# Neighborhood Social Interactions Lead to Policy Spillovers: Evidence from Mortgage Refinancing following Conforming Loan Limit Changes

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This Version: *January 4, 2023*

**Abstract**

Policy interventions often have effects on groups outside those directly targeted by the program. We test whether hyperlocal spillovers amplified the intended effects of a program designed to encourage households to refinance. We use a nearest neighbor research design to analyze borrowers' refinancing decisions following a large increase to the conforming loan limit. We find that households with mortgages that fell under the old conforming loan limit were more likely to refinance if they had at least one newly conforming neighbor on their residential block. The refinancing rates of always-conforming households were especially affected when their newly-conforming neighbors also refinanced. We use a difference-in-differences research design to identify positive spillover effects. We show that always-conformers with at least one newly conforming neighbor were 55% more likely to refinance relative to those with no newly conforming neighbors. Consistent with a word-of-mouth mechanism, the social influence effect of slightly farther away neighbors increases with neighborhood walkability. We conclude that neighbor social networks, and the built environment in which they interact, can affect households' financial decision-making and induce policy spillovers.

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# 1 Introduction

Policymakers hope that one effect of lowering interest rates is to encourage home owners to refinance and save money, thereby boosting the economy (Keys et al., 2016). In response to the Great Recession, central banks lowered interest rates to encourage refinancing and, in so doing, spur economic recovery (Beraja et al., 2019).[1] To further encourage mortgage refinancing and support housing markets, Congress dramatically increased the conforming loan limit — the limit that sets the maximum size of a mortgage that the government-sponsored entities Fannie Mae and Freddie Mac will purchase from originating institutions — when it passed the Economic Stimulus Act of 2008 (ESA). Since conforming loans are both cheaper and easier to access, the hope was that borrowers with newly-conforming loans would be able to refinance and save money (Adelino et al., 2012; Ambrose et al., 2004; Loutskina and Strahan, 2009).

Extant research in household financial decision-making has found that households are influenced by their neighbors' choices. Households are more likely to purchase new cars, install solar panels, and even default on their mortgages if their neighbors have recently done so (Bollinger and Gillingham, 2012; Grinblatt et al., 2008; Gupta, 2019; McShane et al., 2012; Newman and Staelin, 1972). With respect to refinancing, McCartney and Shah (2022) document that households are more likely to refinance when their neighbors have recently refinanced and that this is likely due to a word-of-mouth social influence effect. If households are influenced by their nearby neighbors, then government interventions, like an increase to the conforming loan limit, may have large policy spillover effects. We hypothesize that borrowers with loans that were conforming even under the prior limit might be motivated by the positive experiences of their newly-conforming neighbors to go and refinance themselves.

To investigate this hypothesis, we turn to the data set used in McCartney and Shah (2022) that follows Los Angeles households and their refinancing decisions between 2006 and 2012. In 2006 and 2007, the conforming loan limit in Los Angeles County was set at $417,000. The Economic Stimulus Act of 2008 designated some counties as high-cost areas and dramatically increased their conforming loan limits. Los Angeles County, one of these high-cost areas, had its conforming loan limit increased

[1] From 2009-2012, mortgage rates dropped significantly to a thirty-year low, with annual average rates ranging between 3.66% to 5.04%. In comparison, from 1979 to 2008, annual average rates ranged between 5.83% at their lowest in 2003 to 16.63% at their peak in 1981. See the 30-Year Fixed-Rate Mortgages Since 1971 Report from Freddie Mac online at the following URL: https://www.freddiemac.com/pmms/pmms30, accessed November 30, 2022.

from $417,000 to $729,750. We therefore define a mortgage as always conforming if its balance is less than $417,000 and newly-conforming if its balance is between $417,000 and $729,750. To test for social influence policy spillovers, we use a modified version of the nearest neighbor research design used in McCartney and Shah (2022).

Specifically, we ask whether always-conforming households are more likely to refinance as a function of having more newly-conforming neighbors living on the same residential block, while controlling for how many newly conforming neighbors they have in their broader neighborhood, i.e., the census block plus those blocks adjacent. This approach, like McCartney and Shah (2022), leverages the fine-grained detail necessary for identifying hyperlocal influence effects that are not typically possible using coarser zip- or county-level activity. McCartney and Shah (2022) measure hyperlocal households using distance, comparing the refinancing decisions made by neighbors who live 50 meters away relative to the decisions made by those who live within 100 or 250 meters away. In contrast, we use census blocks and census block groups. Census blocks and the next higher geographic level of block groups, as defined by the census are both "formed by streets, roads, railroads, streams and other bodies of water, other visible physical and cultural features, and the legal boundaries shown on Census Bureau maps," (pg. 11-1 of the Census (1994)). Using this approach ensures that hyperlocal households are bounded in ways that account for potential physical barriers that may capture socioeconomic and political variations in a manner that spatial differences may not.

