incidence of low-priced cash transactions depresses the comps used in appraisals. Second, these lower comps result in reduced appraised values for future mortgage-financed sales. Third, lower appraisals constrain the loan amount a buyer can

[1]The definition and categorization of institutional buyers follow Gorback et al. (2025), including long-term rentals (LTRs), iBuyers, builders, flippers, etc.

obtain, unless they increase their down payment. Finally, in the absence of sufficient unconstrained buyers (e.g., cash buyers), sellers may reduce their asking prices to align with the appraised value, effectively anchoring transaction prices to those lower valuations. While a high cash share may also reflect strong local housing demand, identifying the appraisal mechanism requires carefully controlling for this and other confounding factors.

To identify this mechanism, I adopt a ring-based spatial research design that leverages hyper-local variation in exposure to cash purchases, following Bayer et al. (2021) and Gupta (2019). For each mortgage-financed transaction, I define three concentric rings—inner, middle, and outer—representing increasing geographic radii. I construct the share of cash transactions (i.e., the cash market share) in each ring and examine their differential effects on the focal property's appraised and transaction values. The empirical rationale is that properties within the inner ring are more likely to be included in appraisal comps, and thus subject to spillovers from nearby cash sales, whereas properties in the middle and outer rings serve as valid counterfactuals. This design enables me to difference out broader local market shocks and trends. I estimate regression models where appraisal and transaction prices are regressed on the cash share in each ring, controlling for property-level characteristics and tract-by-year fixed effects to account for unobserved, time-varying neighborhood trends.

The results reveal a statistically significant negative coefficient on the inner-ring cash share and positive coefficients on the middle and outer-ring measures. These findings are consistent with the appraisal mechanism: conditional on local demand and property characteristics, nearby cash transactions exert downward pressure on appraisal and sale prices. In contrast, positive coefficients on cash shares in wider rings suggest that higher overall cash activity is associated with increased local demand. These results remain robust when modestly expanding the inner ring radius from 0.1 to 0.15 or 0.2 miles, and when adjusting the outer rings accordingly. That said, the average spillover effects may mask important cross-neighborhood and temporal heterogeneity. A natural next step (under construction) is to examine whether the price-depressing effects of nearby cash sales are amplified in distressed or credit-constrained neighborhoods or among vulnerable buyer groups—an analysis enabled by buyer-level information on income, credit score, and other demographics in a CoreLogic-HMDA matched sample.

To rationalize these findings, I develop a stylized housing choice model incorporating appraisal constraints. The model highlights the context-dependent welfare implications of

these cash buyer spillovers. In distressed markets, price declines driven by cash purchases and their influence on appraisals can reduce welfare by excluding mortgage-dependent buyers and limiting opportunities for wealth accumulation through homeownership. In contrast, in high-demand areas, such spillovers may not be detrimental and can even enhance affordability by lowering entry prices for prospective buyers.

Related Literature

This paper is directly motivated by an emerging strand of finance and real estate literature that examines the cash versus mortgage buyer outcomes. A number of aforementioned recent papers document the mortgage-cash premium (or the "cash-mortgage discount") and rationalize it by incorporating a suite of housing market frictions and bahavioral factors into search-based models (Reher and Valkanov, 2024; Han and Hong, 2024). My analysis complements this line of work by demonstrating that the prevalence of cash buyers not only affects individual transaction prices, but can also *spill over* by depressing the appraised values of neighboring sales. In other words, there exists a mechanism for how the "cash discount" can propagate: a high local share of cash transactions may shift the local pricing baseline downward via lower comps, consequently forcing mortgage deals to transact at lower prices than they otherwise would. This new channel links the micro-level negotiation advantage of cash buyers to a broader implication for local price dynamics and housing affordability.

Notably, a relevant study by Chia and Ambrose (2024) identifies the adverse effects of a declining supply of small-dollar mortgages on housing prices *via cash discounts*. The authors are the first to causally establish how tighter credit conditions increase the magnitude of cash discounts, a mechanism that disproportionately depresses house prices in low-income neighborhoods. In contrast, the mechanism proposed in this paper may operate even in the absence of explicit credit supply constraints—cash buyers alone can depress house prices through their influence on future appraisals.

This paper also relates to the broader urban and housing economic literature that underscores the crucial role of financing frictions in local house price formation. Classic theories have long recognized that homebuyers' borrowing constraints can amplify housing market volatility. For example, Stein (1995) develops a model where minimum down-payment requirements link buyers' purchasing power to their existing equity, resulting in larger swings

in prices and volumes over housing cycles. Empirical studies confirm the importance of such credit frictions matter. Notably, Genesove and Mayer (2001) finds that homeowners with low equity (i.e. tighter liquidity constraints) set higher list prices and endure longer time on market, implying that credit constraints distort transaction outcomes. These housing market frictions can also be reinforced by behavioral biases as the authors show that loss-averse sellers exhibit downward price stickiness in busts, rendering higher prices and slower market clearing. More recent empirical studies that incorporate heterogeneous homebuyers into a structural model highlight how financing availability shapes the cross-section of prices. The calibrated model for San Diego's housing boom by Landvoigt et al. (2015) illustrates that cheap credit for marginally poorer buyers was a major driver of price increases at the lower segments. Consistent with the mechanism, Kaplan et al. (2020) argues that the recent housing boom-and-bust cycle was amplified by an influx and then retreat of credits, especially for subprime borrowers. I build on this broader literature on housing credit frictions by highlighting an appraisal-induced financial constraint and showing how the interplay of comparable sales and mortgage limits can suppress local prices., especially in lower-demand credit-constrained areas.

The appraisal-based channel also relates to a growing literature that features informational frictions and documents how and why house prices exhibit momentum and sluggish adjustments. Guren (2018) finds that home sellers tend to extrapolate asking prices from recent sale prices, which generates positive autocorrelation in house prices over multiple years. Such strategic complementary behavior implies that even small frictions in updating valuations can create substantial momentum in housing markets. The appraisal mechanism is closely related in the sense that appraisers can inherently propagate past transaction outcomes into current valuations by relying on comps, potentially inducing momentum. In contrast to momentum driven by seller heuristics, the appraisal channel represents an institutional feedback loop that can rigidly cap prices. Both backward-looking pricing by sellers and appraisal-based pricing for lenders highlight sources of inertia in housing markets that depart from frictionless asset pricing. My relative contribution is to pinpoint a specific institutional source of price stickiness (i.e., appraisal conventions in mortgage underwriting) and to demonstrate its importance in shaping local housing trends. By doing so, I also complement recent segmented-search models (e.g., (Piazzesi et al., 2020)), which show that cash buyers and constrained buyers occupy different submarkets. In my setting, this segmenta-

tion is endogenous: when appraisals become binding, mortgage-dependent buyers are priced out, leaving the housing stock to all-cash buyers – a dynamic that can strengthen low-price equilibria in certain neighborhoods.

Lastly, this study also directly relates to the contemporaneous study by Aldana and Zhu (2025) where the entry of cash buyers serves as a negative demand shock for local mortgage borrowers and lenders. The authors find that an increased presence of cash buyers in local housing markets can change lender behavior, particularly among smaller mortgage lenders. In response to declining demand from mortgage borrowers, small lenders (e.g., community banks) shift their lending portfolios toward non-residential assets, often leading to over-exposure in specific sectors, while larger lenders with more branches subsidize across geographies more easily. These dynamics raise concerns about local financial stability.

1 The Appraisal Mechanism

1.1 The Financing-Neutrality of Residential Appraisals

A residential appraisal provides an impartial assessment of a property's value and is typically required by a lender during the mortgage approval process. A central tenet of federal regulations, industry guidelines, and professional standards is that *the source or type of financing must not influence the appraisal's outcome*[2]. In practice, this means that an appraiser's estimate of market value should remain consistent regardless of whether a purchase is financed by a conventional loan, an FHA-insured loan, a VA loan, or completed with cash.

Both housing and banking regulatory frameworks adopt a market value definition that presumes a fair, arm's-length transaction, free of special financing or sales incentives. For instance, Fannie Mae's Selling Guide[3] defines market value as "the most probable price that a property should bring in a competitive and open market... assuming the price is not affected by undue stimulus," further specifying that "payment is made in terms of cash... or financial arrangements comparable thereto; and the price represents the normal consideration for the

[2]Anecdotally, *commercial* real estate appraisers often incorporate the source of financing into their evaluations, such as applying discounts to all-cash acquisitions of income-producing properties like shopping malls.

[3]https://selling-guide.fanniemae.com/

property sold unaffected by special or creative financing or sales concessions granted by anyone associated with the sale." This guidance reinforces that financing terms, such as interest rate buydowns or seller concessions, should neither inflate nor deflate the appraised value.

The FDIC follows similar standards, requiring that the agreed-upon sale price reflect normal consideration without creative or non-market financing[4]. Appraisers are instructed to treat each sale as if conducted with cash or its equivalent to avoid distortions introduced by atypical financing. The agency further mandates that appraisal reports include a certification stating that "the appraisal assignment was not based on a requested minimum valuation, a specific valuation, or the approval of a loan." In other words, an appraiser must not allow loan type or financing terms to influence their valuation approach or conclusion.

In cases where a comparable sale includes *non-market* financing or incentives, appraisers are required to adjust the observed sale price to reflect a cash-equivalent value. Fannie Mae explicitly states that "adjustments to the comparables must be made for special or creative financing or sales concessions," instructing appraisers to apply adjustments that "approximate the market's reaction" rather than using a mechanical formula. The overarching goal is to ensure that the appraised value reflects the property's intrinsic worth, independent of how the transaction is financed. This financing-neutral approach safeguards lenders and investors by offering a credible assessment of collateral value and ensures fairness for buyers and sellers by grounding appraisals in genuine market dynamics rather than temporary financial incentives.

1.2 Comparable Sales

Residential appraisers mainly rely on comparable sales to perform home evaluations, together with the cost approach[5]. Appraisers usually select comparables based on proximity, time of sale, similarity in property characteristics, etc. For geographic proximity, a comparable is ideally within 1 mile in urban/suburban areas - the closer the better. In rural or unique markets, appraisers may expand the search radius if necessary, explaining the rationale. For

[4]See Code of Federal Regulations at: https://www.ecfr.gov/current/title-12/chapter-III/subchapter-B/part-323/subpart-A/section-323.2.

[5]Addtionally, unlike residential, commercial real estate appraisers mostly use the income approach by discounting all future expected cash flows of an income-producing property to arrive at its fair market value.

temporal proximity, appraisers usually select recent sales within 90–180 days; however, older comps may be used in slow markets. Naturally, comps are also selected based on how similar they are to the target property in terms of lot size, square footage, age, number of bedrooms, conditions, etc.

In residential appraisals conducted for mortgage lending purposes in the U.S., the minimum number of comparable sales is three. The standard number of comparable sales can lie between 3 to 6. Quoting institutional standards, Fannie Mae and Freddie Mac require that appraisers provide at least three settled (closed) comparable sales in the appraisal report (typically on the Uniform Residential Appraisal Report, Form 1004). Under Fannie Mae Selling Guide B4-1.3-08, "The appraiser must analyze and report at least three closed comparable sales that are the most recent and the most similar to the subject property." Similarly, FHA has the same minimum requirement: "The appraiser must provide a minimum of three comparable sales to support the value of the property," quoting HUD Handbook 4000.1, II.D.4.c.

In practice, despite regulatory requirements and industry standards, appraisers retain considerable discretion in selecting comparable sales, which can significantly influence the final appraised value. As a result, the extent to which appraisers consistently adhere to these guidelines remains an open empirical question[6].

1.3 Spillover Effects of Cash Buyers via The Appraisal Mechanism

Here I illustrate the appraisal mechanism through which cash buyers—conditional on other factors such as housing demand—can exert downward pressure on house prices, particularly in distressed or credit-constrained markets.

It is well established that cash buyers frequently purchase homes at discounted prices, often because sellers are willing to accept lower offers in exchange for the speed and certainty associated with cash transactions. As a result, a higher prevalence of cash sales at reduced prices can *depress the recent comparable sales* (comps) used in future appraisals. If a sufficient number of nearby comps reflect cut-rate cash transactions, subsequent mortgage-financed

[6]Relatedly, there have been legal issues surrounding appraisal gaps in the U.S. have centered on allegations of racial bias, discriminatory undervaluation, and regulatory scrutiny of appraisal practices. See, for example, https://www.justice.gov/archives/opa/pr/justice-department-sues-rocket-mortgage-appraisal-management-company-and-appraiser-race.

home sales are likely to receive lower appraised values.

This dynamic can create a financing constraint for mortgage-dependent buyers: lower appraisals reduce the maximum loan amount a lender is willing to approve, unless the buyer is able to make a larger down payment. In markets where unconstrained (cash) buyers are scarce, sellers may be compelled to reduce asking prices to meet appraisal thresholds, thereby anchoring sale prices to the artificially low appraised values and reinforcing downward price momentum.

A further consequence of this mechanism is that buyers facing appraisal shortfalls may resort to riskier forms of financing, such as loans with higher loan-to-value ratios, adjustable rates, piggyback structures, or otherwise unfavorable terms[7].

This appraisal mechanism is likely to be more pronounced in lower-priced or credit-constrained neighborhoods, where even modest appraisal gaps can jeopardize financing and where distressed sellers are more inclined to accept discounted cash offers. Supporting this dynamic, Chia and Ambrose (2024) document that in disadvantaged communities, a decline in the availability of small-dollar mortgages led to a rise in cash purchases and a corresponding decline in house prices—consistent with cash buyers stepping in and transacting at lower valuations.

1.3.1 An Example of The Appraisal Mechanism

Consider a neighborhood in a low-income, credit-constrained ZIP code where the *typical home value* is \$150,000. Historically, appraisals are anchored to three nearby comparable sales ("comps") within the past three months.

Step 1: Discounted Cash Sales Pull Down Comps And Appraisals

Suppose a distressed seller accepts a *cash offer at* \$135,000 (a 10% discount) due to the speed and certainty of closing. Over a short period, **two out of three comps** used by appraisers are such cash sales at \$135,000, while the third comp is a conventional sale at \$150,000. The resulting average of the three comps becomes:

$$\text{Average Comp Price} = \frac{135{,}000 + 135{,}000 + 150{,}000}{3} = 140{,}000$$

[7]However, this scenario can happen only if the seller is unwilling to drop the price.

An appraiser, aiming to remain consistent with recent market evidence, values the next property at $140,000—$10,000 below what a mortgage-dependent buyer might otherwise offer.

Step 2: Lower Appraisals Place Pressure on Mortgage Buyers

A home is pending at $150,000, but the appraisal comes in at $140,000. Suppose the lender requires an 80% loan-to-value (LTV) ratio. Then the maximum loan amount becomes:

$$\text{Loan Cap} = 0.80 \times 140{,}000 = 112{,}000$$

To close at the agreed price, the buyer must now bring:

$$\text{Required Down Payment} = 150{,}000 - 112{,}000 = 38{,}000$$

In credit-constrained markets, such a shortfall is often unaffordable. The buyer either renegotiates the purchase price, turns to a riskier loan product, or exits the deal.

Step 3: Downstream Effects

This mismatch creates several ripple effects:

- Sellers often lower prices to align with appraisals, especially when cash-rich buyers are scarce.
- Buyers unable to cover shortfalls may resort to higher LTV loans, adjustable-rate mortgages, or piggyback loans—exposing them to more risk.
- Repeated discounted cash comps reinforce lower appraisals, potentially triggering a localized price decline.

Step 4: Amplification in Credit-Starved Areas

This mechanism can be particularly pronounced in disadvantaged or credit-scarce neighborhoods, where small price shortfalls can derail deals and sellers are more willing to take quick, lower cash offers.

1.4 Cash Buyers as A Signal of High Demand

It is important to note that cash buyers do not always portend price declines. Instead, a high cash-buyer presence can be a symptom of a hot market rather than a weak one. For instance, in booming housing markets or desirable neighborhoods, buyers with ample liquidity might use cash to win bidding wars. In such cases, cash offers may actually drive prices up (or at least keep them high) because these buyers are willing to pay a premium for a quick, guaranteed close.

Existing studies find that the typical price discount for cash purchases shrinks during housing booms and in liquid markets. In other words, when demand is strong, sellers gain little by accepting a lower cash price; financed buyers often match or exceed cash offers. Indeed, nationally, mortgage buyers have been observed to pay more than cash buyers on average (an 8–11% premium), which suggests that in many cases cash buyers are not depressing prices but rather that financed buyers stretch to compete.