To validate our effects, we test whether spillovers occur for always-conforming households both in the period following the passage of the ESA and the period prior to the introduction of ESA. Testing for hyperlocal peer effects prior to 2008 allows for a natural falsification test. Hyperlocal social influence effects should be unlikely to occur in the years preceding the introduction of the ESA since the conforming loan limit had yet to increase. Next, we test whether always-conformers are especially affected by newly-conforming neighbors when those newly-conforming neighbors also refinance. Finally, we identify the positive spillover of the government intervention via a difference-in-differences research design, comparing the refinance rates of always-conforming households who have at least one newly-conforming neighbor living on their same residential block versus always-conforming households who do not. Intuitively, if hyperlocal spillover effects occur, then always-conforming households should be especially more likely to refinance if they specifically live on the same block as newly-conforming neighbors.

We also look to determine a potential underlying mechanism for our effects. Household refinances and conforming loan eligibility are both not typically observable by nearby neighbors. As a result, we hypothesize our results are most likely driven, at least partially, by word-of-mouth neighborhood social interactions. Prior work has tested the veracity of a word-of-mouth mechanism using differences in geographic proximity, owner occupancy, and racial similarity between neighbors (McCartney and Shah, 2022). Instead, we explore a context where the likelihood of social interactions among neighbors may vary by estimating how our effects correlate with neighborhood walkability. Using neighborhood walk scores as a proxy for nearby neighbor social interactions allows us to test i) whether the strength of hyperlocal social influence effects vary for blocks located in more walkable areas relative to those in less walkable areas, and ii) whether having newly conforming neighbors especially increases refinance likelihood for *adjacent* block peers in more (versus less) walkable areas, presumably where neighborhood social interactions are more (versus less) likely to occur.

Our paper proceeds as follows. First, we describe the data and sample construction. We then describe our baseline identification strategy and empirical approach. We present our empirical results, ensuring that our results are robust to the inclusion of a variety of geographic and time fixed effects. We then look at the implications of our effects and how these effects may propagate by testing the impact of hyperlocal and neighborhood-level peer effects across walkability. Finally, we conclude by discussing the implications of our findings for policy and consumer welfare.

## 2 Data Description and Setting

Following McCartney and Shah (2022), we build a panel data set that follows owner-occupied properties in Los Angeles County from the first quarter of 2006 to the last quarter of 2012. We observe each property's precise geolocation, size, age, appraised value, owners, and any outstanding liens against it. Since we are interested in households' refinancing activity, we focus on owner-occupied properties with mortgages. For each mortgage, we know the names of the borrowers, the date of its origination, its purpose (purchase or refinance), its dollar amount, and the name of the lender. We acquired this data from the real estate data company, DataQuick Information Services, that collects and cleans raw data from two public sources: deeds registries and tax assessors' offices. We supplement the DataQuick data with information on the prevailing interest rates from the Monthly Interest Rate

Survey (MIRS) conducted by the Federal Housing Finance Agency (FHFA). Specifically, we use the yearly file for Los Angeles to estimate the interest rate being charged to each borrower in our sample. Finally, we use data from www.walkscore.com to define the walkability of every ZIP Code in Los Angeles county (see Appendix Figure A1 for a map of Los Angeles County by walkablity).

We analyze refinancing decisions made between 2006 to 2012, the time period prior to and immediately following the changes to the conforming loan limit in Los Angeles County made in 2008. Our full sample includes data from 26,294,507 owner-by-quarter observations who live on 70,213 distinct census blocks. Of these, 88.1% had always-conforming loans, 9.6% had newly-conforming loans, and the remaining 2.3% had loans that were non-conforming even following the loan limit increase. We focus exclusively on the refinance decisions of the 88.1%, always-conforming households who were not directly targeted by the limit change. A key assumption to our empirical design is the assumption that households choose particular neighborhoods to live in, but are less likely to choose specific blocks within that neighborhood. If true, then conditional on its neighborhood peers, a household's block peers are quasi-randomly assigned. To increase our confidence that this assumption is valid, we restrict our sample to census blocks with fewer than five owner-occupied properties. Blocks with very few households, where homes are often spread out, typically vary substantially from block to block leaving us less confident that households randomly choose a block within a neighborhood. We also restrict our sample to blocks with over one hundred owner-occupied properties, as it is more likely for households to specifically choose that particular block, potentially leading to non-random sorting at the neighborhood-level. Restricting our sample to blocks with five or more owner-occupied properties reduces our sample by 11,439 blocks (491,102 observations), while restricting our sample to blocks with 100 or fewer owner-occupied properties reduces our sample by an additional 1,177 blocks (3,356,497 observations). In total, we are left with a final sample of 19,793,352 owner-by-quarter observations across 57,345 distinct census blocks. Our final sample is described in Table 1.