Thus, we must consider that the effect of cash buyers could be context-dependent instead of applying to all areas or scenarios. In order to empirically identify the new appraisal mechanism through which cash buyers can depress prices, it is crucial to *control for demand.*

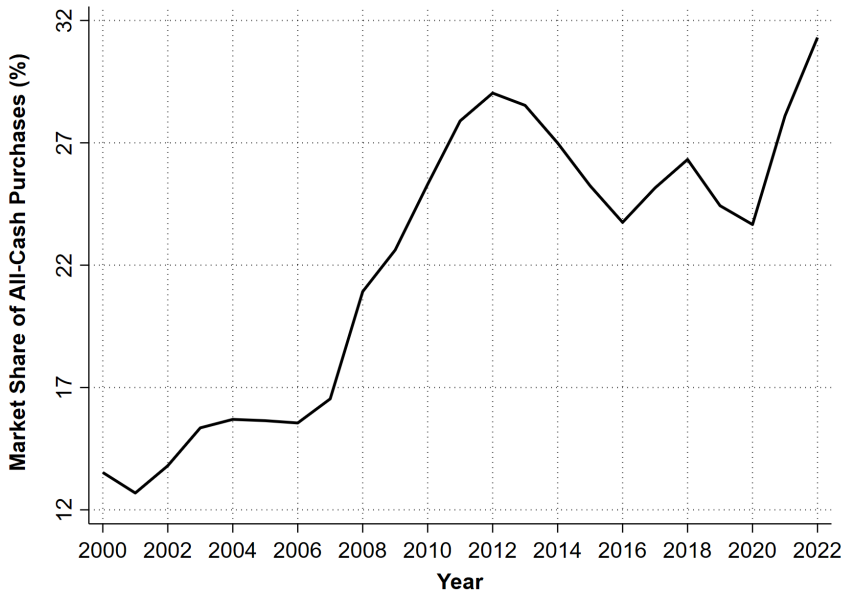
2 Data

In this section, I introduce the process that constructs the main sample and describe how to measure the exposure to nearby cash buyers of each focal property in preparation for the ring-based research design.

2.1 Primary Sample Overview

To construct the primary dataset, I first match deed records from CoreLogic with loan applications from the Home Mortgage Disclosure Act (HMDA), administered by the Consumer Financial Protection Bureau (CFPB), at the property transaction level. Appendix Section A provides complete details on the matching process. The final matched sample consists of over 7.9 million residential transactions from 2018 to 2022—the only period during which appraisal values are reported. The sample includes only arms-length transactions involving individual buyers and excludes intra-family transfers and investor purchases. In

Figure 1: National Cash Purchase Share (2000-2022)



Notes: This figure plots the annual national market share of all-cash home purchases during 2000-2022. Only arms-length transactions by individual home buyers are included.

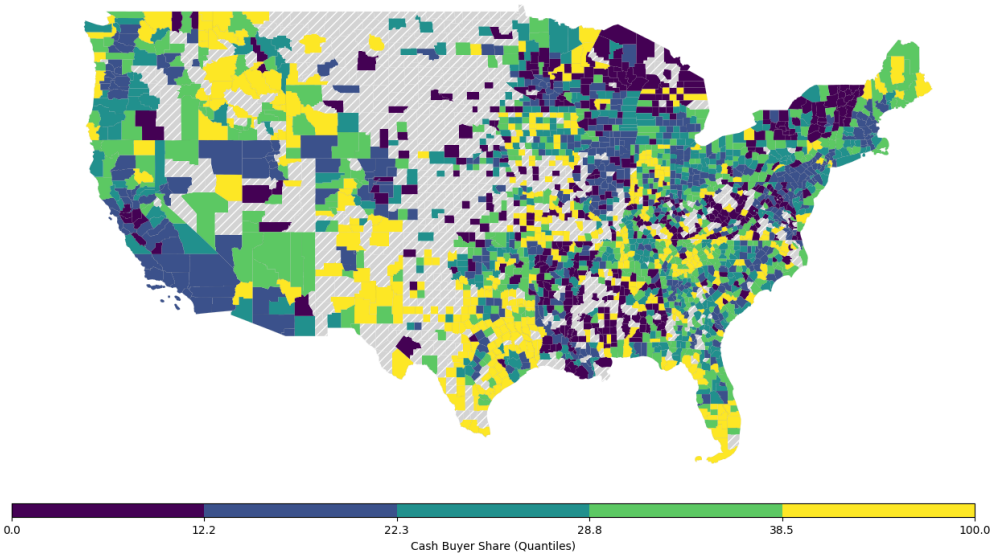
total, the dataset spans 2,074 counties, approximately 76,000 census tracts, and covers more than 90% of the U.S. population.

Including investor purchases in the sample does not materially affect the estimation results. Indeed, individual buyers account for more than 85% of all housing transactions and are likely the primary driver of cash buyer activity in local housing markets. I exclude investor transactions to provide a cleaner identification of the appraisal mechanism, as institutional buyers may affect housing markets through their own unique channels and incentives (e.g., see Gorback et al. (2025)).

2.2 Variations of All-Cash Purchase Market Share

I document substantial temporal and cross-sectional variation in the market share of all-cash home purchases over a longer horizon during 2000–2022. As illustrated in Figure 1, the national share of all-cash transactions has steadily increased over the past two decades. This trend aligns with findings from Han and Hong (2024) and Reher and Valkanov (2024),

Figure 2: Cash Purchase Share Quantiles by County in 2020



Notes: This figure shows the heat map for the cash purchase market share quantiles cross all 2,076 counties in the U.S. The grey areas indicate counties with missing data. Only arms-length transactions by individual home buyers are included.

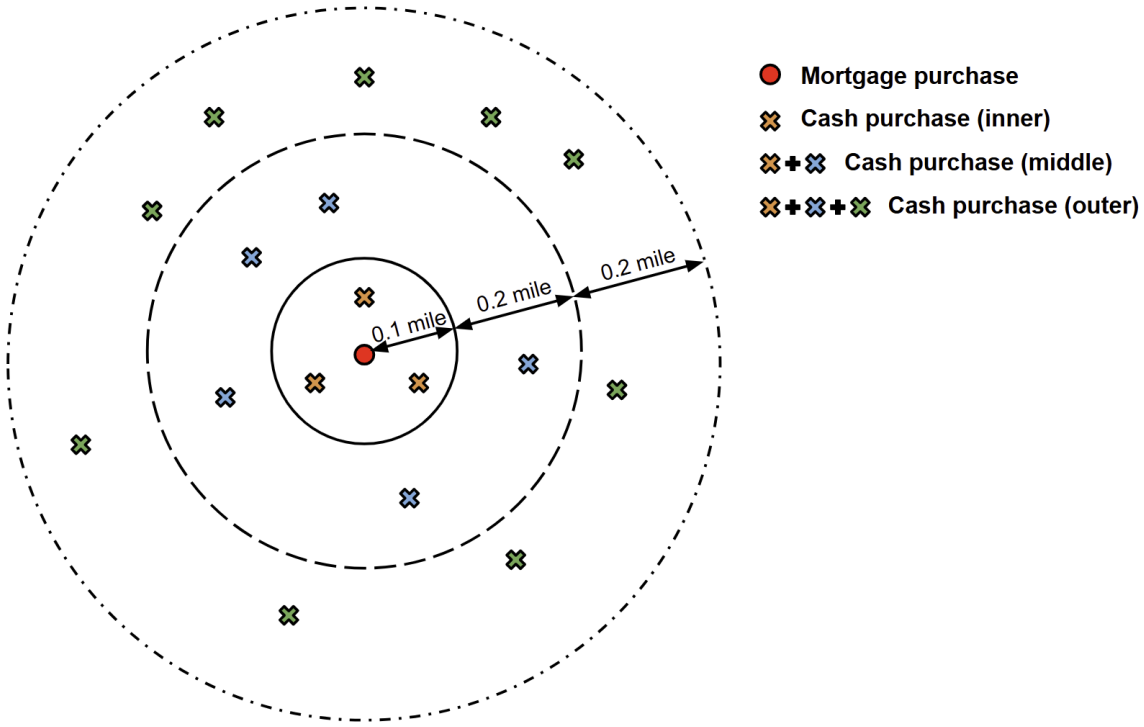
notwithstanding minor differences in sample construction. Figure 2 highlights considerable heterogeneity in cash purchase shares across counties in 2020, measured by quantiles. This spatial variation suggests that cash buyers may systematically sort into specific markets or property types, reinforcing the importance of incorporating both neighborhood- and property-level controls in the subsequent empirical strategy.

3 Estimating Spillovers of Cash Buyers

3.1 Ring-Based Research Design

The primary objective of this analysis is to identify the causal effects of all-cash home purchases on both appraisal values and transaction prices of nearby mortgage-financed home sales. The central hypothesis is that the appraisal mechanism leads to lower appraised values and transaction prices for mortgage-dependent buyers when the local market share of nearby cash purchases is high.

Figure 3: Ring Analysis



Notes: This figure shows how the inner, middle, outer rings are designed around the focal mortgage purchase represented by the red circle. The inner ring encompasses all cash purchases within, say, a 0.1-mile radius while the middle ring encompasses both cash transactions contained in the inner ring and those in the donut-shaped area between the range of 0.1 mile and 0.3 mile. Similarly, the outer ring includes all transactions within its 0.5-mile radius.

There are two main challenges with identifying this mechanism: (i) cash purchases are not randomly distributed across neighborhoods, and (ii) unobserved neighborhood-level factors—such as local housing demand—may simultaneously influence both the incidence of cash purchases and housing outcomes, potentially confounding the estimated effects.

To address these concerns, I adopt a ring-based spatial identification strategy, following the approach used by Bayer et al. (2021) and Gupta (2019), who study investor activity and foreclosure spillovers, respectively. These studies build on a broader literature examining neighborhood effects and local contagion. The core idea is to compare the influence of hyper-local housing activity (e.g., cash purchases within one's own block) to nearby but

slightly more distant areas. In this setting, I estimate the effect of cash buyer activity within concentric rings of 0.1, 0.15, and 0.2 miles, while controlling for comparable activity in broader bands (e.g., 0.3, 0.5, and 0.6 miles). The specification also includes property- and neighborhood-level controls to further isolate the appraisal channel. A visual representation of the ring design is provided in Figure 3.

The rationale for this design is that properties located in the immediate vicinity of a cash transaction (the inner ring) are more likely to be directly affected through their inclusion in the same set of comparables used by appraisers. In contrast, properties just outside this range (middle and outer rings) serve as a quasi-control group, exposed to the same general market conditions but not directly influenced by the cash sales in the inner ring. This spatial differencing approach is intended to isolate the causal effect of nearby cash purchases by differencing out broader neighborhood-level shocks or trends common to all rings.

The complete housing transaction-level regression specification is

$$Y_{i,t} = \beta_1 \, \text{CashShare}_{i,t-1}^{(\text{inner})} + \beta_2 \, \text{CashShare}_{i,t-1}^{(\text{middle})} + \beta_3 \, \text{CashShare}_{i,t-1}^{(\text{outer})} + \gamma X_i + \delta_{c(i),t} + \varepsilon_{i,t}. \quad (1)$$

where i indexes properties and t denotes the transaction date. The dependent variable $Y_{i,t}$ refers to either the appraisal value recorded in the mortgage application or the actual transaction price of the property. The three key explanatory variables capture the market share of cash purchases within specific geographic bands around each focal mortgage-financed transaction, based on transactions that occurred in the 12 months prior to date t. Specifically, these variables measure the prevalence of cash purchases within the inner, middle, and outer rings. Their formal definitions are provided below[8].

$$\text{CashShare}_{i,t-1}^{(\text{inner})} = \frac{\text{Number of cash transactions within 0.1 mile of property } i \text{ in the past year of } t-1}{\text{Number of all transactions within 0.1 mile of property } i \text{ in the past year of } t-1} \quad (2)$$

[8]The choice of radius can be varied without meaningfully affecting the regression results. However, the ring sizes have to remain sufficiently narrow to preserve the hyper-local identification necessary to isolate the appraisal mechanism. Expanding the inner ring from 0.1, 0.15, 0.2, up until 0.4 mile has modest effects on the estimated coefficients, as discussed in Section 3.3.

$$\text{CashShare}_{i,t-1}^{(\text{middle})} = \frac{\text{Number of cash transactions within 0.3 mile of property } i \text{ in the past year of } t-1}{\text{Number of all transactions within 0.3 mile of property } i \text{ in the past year of } t-1} \tag{3}$$

$$\text{CashShare}_{i,t-1}^{(\text{inner})} = \frac{\text{Number of cash transactions within 0.5 mile of property } i \text{ in the past year of } t-1}{\text{Number of all transactions within 0.5 mile of property } i \text{ in the past year of } t-1} \tag{4}$$

The inner-ring cash share serves as a proxy for the local prevalence—or treatment intensity—of cash purchases in the immediate vicinity of property i. In contrast, the middle and outer ring measures function as controls to account for broader neighborhood-level housing trends. Notably, both the middle and outer rings include all transactions within the inner ring. The vector X_i captures time-invariant property characteristics to address potential selection at the property level. The fixed effects $\delta_{c(i),t}$ represent tract-by-year controls, which absorb unobserved shocks specific to each census tract in a given year. Similar to tract-by-year fixed effects in hedonic models, these controls help isolate the effect of local cash transactions by netting out time-variant neighborhood-level unobservables—such as shifts in housing demand—that could otherwise confound identification. For instance, a high concentration of cash buyers may reflect intense bidding wars rather than the appraisal mechanism of interest. Intuitively, the coefficient β_1 captures the average spillover effect of nearby cash purchases on the focal property, while β_2 and β_3 absorb the influence of cash transactions in the broader surrounding area and any associated housing market trends.

Table 1 reports summary statistics for the estimation sample, which includes 7,954,675 mortgage-financed transactions matched between CoreLogic and HMDA from 2018 to 2022. On average, although appraisal values slightly exceed actual transaction prices, both in mean and standard deviation, the difference is not statistically significant. The table also shows how exposure to cash transactions and the number of nearby transactions increase with ring size. For example, the smallest ring (0.1 mile) has a mean cash purchase share of 20% and includes roughly six transactions on average. Expanding the radius to 0.15 mile increases the exposure to 23% and adds about five more transactions. At a 0.6-mile radius, the exposure converges to 26%, with a substantial increase in the number of included transactions. Because each marginal expansion increases the area of the ring substantially—particularly the donut-shaped outer portions—the number of captured transactions rises disproportionately.

Table 1: Estimation Sample Summary Statistics (2018–2022)

Panel A: Number of Mortgage-Financed Transactions	
7,954,675	

Panel B: Outcome Variables

	Mean	**SD**
Transaction Prices	343,830	293,197
Appraisal Prices	349,123	308,489

Panel C: Exposure to Cash Purchases

Distance (miles)	**Mean**	**SD**
0.1	0.20	0.18
0.15	0.23	0.17
0.2	0.24	0.15
0.3	0.25	0.14
0.4	0.25	0.12
0.5	0.26	0.11
0.6	0.26	0.10

Panel D: Number of Housing Transactions

Distance (miles)	**Mean**	**SD**
0.1	8.07	9.35
0.15	14.11	15.17
0.2	19.18	17.99
0.3	38.15	35.11
0.4	52.72	46.74
0.5	80.95	66.58
0.6	95.68	79.82

Notes: This table reports the main summary statistics for the estimation sample, including the number of CoreLogic-HMDA matched housing transactions, the main outcome variables, and the exposure to cash purchases and the number of housing transactions in each ring across different ranges.

The 0.6-mile cutoff appears well-suited to balance precision and hyper-locality, allowing the identification strategy to capture the appraisal mechanism without being overly influenced by broader demand-side effects.

3.2 Baseline Results

Table 2 presents estimates from equation 1, using 0.1, 0.3, and 0.5 miles as the radii for the inner, middle, and outer rings, respectively. All specifications include tract-by-year fixed effects to account for unobserved, time-varying neighborhood-level factors such as local economic shocks, gentrification, fluctuations in mortgage credit supply, or shifts in housing demand. Standard errors are clustered at the census tract level to accommodate arbitrary spatial and temporal correlation in the residuals within tracts. This clustering is particularly important given that housing transactions within a neighborhood are likely to be correlated due to shared amenities, school quality, or appraisal practices that may systematically influence pricing and valuation outcomes.