[TABLE 1 HERE]

The average likelihood a borrower refinanced in a given quarter is 3.3%. The average outstanding loan, either purchase mortgage or previous refinance, was originated nearly five years ago. The average outstanding balance is $174,089 (by construction, all mortgage amounts in our sample are below

the initial conforming loan limit of $417,000). The average home in our sample is 1,664 square feet in size and was built in 1957. To estimate current LTV, we assume that each borrower is following a standard 30-year repayment schedule and build an amortization table that computes their outstanding loan balance. To calculate the current value of the house, we start with the house's appraised value from the tax assessor's office in 2011 and then adjust it quarter by quarter assuming that the house's price changes at the same rate as the median house price in its ZIP Code (data we access from Zillow). Based on these calculations, the average home has an assessed value of $294,000.

[FIGURE 1 HERE]

We classify households' neighbors as follows. We define a neighborhood as a census block *and* those blocks adjacent to it. Each block corresponds to one, and only one, neighborhood as illustrated in Figure 1. We then define households as having two kinds of neighbors, block peers and neighborhood peers. Block peers are those who live on the same census block as the household and neighborhood peers are those who live in the same neighborhood (i.e., on the same block or on an adjacent block). Since a block is a subset of a neighborhood, each block peer is *also* a neighborhood peer. The average household has 27 block neighbors with mortgages. Of these, two have mortgage amounts that make them newly conforming, that is, two have outstanding mortgage balances between $417,000 and $729,750. A large percentage (32%) of households in our sample live on blocks with *no* newly conforming neighbors. Finally, we see that the average household lived in a ZIP code with a walkability score of 52, on a scale from 1 to 100. However, the spread is considerable, with some living in very unwalkable and others in highly walkable neighborhoods.

# 3 Empirical Design

## 3.1 Neighbor Peer Effects

To test for the effect of having neighbors with newly-conforming mortgages on always-conformers' refinancing decisions, we use a strategy similar to the one used in McCartney and Shah (2022).[2] That is, we test for the effect of neighbors' newly conforming status by investigating whether households

[2]This empirical strategy is itself similar to prior research investigating neighbor-level peer effects, e.g., Anenberg and Kung (2014); Bayer et al. (2021, 2008); Campbell et al. (2011).

are especially affected by those who live closest while controlling for those who live just slightly farther away. Specifically, using the sample of always-conforming owner-occupied households, we estimate the following linear probability model:

$$Refi_{it} = \beta_1 \times Newly\text{-}Conforming\ Block\text{-}Peers_{i,t} + \beta_2 \times Newly\text{-}Conforming\ Neighborhood\text{-}Peers_{i,t} + \delta \times X_i + \kappa_{pt} + \epsilon_{i,t} \quad (1)$$

where $Refi_{it}$ is binary variable equal to 100 if household $i$ refinanced in quarter $t$. For ease of interpretation, we set the binary variable equal to 100 (instead of 1) so that the coefficient can be read in percentage point terms. Our parameter of interest, $\beta_1$, estimates the effect of *Newly-Conforming Block-Neighbors*$_{i,t}$, the count of hyperlocal block peers with newly-conforming mortgage amounts. The key control variable, *Newly-Conforming Neighborhood-Peers*$_{i,t}$, is defined as the number of household $i$'s neighborhood-peers with newly conforming neighbors. $X_i$ is a vector of control variables and $\kappa_{pt}$ is a place-by-time fixed effect. Since block-peers are *included* in the broader set of neighborhood-peers, the parameter $\beta_1$ picks up the *out-sized* effect of having newly conforming hyperlocal block-peers over and above the effects of living in the kind of neighborhood where more borrowers were newly-conforming. Our main results are valid if households are randomly assigned blocks within given neighborhoods (an assumption with much supporting evidence laid out in McCartney and Shah (2022)). As a result, observing a positive $\beta_1$ is evidence that households are affected by the loan types of their very nearest, hyperlocal neighbors.