Column (1) reports a statistically significant and negative coefficient on the inner-ring cash share, while the coefficient on the outer-ring share is positive. A 100-percentage-point increase in the share of nearby all-cash purchases within the immediate vicinity (i.e., the inner ring) is associated with a $29,680 decrease in the appraised value of a mortgage-financed home. Interpreted proportionally, a one-standard-deviation increase in inner-ring cash share (0.18 within a 0.1-mile radius) corresponds to an estimated $5,342 reduction in appraised value ($29{,}680 \times 0.18$). This result provides suggestive evidence for the appraisal mechanism: nearby cash purchases, often occurring at discounted prices, can depress the comparable sales used in subsequent appraisals, thereby lowering the appraised values of surrounding mortgage-financed transactions. The positive coefficients on the middle and outer-ring cash shares further validate the identification strategy. These more distant transactions likely reflect broader local housing demand and are less likely to be used as direct comparables, consistent with the absence of a negative appraisal spillover. The finding that only the inner ring exhibits a negative effect underscores the role of comparables in appraisal-based lending constraints.

However, moving from Column (1) to Column (2), the estimated coefficient on the inner-ring cash share declines by nearly half after controlling for property characteristics, indicating substantial selection at the property level. For instance, newer and larger single-family homes (the benchmark property type), as well as those with more bedrooms, tend to have higher appraised values. After accounting for this selection, the estimated spillover effect of a 100-percentage-point increase in inner-ring cash share is a $16,232 reduction in appraisal

Table 2: Main Regression Results

	(1)	(2)	(3)	(4)
	Appraisal Values		*Transaction Prices*	
Inner Share	-29,680***	-16,232***	-29,680***	-16,233***
	(2,203)	(2,256)	(2,203)	(1,203)
Middle Share	-12,819	1,447	-10,583***	3,865
	(6,085)	(6,158)	(2,146)	(2,350)
Outer Share	17,648***	28,604***	18,635***	29,663***
	(8,902)	(8,849)	(3,962)	(3,872)
Property Category - Condo		-187,242***		-190,080***
		(7,271)		(6,636)
Property Category - Duplex		60,646***		51,686***
		(7,297)		(4,593)
Building Age		-1,511***		-1,521***
		(39)		(29)
Land Sqft		0.223**		0.210**
		(0.180)		(0.151)
No. Bed		9,384**		9,062**
		(4,070)		(3,924)
Observations	7,363,648	7,363,648	7,363,648	7,363,648
Tract-by-Year FE	Y	Y	Y	Y
R-squared	0.146	0.147	0.757	0.763

Notes: This table shows the regression results estimated for equation 1 with 0.1, 0.3, and 0.5 mile for the inner, middle, and outer ring respectively. All specifications include tract-by-year fixed effects. All standard errors are clustered at the tract level. with robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

value. Translating this into standard deviation units, a one-standard-deviation increase in inner-ring cash share (0.18) is associated with a $2,921 decrease in appraisal value, which is statistically significant. Consistent with Column (1), the coefficients on the cash share in the wider rings remain positive and statistically significant, suggesting that a higher prevalence of cash purchases in the broader neighborhood reflects stronger underlying housing demand. For example, a 100-percentage-point increase in cash share within the 0.5-mile radius is associated with an average increase of $28,604 in appraisal value.

Do these estimated appraisal spillovers translate into lower transaction prices for homes in the inner ring? Columns (3) and (4) confirm this conjecture, showing highly similar patterns

when the dependent variable is the actual transaction price. Specifically, a 100-percentage-point increase in the inner-ring cash share leads to a $16,233 decline in transaction price, or approximately $2,922 for a one-standard-deviation increase, virtually identical to the effect on appraisals. The influence of property-level selection follows the same pattern as observed in Column (2), reinforcing the robustness of the estimated spillover effects.

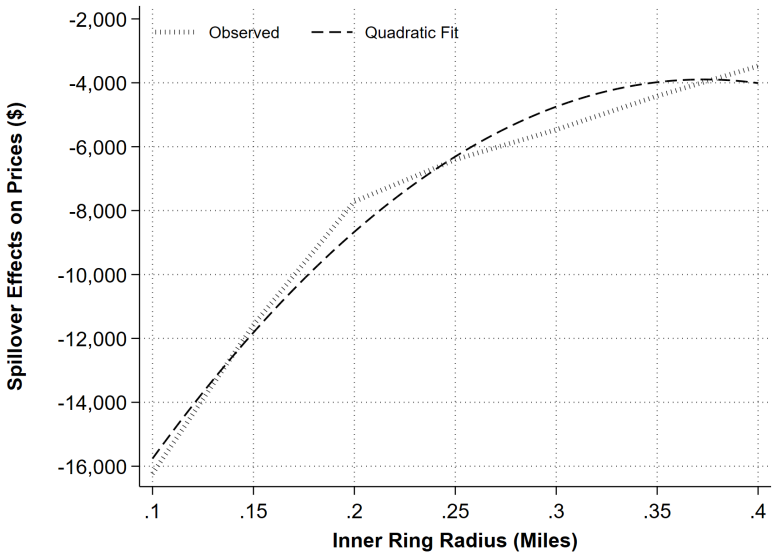
3.3 The Impact of Ring Expansion

It is natural to ask whether the baseline results are sensitive to changes in the radius definitions used to construct the spatial rings, especially the inner ring. Figure 4 plots the estimated spillover effects of cash purchases on the mortgage-financed properties in the *inner ring* across a range of radii, including 0.1, 0.15, 0.2, ..., and up to 0.4 mile while adjusting the middle and outer ring expanded accordingly[9]. To compare across different settings easily, I simply report the estimated effect of a 100-percentage-point increase in inner-ring cash purchase share on the appraisal or sale price of an average focal property

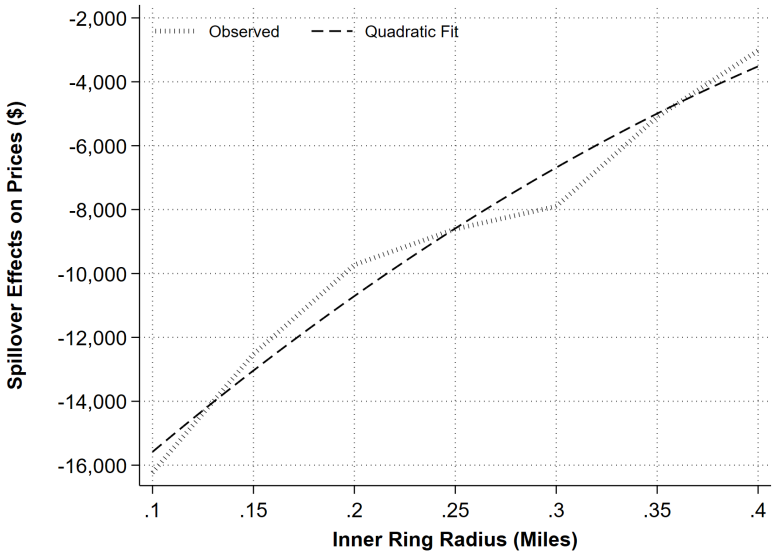
Panel A displays the estimated effects on appraisal values (all negative), which exhibit a slightly increasing trend as the inner ring expands. In other words, the absolute value of the negative effect becomes smaller. The concave shape of the fitted quadratic line suggests a convergence of the spillover effects as the radius increases. For example, the estimated effect declines in magnitude from approximately $12,000 at a 0.15-mile radius to around $4,000 at 0.4 miles. Panel B shows a similar upward trend in the effect on transaction prices, albeit with a less pronounced curvature. Appendix Tables 3, 4, and 5 report detailed regression results for inner-ring radii of 0.15, 0.2, and 0.3 miles, respectively. Although the estimated effects remain negative across all specifications, they start to lose statistical significance as the inner ring expands beyond 0.4 miles.

These attenuated effects likely reflect that, as the spatial definition of "hyper-locality" broadens, the estimated coefficients increasingly capture general correlations between cash buyer activity and local housing demand, rather than the narrowly defined appraisal spillover channel. This highlights an inherent tradeoff: maintaining the hyper-local nature of the identification strategy is essential for isolating the appraisal mechanism, but expanding the radius too far risks confounding the mechanism with broader market dynamics. Determining

[9]For example, a 0.4-mile inner radius correpsonds to a 0.6-mile middle ring and a 0.8-mile outer ring.



(A) Panel A: Spillover Effects on Transaction Prices



(B) Panel B: Spillover Effects on Appraisal Values

Figure 4: Spillover Effects with Expanded Inner Ring Radii

Notes: This table shows the estimated spillover effects of nearby cash purchases on the focal mortgage-financed homes in the inner ring. All specifications used in the baseline results apply.

the appropriate spatial scale to identify the causal spillover effects of cash purchases through the appraisal channel remains an open question, which I plan to address in the next iteration of this working paper.

3.4 Heteogeneity (Under Construction)

The average negative effects estimated across all neighborhoods in the U.S. may obscure important heterogeneity across neighborhoods and time. I intend to investigate whether the spillover effects of cash purchases are more pronounced in distressed or credit-constrained neighborhoods, or among financially vulnerable households. This exercise is interrelated with and potentially rationalizable by the theoretical framework in Section 4.

Leveraging transaction-level data, I can observe buyer characteristics such as race, credit score brackets, and income bracket for each home purchase, which enables a more granular analysis of these heterogeneous impacts.

3.5 Internal Validity (Under Construction)

The current identification strategy implicit assumes that the inner ring has similar endogeneity to the rings outside. Though it seems a reasonable enough assumption, the other interpretation of the estimation results could be that endogeneity drives the results. For example, cash deals occur where the market is declining and the decline is concentrated around the cash deal house. In response, I should be able to provide strong evidence that comps will be disproportionately taken from the inner circle.

To further build confidence towards the appraisal channel, I am manually constructing my own comparables used for each mortgage-financed transaction (at least for a limited sample) following the standard workflow adopted in industry, such as how Zillow and redfin identify similar homes for each home listed on their website[10]. This way, I would be able to proxy the set of homes used in an appraisal and show these comp homes are located in or have a much higher likelihood to exist in the inner ring. A prerequisite of this exercise is that there are enough similar homes transacted recently to be used as the comp so that there is no reason to go outside the ring, for which Table 1 provides suggestive evidence.

[10]For example, see https://www.zillow.com/learn/real-estate-comps/.

Meanwhile, the diagnostic checks presented in Figure 4 of Bayer et al. (2021) can be readily adapted to my setting, given the similarity in the spatial radii used to define the rings.

4 Depressing Prices or Signaling Demand?

One might expect the appraisal mechanism to operate more prominently in specific neighborhoods or during particular time periods. To interpret the empirical findings more systematically, it is useful to conceptualize the conditions under which *the appraisal-induced effects dominate* and when they are likely to be mitigated or absent.

To this end, I model a static housing market in which sellers interact with two types of buyers—cash buyers and mortgage-financed buyers—who segment the market, following the framework of Piazzesi et al. (2020). The model illustrates how *appraisal-based financing frictions* can lead to price declines and restricted credit access, and under what circumstances such dynamics are likely to prevail.

4.1 Setup

Let there be a continuum of homogeneous houses and a continuum of buyers. A fraction μ of buyers are cash buyers, and $1-\mu$ are mortgage buyers. *Mortgage-financed buyers* are constrained by loan-to-value limits, appraisals, and underwriting frictions. They cannot buy above a certain price if the appraisal is low, or if they can't make a large down payment. *Cash buyers*, by contrast, face no such constraints. They can bid at or above the appraisal, close quickly, and have greater flexibility. All buyers draw valuations $v \in [0, \bar{v}]$ from a common distribution $F(v)$.

Supply: Let $S(P)$ be the housing supply at price P. This can be upward-sloping or fixed at $\bar{S}$.

Appraisal Rule: Appraisers set the valuation A based on recent transaction prices:

$$A = \mathcal{A}(P_{\text{recent}})$$

For simplicity, assume $A = P_{t-1}$. In other words, A is the exogenously given appraised value of the house (determined by recent comparable sales in the neighborhood).

Financing Constraint: Mortgage buyers can borrow up to a fraction λ of the appraisal value:

$$L = \lambda A$$

They must cover the gap $P - L$ from their own liquid wealth W. Assume $W = (1 - \lambda)A$, so buyers can afford $P \leq A$.

4.2 Buyer Demand

- If $P \leq A$, both buyer types with $v \geq P$ can purchase. Demand is:

$$D(P; A) = 1 - F(P)$$

- If $P > A$, mortgage buyers are excluded, similar to Kaplan et al. (2020). Demand is:

$$D(P; A) = \mu[1 - F(P)]$$

4.3 Equilibrium

An equilibrium price P^* satisfies:

$$S(P^*) = D(P^*; A)$$

This condition balances supply with the effective demand, which depends on whether mortgage buyers are active (if $P^* \leq A$) or priced out (if $P^* > A$).

Equilibrium house prices in a neighborhood are determined by the interaction of buyer valuations and the appraisal-induced cutoff:

- In the absence of any binding constraint ($A \geq v$ or effectively no appraisal cap), standard competition would drive the price to $P^* = v$ as both mortgage and cash buyers bid up to their valuations. This unconstrained benchmark corresponds to a scenario of abundant liquidity, in line with cases where influxes of liquid wealth fuel higher local house prices (Hartman-Glaser et al., 2023)

- However, if the appraisal value is below fundamentals ($A < v$), the financing friction

comes into play. Two cases illustrate the possible outcomes:

1. **Bidding wars:** If at least two cash buyers are actively bidding, they will compete against each other up to their valuation v. In this case, the winning bid will reach v (or arbitrarily close to it in a continuum of buyers), and the price is effectively unconstrained by A. The presence of sufficient unconstrained capital in the buyer pool allows the market to realize the full fundamental value of the house, despite the low appraisal, as cash buyers are not limited by A.
2. **The appraisal trap:** If cash buyer presence is very limited (for example, only one or none in the bidding pool), the appraisal constraint binds and caps the price. With no competition from another cash buyer, a sole cash buyer would only need to bid slightly above the highest constrained buyer's bid (which is capped at A) to win, resulting in a sale price approximately equal to A. In the extreme case of no cash buyers, all bidders drop out once $P > A$, so the house trades at $P = A$. In either scenario, the price is pinned near the appraisal ceiling when cash-funded demand is scarce.

This equilibrium outcome implies that the neighborhood's sale price will be $P = v$ in a regime with ample cash buyers, and $P = A$ in a regime dominated by mortgage buyers who are constrained by a low appraisal. The comparative statics are intuitive: holding A fixed, a higher share μ of cash buyers makes it more likely that the price will be bid up to v, while a lower μ increases the likelihood that P stays at the constrained level A. In equilibrium, a tract with very few unconstrained buyers will experience depressed prices relative to fundamentals due to the appraisal cap, consistent with evidence that tighter credit conditions or a greater reliance on constrained financing tend to dampen housing prices (Guren et al., 2021). On the other hand, when unconstrained buyers form a large part of the market, the constraint is endogenously relaxed by competitive bidding, and the tract realizes higher prices.

5 Welfare Implications

Given the finding that house prices can be depressed by nearby cash sales in a hyper-local setting, in what context are these effects good or bad? Adapting the set-up in Section

4, I aim to examine how these spillovers from cash purchases propagate through appraisal adjustments and under what conditions they are welfare-enhancing or detrimental.

5.1 Model Framework

Consider a housing market where buyers derive utility from both housing services and non-housing consumption. Each buyer i has utility $U_i(h_i, c_i)$ defined over housing h_i and a composite non-housing consumption good c_i. We can express this separably as:

$$U_i(h_i, c_i) = u(h_i) + v(c_i),$$

where $u(\cdot)$ captures the utility from housing and $v(\cdot)$ from other consumption. For example, one convenient specification is $U_i(h, c) = \alpha \ln(h) + (1 - \alpha) \ln(c)$, where $\alpha \in (0, 1)$ reflects the importance of housing in utility.

In this context, each buyer demands at most one house (a discrete unit $h_i \in \{0, 1\}$ of a standardized home), so $u(h_i)$ can be thought of as $u(1) = u_0$ if the buyer purchases the home (of a given quality) and $u(0) = 0$ if not. The term u_0 thus represents the utility benefit (or intrinsic value) of owning that particular house. We denote by v_i the *monetary equivalent* of this housing utility for buyer i (their willingness-to-pay), i.e. v_i satisfies $u_0 = v_i$ in utility units. Each buyer also has an initial wealth or liquid assets W_i that can be used toward a down payment. Non-housing consumption c_i is then constrained by income/wealth minus housing expenditure. We assume quasi-linear preferences for tractability, so that $v(c_i)$ is roughly c_i (or linear in money), ensuring that v_i indeed measures willingness to pay in dollar terms. Under these assumptions, buyer i will choose to purchase the house if and only if it maximizes their utility, which in monetary terms requires $v_i \geq P$ (their value exceeds the price P) and that they can finance the price P given their budget constraints.