By design, interactions that occur between households and those not living on their block will not contribute to our estimated effect of block peers ($\beta_1$ in equation 1), but rather to the effect that soaks up the effects of endogenous group formation and correlated unobservables ($\beta_2$), if the social interactions are with those living on adjacent blocks, or the error term, if outside of the neighborhood. This means that the estimate of $\beta_1$ does not capture all of the total effect of a households' social interactions, but only those with its closest neighbors. Assuming households are randomly assigned to a block conditional on their neighborhood, the estimate of $\beta_1$ is consequently likely a lower bound of the true magnitude of the overall social influence effect.

### 3.2 Identifying Spillovers

To identify the spillover effects a word-of-mouth social influence effect would imply, we use a difference-in-differences strategy. Specifically, we split always-conforming households into two groups, those that have newly-conforming neighbors and those that do not. We then estimate the following model:

$$\begin{aligned} Refi_{it} = \beta_1 \times Has\ a\ Newly\text{-}Conforming\ Block\text{-}Peer_{i,t} + \beta_2 \times Post\text{-}ESA_{i,t} \\ + \beta_3 \times Has\ a\ Newly\text{-}Conforming\ Block\text{-}Peer_{i,t} \times Post\text{-}ESA_{i,t} + \delta \times X_i + \rho_p + \epsilon_{i,t} \end{aligned} \quad (2)$$

where $Refi_{it}$ is binary variable equal to 100 if household $i$ refinanced in quarter $t$ as before. *Has a Newly-Conforming Block-Peer* is a dummy equal to 1 if household $i$ has a block-peer with a newly-conforming mortgage amount and *Post-ESA* is a dummy equal to 1 if the current quarter is in between 2009Q1 and 2012Q4, after the conforming loan limit has been increased by the Economic Stimulus Act of 2008. *Post-ESA* is set equal to 0 for quarters in 2006 and 2007 and missing for 2008 while the laws around the conforming loan limit were in flux. $X_i$ is a vector of control variables and $\rho_p$ is a place fixed effect. As with any difference-in-differences strategy, the identifying assumption is that, save for the policy, those always-conforming households with newly-conforming neighbors would have continued to track in parallel with respect to their refinancing decisions to always-conforming households without newly-conforming neighbors.

## 4 Results

### 4.1 The Outsized Effect of Nearest Neighbors

Our first result is a replication of the main result in McCartney and Shah (2022). In column (1) of online appendix Table A1, we show that owner-occupiers with always-conforming loan amounts were .075 percentage points, or 3.1 percent, more likely to refinance if a block neighbor refinanced in the previous quarter, controlling for the refinancing activity of neighborhood neighbors. Importantly, we show that there is nothing particularly special about having newly-conforming neighbors refinance. That is, in column (2), we show that if a newly-conforming borrower recently refinanced then always-conforming households refinancing likelihoods increase by .076 percentage points, indistinguishable

from the .075 pencentage points estimated in column (1).

[TABLE 2 HERE]

Next, we use our main research strategy to ask if having newly-conforming households, who were incentivized to refinance by the Economic Stimulus Act of 2008, increased the refinancing likelihood of always-conforming households, who were *not* especially incentivized by the new policy. We show in columns (3) and (4) of Table 2 that they were. From column (4), we see that for each additional newly-conforming block-neighbor that always conformers had, they were .0247, or 1 percent, more likely to refinance. The average household in the sample had 2.37 such neighbors and was therefore .058 percentage points more likely to refinance in a given quarter due to the policy change. Our empirical strategy means we can interpret the .0247 in column (4) causally, but our setting provides an additional confirming test.

Since the policy was not instituted until 2008, simply having neighbors in 2006 or 2007 that would later become newly conforming should have no extra effect on always-conformers. If there was something about having block peers with loan amounts between $417,000 and $729,750 that affects refinancing rates of always-conformers, then we would expect to see the same positive relationship in the pre-period. In columns (1) and (2) of Table 2, we show a precisely estimated zero effect of peers during this time period on peer refinancing rates. In other words, prior to the ESA and the shock to the conforming loan limit in Los Angeles County, having block peers who had loans between these two amounts did not imply an especially high rate of household refinancing.

Our next test more rigorously explores a social interactions mechanism. So far, we have documented that *having* newly-conforming neighbors causally makes always-conforming households more likely to refinance. We have hypothesized that this is because newly-conforming neighbors were incentivized to refinance following passage of the Economic Stimulus Act, did so, and then talked to their neighbors about refinancing and its benefits in manner of McCartney and Shah (2022). But, since we observe all households' refinancing decisions, we can test this directly using a two-stage least squares approach.

[TABLE 3 HERE]

First, we show in column (1) of Table 3 that having neighbors with newly-conforming loans does

indeed predict the number of neighbors who have recently refinanced (the relevance assumption). We find that for each additional block peer with a newly-conforming loan, the average always-conforming household had .075 additional block peers who actually refinanced *each quarter*. We then show in column (2) that having one additional block peer refinance in the previous quarter makes the average household with an always-conforming loan .64 percentage points, or 26%, *more likely* to refinance. Column (3) of online appendix Table A1 simultaneously estimates the effect of having newly conforming block peers and newly conforming blocks peers who refinanced last quarter and reaches the same conclusion – having newly conforming nearby neighbors affects households' refinance largely through the newly conforming nearby neighbors themselves refinancing. When taken together with Table 2 and McCartney and Shah (2022), these results strongly support the notion that the passage of the Economic Stimulus Act, which incentivized particular households to refinance spilled over via social influence effects to other borrowers who were not the intended targets of the policy.

### 4.2 Identifying Policy Spillovers

To more directly identify the positive spillover of the Economic Stimulus Act's increasing of the conforming loan limit, we use a difference-in-differences research design that compares the 67% of always conforming households who had newly-conforming block neighbors to the 33% of always-conformers who did not. We confirm in Figure A2 that newly conforming households themselves became more likely to refinance following the policy change, as intended. In this section, we ask if this effect then spilled over onto households not the intended targets of the policy. We begin with an unconditional comparison of the refinancing activity of these two groups.

[FIGURE 2 HERE]

In Figure 2, we plot in solid block the share of always-conformers with newly conforming block-peers that refinance each quarter. In the dashed grey line, we plot the refinancing rates of always-conformers who did not have any newly conforming block-peers. In the pre-period, 2006 and 2007, we see that always-conformers living on blocks that did not have newly-conforming neighbors were more likely to refinance. Following the policy change, in 2008, we see this pattern completely reverse. Of course, there are other differences between the borrowers who did and did not have newly conforming block-neighbors, so we use a difference-in-difference strategy that absorbs many of these differences.

[TABLE 4 HERE]

In Table 4 we estimate our formal difference-in-differences model described by Equation 2. This rigorous comparison that includes a number of control variables and census tract fixed effects shows that always-conformers were less likely to refinance in the post-period, during the Great Recession, than during the boom that preceded it. However, having at least one newly-conforming neighbor that might seed a social influence effect as described in the previous section halves this estimate. Always-conformers with at least one newly conforming neighbor were 55% more likely to refinance relative to those with no newly conforming neighbors following the passage of the ESA. When considered along with the results from the previous section, a social influence spillover seems a likely explanation for much of this difference.

### 4.3 Evidence Using Walkability Scores Supports a Word-of-Mouth Mechanism

Refinance decisions are private decisions, not typically observable to neighboring households. Thus, we believe that our documented effects are driven mainly via a social interaction, word-of-mouth transmission mechanism, where neighbors talk to each other about their financial decisions. In prior work, McCartney and Shah (2022) argue for a word-of-mouth, social interaction channel by demonstrating that the effects neighbor social influence are weaker for non-occupant owners and stronger when neighbors and households are of the same race. One limitation of both approaches is that the proxy for whether neighbors talk to each other or not is binary; either households are owner-occupied or not, or of similar racial backgrounds or not.

Here, we introduce a new strategy where the likelihood of word-of-mouth social interactions varies more continuously. Specifically, we use heterogeneity in ZIP code-level walkability scores. Walkability scores are determined by accessibility to public transportation, the presence and quality of footpaths, and traffic and road conditions, and the distance to amenities to meet daily needs without the use of a vehicle among other factors (Duncan et al., 2011). Neighborhoods that are more walkable are associated with a higher probability of crossing blocks and, in turn, socially interacting with more distant neighbors. Effectively, neighborhood-level walkability scores serve as a proxy for the ease of accessibility to a household's *adjacent block* peers (Brown et al., 2008). This test also allows us to examine whether increasing the accessibility of adjacent block peers weakens the in-

fluence of hyperlocal same-block peers, or whether these nearest neighbors still exert a significant influence.