5.1.1 Financing and Appraisal Constraint

Buyers may use mortgage financing subject to an *appraisal-based constraint*. Let A_t denote the appraised value of the house at time t. If buyer i seeks a mortgage, the lender will typically lend no more than a fraction λ (loan-to-value ratio) of the appraised value.

Thus the loan L_i must satisfy:

$$L_i \leq \lambda \cdot A_t \ ,$$

where $\lambda \in (0, 1)$ (e.g. $\lambda = 0.8$ for an 80% LTV limit). In addition, the buyer must cover the remainder of the purchase price with their own wealth as a down payment:

$$P - L_i \leq W_i \ .$$

Combining these constraints, a mortgage-dependent buyer i cannot pay a price above

$$P_{i,\max} = W_i + \lambda A_t \ ,$$

since any $P > W_i + \lambda A_t$ would require a loan exceeding the appraisal-based cap or a down payment beyond the buyer's means. In contrast, a *cash buyer* does not face the appraisal limit – effectively $\lambda = 1$ and L_i is only limited by their own funds. We assume cash buyers have sufficient liquid wealth to cover the price (or access to unsecured funds), so their only limit is their valuation v_i.

5.1.2 Appraisal Updates from Comparable Sales

The appraised value A_t is based on recent comparable sales. A tractable updating rule is:

$$A_{t+1} = (1 - \rho)A_t + \rho P_t \ ,$$

where P_t is the price of the most recent transaction and $\rho \in (0, 1]$ reflects appraisal sensitivity to new comps. This defines an *appraisal feedback loop*, where recent sales influence borrowing capacity for future buyers.

5.2 Differential Welfare Implications in Two Scenarios

Here I analyze two market environments: (1) *distressed, low-demand neighborhoods*, and (2) *high-demand, competitive neighborhoods*. In both, a house is sold to the buyer with the highest *effective* willingness-to-pay, constrained by financing ability.

5.2.1 Distressed Neighborhoods

These areas are characterized by weak demand, sparse transactions, and prevalently discounted cash sales. Appraisers rely heavily on these low comps, leading to *low appraised values* A_t. Consequently, mortgage-dependent buyers face tight constraints:

$$P_i \leq W_i + \lambda A_t \ ,$$

which may be *well below* their true willingness-to-pay v_i. Hence, high-valuation buyers are *excluded* due to financing limits. When cash buyers with lower valuations v_c can bid more than P_i, they win. This leads to a *misallocation* where homes do not go to the highest valuing buyers. It also triggers further appraisal declines:

$$P_t \downarrow \Rightarrow A_{t+1} \downarrow \Rightarrow \text{financing caps tighter} \Rightarrow P_{t+1} \downarrow \ .$$

This feedback loop traps the neighborhood in a low-price, low-equity equilibrium. Welfare is lost both due to misallocation and exclusion of credit-constrained households. Buyers may either forgo homeownership or take on riskier financing (higher LTV, second liens), reducing utility further.

5.2.2 High-Demand Neighborhoods

Here, demand is strong, and prices are high. Frequent high-price transactions ensure that appraisals A_t keep pace with the market. Buyers typically have substantial wealth W_i or can compensate for appraisal gaps. Thus:

$$P_i \leq W_i + \lambda A_t \approx v_i \ ,$$

meaning constraints are *not binding*. Homes go to those who value them most. Cash buyers do not depress future appraisals; if anything, they raise them. The feedback loop is benign or even positive:

$$P_t \uparrow \Rightarrow A_{t+1} \uparrow \Rightarrow \text{future } \mathrm{P}_i \uparrow \ .$$

Welfare is near-efficient: no exclusion or misallocation occurs. Appraisal constraints do not distort outcomes.

5.3 Context-Dependent Welfare Implications

The separating equilibria above highlight that *context matters*. In distressed areas, price declines due to cash purchases and appraisals *reduce welfare* via exclusion and reduced wealth-building. In high-demand areas, cash buyer spillovers are *not harmful* and may even improve affordability.

Furthermore, exploring comparative statics over W_i, λ, or appraisal rigidity ρ can help identify thresholds where credit frictions really bite. Policies that increase W_i (e.g., down payment assistance) or relax appraisal constraints (e.g., adjusted rules for comps) may restore efficiency in low-demand markets.

6 Conclusion

In this paper, I theoretically propose and empirically identify a new channel through which cash purchases can exert downward pressure on nearby mortgage-financed home sales via appraisal constraints. I aim to bridge the gap between the urban economics studies and the finance and real estate literature by demonstrating how who the buyers are (cash vs. financed) can have spillover impacts on how the nearby market operates through a previously under-studied channel.

Using a ring-based identification strategy, I provide evidence that all-cash transactions have meaningful spillover effects on local housing markets through what I term the "appraisal mechanism". Cash purchases can distort local price discovery by bypassing traditional mortgage appraisal processes. I show that homes in close proximity to a cash sale tend to sell at lower prices, suggesting that the discount embedded in the cash transaction influences subsequent valuations in the area. Because appraisal practices rely heavily on recent comparable sales, the presence of discounted cash purchases can depress appraised values for neighboring properties. This mechanism reveals an underexplored pathway through which financing conditions—or the lack thereof—can influence not just individual transactions, but the broader price formation process in local housing markets.

A stylized housing choice model incorporating appraisal constraints highlights the context-dependent welfare implications of these spillover effects and motivates several policy considerations. First, lenders and appraisal professionals should recognize the externalities intro-

duced by cash transactions. Appraisal standards may need to evolve to account for the distinct pricing dynamics of cash sales, ensuring that unusually low (or high) cash transactions do not inadvertently restrict credit availability or distort appraised values for other buyers. Second, from a housing market stability perspective, policymakers should monitor neighborhoods experiencing surges in cash buying—particularly during downturns or waves of investor activity—and consider interventions to prevent the undervaluation of fundamentally sound properties. This may be especially important in lower-income or credit-constrained areas, where appraisal-driven price declines could erode housing wealth and limit access to mortgage credit. Accounting for the appraisal mechanism may help mitigate such unintended consequences and promote more equitable outcomes in housing finance.

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APPENDIX

A Merging CoreLogic Deed Records and HMDA Loan Applications

My procedure of matching CoreLogic and HMDA (2007-2022) closely follows the methodology adopted by Mateen et al. (2023).

A.1 Processing HMDA Data

The HMDA data used in this paper is comprised of two components: (1) Loan Application Registration (LAR) contains borrower, loan, and property information. Each observation is a unique loan application record. (2) Transmittal Sheets (TS) includes lender names – an important merging key to identify the same lender that exists in both CoreLogic deed records and HMDA.

When cleaning LAR, I only keep originated loans and drop denied ones, loans with missing loan amount, and refinance or home improvement loans. For TS, I harmonize lender names by converting them into lower cases, standardizing frequently seen abbreviations (e.g., " bk" into " bank"), dropping redundant strings (e.g., " corp"), and removing punctuations and spaces. Following these steps, to streamline the name cleaning and subsequent matching process, I only keep the first seven letters and the first five letters of each lender name.

The final step is to link lender names with borrower characteristics by matching cleaned LAR and TS data. The merging keys include the activity year, lender unique identifier " respondent id" (by 2018) or " lei" (after 2018). The merged data set contains more than 55 million mortgage origination and deed records, including detailed borrower, lender, loan, and property information.

A.2 Matching HMDA and CoreLogic at The Transaction level

I mainly follow four steps to match each loan origination record from HMDA with each deed record from CoreLogic. The following steps are repeated for each year, state, and county.

Step 1: Merge two data sets based on the cleaned 7-digit lender names and mortgage amount in thousands. This will result in a roughly merged data set with many duplicates, since the merge does not restrict to the same census tract.