Intuitively, households should still show evidence of being influenced by their hyperlocal block peers regardless of their neighborhoods' walkability score. Interactions with hyperlocal block peers are inevitable anytime individuals leave the house, take out the trash, or mow the lawn. However, households located in more walkable areas should be more likely to walk past their own block peers, increasing the likelihood for social interactions with adjacent-block, neighborhood peers. If our effects operate at least, in part, via word-of-mouth social interactions, then we should see that areas with higher walkability scores are associated with an increased neighborhood peer influence effect. We estimate Equation 1 on quintiles of walkability scores and present the results in Table 5.

[TABLE 5 HERE]

[TABLE 6 HERE]

Consistent with our predictions, we see in Table 5 that the estimated effect of having a newly-conforming block peer is relatively steady across all five quintiles. The intriguing result from Table 5 is that the effect of having an additional neighborhood (as opposed to block) peer with a newly conforming mortgage amount increases with walkability. To measure whether these effects are statistically distinguishable, we estimate our results using a fully interacted model. We present the results of the fully interacted model in Table 6. First, we show that the effect of an additional newly conforming block peer is statistically indistinguishable across all five quintiles of walkability. Second, Table 6 confirms the statistical significance of an increased adjacent-block, neighborhood peer effect in areas with higher walkability. Though it is plausible that our estimates are confounded by endogenous sorting and correlated unobservables, our evidence is consistent with spillover effects operating via word-of-mouth, social transmission. While households are likely to socially interact with their hyperlocal neighbors regardless of walkability, households located in more walkable areas are socially influenced by a geographically wider set of neighbors since they are more likely to socially interact with neighbors who live farther away.

# 5 General Discussion

Using a nearest-neighbor design along with a surprise change to the conforming loan limit following the introduction of the ESA, we find evidence of hyperlocal spillovers of a policy designed to motivate households to refinance. We show that always-conforming households are more likely to refinance the more newly-conforming block peers they had, even after controlling for how many newly-conforming neighborhood peers they had. Importantly, we find that this relationship holds following, but not before, the passage of the ESA. Next, we use both a reduced form and a two-stage least squares strategy to show that always-conformers are most affected by newly-conforming neighbors when those newly-conforming neighbors also refinance. We identify the positive spillover of the government intervention with a difference-in-differences research design that compares the 67% of always conforming households who had newly-conforming block neighbors to the 33% of always-conformers who did not. Our results show that always-conformers with at least one newly conforming neighbor are 55% more likely to refinance relative to those with no newly conforming neighbors following the passage of the ESA.

While we are unable to directly observe the mechanism underlying our effects, the fact that household refinances are not observable by neighborhood peers suggests that our results are most consistent with a word-of-mouth social interaction mechanism. To further investigate this potential mechanism, we investigate how peer effects depend on neighborhood walkability. Since social interactions with adjacent-block neighborhood peers are more likely to occur in more walkable areas, we use walkability as a proxy for intensity and frequency of word-of-mouth social interactions with farther away neighborhood peers. We find that as neighborhood walkability increases, the refinance rates of always-conforming households are more greatly influenced by their broader, neighborhood peers.

Our work makes numerous contributions. First, from both a research and policy standpoint, it is important to determine how hyperlocal social influence effects propagate. In many cases, hyperlocal peer influences travel via visual cues: households can see their neighbors purchase new cars, install new air conditioning units or solar photovoltaic panels, or otherwise outwardly improve their homes (Bollinger et al., 2019; Bollinger and Gillingham, 2012; McShane et al., 2012; Newman and Staelin, 1972). Mortgage refinancing and conforming loan eligibility, however, are not visually perceptible.

We build off of McCartney and Shah (2022) and Bayer et al. (2008) and demonstrate the importance of neighborhood peers in influencing private financial decisions.

Second, we add to the literature on the importance of propinquity. Much of the past research has investigated the role of propinquity for the formation of friendships and romantic relationships (Back et al., 2008; Festinger et al., 1950; West et al., 2009). By investigating mortgage refinancing, our work adds to this literature by providing evidence on the importance of propinquity for not only shaping social networks, but for influencing important, consequential, and largely private financial decisions.

Third, while previous work documents the existence of hyperlocal peer influence in refinancing decisions more broadly, this paper provides evidence that hyperlocal influences induce policy spillovers. The unintentional spillover effects that we identify suggest that the overall value and effectiveness of government interventions such as the ESA may be significantly underestimated if researchers and practitioners focus only on the metric of eligible household adoption. Accounting for hyperlocal and broader neighborhood spillovers over time may be necessary to accurately estimate the true impact of these types of policy interventions.

Finally, our paper highlights another benefit of neighborhood walkability: economic social information exchanges between neighbors. Improved neighborhood walkability has been associated with higher incidental walking, lower levels of obesity, lower foreclosure rates, and reduced crime levels (Frank et al., 2004, 2005; Gilderbloom et al., 2015). From an urban planning and community development perspective, it is foreseeable that infrastructure investments designed to improve walkability—-e.g., installing sidewalks, increasing public transportation access, developing mixed-use neighborhoods (Duncan et al., 2011)—-may foster social interactions between a greater number of households and the benefits that might follow.

It is commonly understood that households fail to optimally refinance (Agarwal et al., 2016) and our evidence shows that, at least in this policy setting, neighborhood peers may be a useful source of influence. Our research opens the door for future work to better understand more broadly when policymakers might encourage hyperlocal social influence. Future work should determine the types of information that neighbors share with one another and what factors may further enhance sharing more broadly. For example, neighbor peer effects might be stronger when neighbors share demographic characeteristics, like political affiliation or having children. Alternatively, investigating

factors that increase the propensity of walking, like owning a dog or living near a park, may provide insight into how neighborhood spillovers may further propagate.

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**Figure 1: Defining Neighborhoods**

The left side of this figure draws a map of census blocks in a northern part of Los Angeles. Each census block roughly corresponds to a city block and is populated by an average of 27 owner-occupied households with mortgages. The right side of this figure zooms in on a view of a particular census block, shaded in dark gray, and the adjacent census blocks. The neighborhood is defined as the block itself and the adjacent census blocks and is filled with a crosshatch pattern. The average neighborhood in Los Angeles is made up of nine blocks and there are the exact same number of neighborhoods as there are census blocks since each neighborhood is defined by a single, unique block. For more information on how census blocks are defined see https://www2.census.gov/geo/pdfs/reference/GARM/Ch11GARM.pdf. The TIGER/Line shapefiles can be downloaded here, https://www.census.gov/geo/maps-data/data/tiger-line.html.

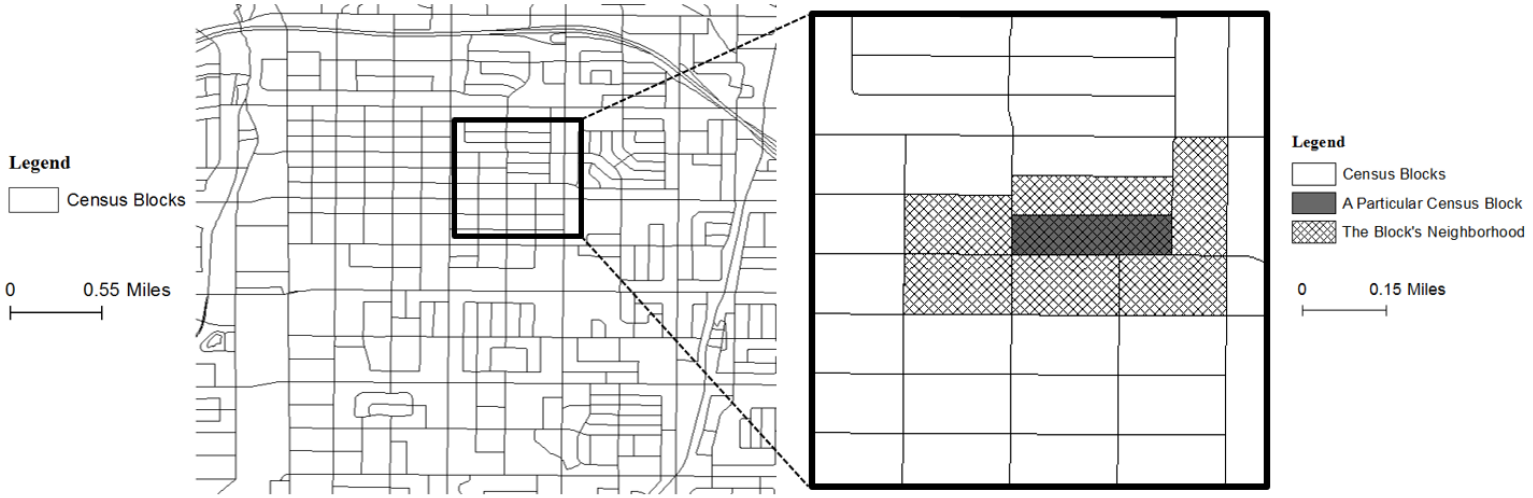

**Figure 2: Refinance Activities of Always Conforming Households Split by if They Have Newly Conforming Neighbors**

This figure uses the sample of households with always-conforming loans, those with loan amounts less than $417,000. We split this sample into two groups, those who have a block neighbor whose loan amount, between $417,000 and $729,750, makes them newly conforming and those who do not. We then calculate the share of each of these groups that refinanced their outstanding mortgage in a given quarter.