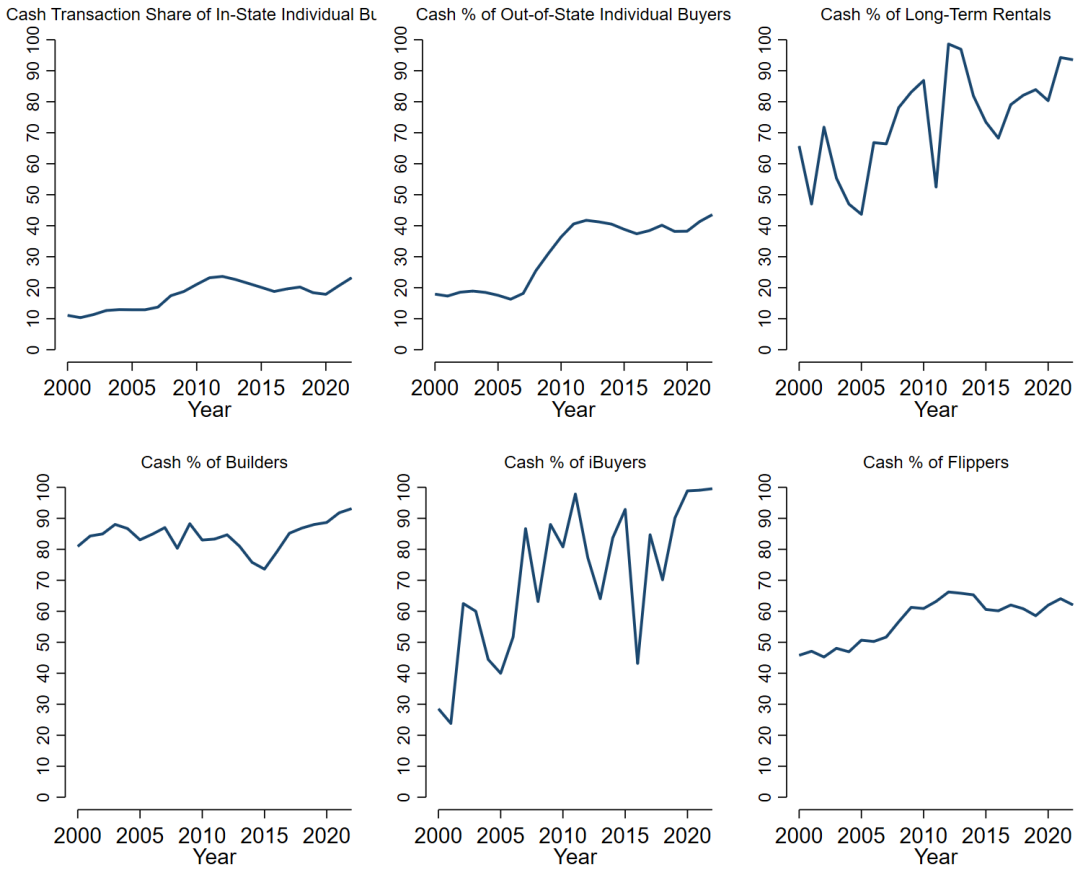
Step 2: Take the minimum of the two distances: the distance between CoreLogic tract and HMDA raw tract and that between CoreLogic tract and HMDA tract in 2010 vintage. Only keep the matched records from Step 1 with a distance that is smaller or equal to 0.02 mile. Save all successfully matched records in this step.

Step 3: For the remaining records that are not yet successfully matched, repeat Step 1 and 2 using the 5-digit lender names and the mortgage amount in thousands. Keep successful matches and use the 7-digit lender names and mortgage amount in tens of thousands to match the remaining records. Repeat this for the remaining records using the 5-digit lender names and mortgage amount in tens of thousands. Finally, use the 7-digit lender names and truncated mortgage amount in tens of thousands and then the 5-digit lender names and the truncated mortgage amount in tens of thousands.

Step 4: Mark observations that still have zero successful matches as "unmerged" and record the number of rounds in which each CoreLogic deed record is matched with at least one HMDA loan origination.

B Cash Purchase Share of Various Types of Home Buyers

Figure 5: Cash Purchase Share of Different Home Buyers



Notes: This figure shows the share of cash transactions for six types of buyers in the U.S. housing market from 2000 to 2022. The definition and categorization of institutional investors (i.e., LTRs, iBuyers, builders) and flippers closely follow Gorback et al. (2025). Each subplot shows the percentage of transactions conducted with all cash within a buyer type over time.

C Estimation Results with Expanded Rings

Table 3: Results with Expanded Rings (0.15/0.3/0.5 Mile)

	(1)	(2)	(3)	(4)
	Appraisal Values		*Transaction Prices*	
Inner Share	-25,143***	-11,579*	-28,357***	-12,525***
	(3,088)	(3,558)	(1,395)	(2,112)
Middle Share	-9,324	3,140	-6,935***	5,598**
	(5,882)	(5,938)	(2,114)	(2,291)
Outer Share	19,663**	31,861***	18,491***	30,476***
	(8,869)	(8,799)	(3,960)	(3,852)
Property Category - Condo		-170,046***		-172,696***
		(11,896)		(10,785)
Property Category - Duplex		76,331***		49,451***
		(12,038)		(4,346)
Building Age		-1,346***		-1,322***
		(112)		(96)
Land Sqft		0.223**		0.210**
		(0.180)		(0.151)
No. Bed		7,348**		7,609**
		(3,134)		(3,389)
Observations	7,363,648	7,363,648	7,363,648	7,363,648
Tract-by-Year FE	Y	Y	Y	Y
R-squared	0.149	0.150	0.757	0.767

Notes: This table shows the regression results estimated for equation 1 with 0.15, 0.3, and 0.5 mile for the inner, middle, and outer ring respectively. All specifications include tract-by-year fixed effects. All standard errors are clustered at the tract level. with robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4: Results with Expanded Rings (0.2/0.4/0.6 Mile)

	(1)	(2)	(3)	(4)
	Appraisal Values		*Transaction Prices*	
Inner Share	-25,745***	-7,714**	-27,992***	-9,728***
	(3,981)	(3,138)	(1,562)	(1,837)
Middle Share	-13,071**	-3,122	-6,640***	3,426
	(6,636)	(6,662)	(2,319)	(2,432)
Outer Share	24,782***	32,878***	22,630***	30,773***
	(9,523)	(9,482)	(4,687)	(4,644)
Property Category - Condo		-188,169***		-190,927***
		(7,295)		(6,649)
Property Category - Duplex		60,200***		51,299***
		(7,293)		(4,600)
Building Age		-1,505***		-1,517***
		(39)		(25)
Land Sqft		0.163*		0.190**
		(0.145)		(0.151)
No. Bed		9,428**		9,105**
		(4,086)		(3,938)
Observations	7,363,648	7,363,648	7,363,648	7,363,648
Tract-by-Year FE	Y	Y	Y	Y
R-squared	0.145	0.146	0.756	0.762

Notes: This table shows the regression results estimated for equation 1 with 0.2, 0.4, and 0.6 mile for the inner, middle, and outer ring respectively. All specifications include tract-by-year fixed effects. All standard errors are clustered at the tract level. with robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 5: Results with Expanded Rings (0.3/0.5/0.7 Mile)

	(1)	(2)	(3)	(4)
	Appraisal Values		*Transaction Prices*	
Inner Share	-29,864***	-7,899*	-27,711***	-5,467**
	(6,417)	(4,541)	(2,281)	(2,636)
Middle Share	7,938	13,932	4,875	10,925***
	(11,277)	(10,264)	(3,854)	(3,792)
Outer Share	8,856*	14,868**	16,999***	23,017***
	(7,003)	(7,981)	(3,082)	(3,056)
Property Category - Condo		-188,349***		-191,213***
		(7,240)		(6,602)
Property Category - Duplex		60,016***		51,055***
		(7,290)		(4,602)
Building Age		1,503***		1,513***
		(39)		(24)
Land Sqft		0.121		0.150***
		(0.098)		(0.065)
No. Bed		9,457**		9,128**
		(4,095)		(3,945)
Observations	7,363,648	7,363,648	7,363,648	7,363,648
Tract-by-Year FE	Y	Y	Y	Y
R-squared	0.145	0.146	0.756	0.762

Notes: This table shows the regression results estimated for equation 1 with 0.3, 0.5, and 0.7 mile for the inner, middle, and outer ring respectively. All specifications include tract-by-year fixed effects. All standard errors are clustered at the tract level. with robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1