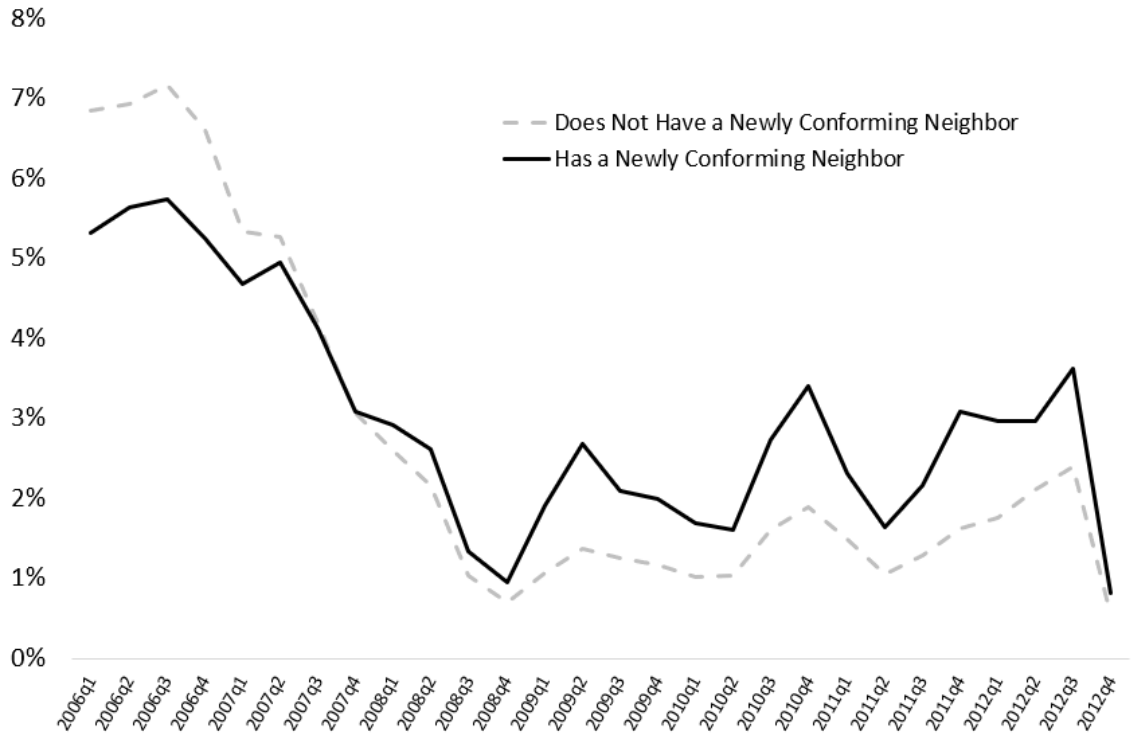

**Table 1: Describing the Sample of Households**

This table describes the sample of owner-occupied households with mortgages that were always conforming, i.e., less than $417,000. The sample is created by filling out a panel that follows every household in Los Angeles County from purchase or 1992Q1, whichever is first, to sale or 2012Q4, whichever is last. We omit households whose most recent mortgage was in the previous two quarters, households living on blocks with fewer than five households or more than 100, and those who borrowed from lenders who originated fewer than 1000 mortgages over the time series. Each quarter, we observe whether or not the household refinanced, the characteristics of their outstanding loan, and how many quarters have passed since their last activity, either their purchase loan or their previous refinance. We also observe time invariant characteristics about the owners and the property. Adjustable rate mortgages are defined as those with adjustable or graduated interest rates; all mortgages have either adjustable or fixed interest rates. Current Balance and Current LTV are as defined in the text. Co-signer indicates that there are two people on the mortgage contract. Property characteristics are from the county assessor's office. Newly Conforming Peers are those with mortgage balances between $417,000 and $729,750.

| | 10th Percentile | Mean | 90th Percentile | Std. Dev. |
|---|---|---|---|---|
| *Refinanced this Quarter* | | | | |
| Household Refinanced this Quarter (=1) | 0.00% | 3.30% | 0.00% | 17.85% |
| *Outstanding Loan Characteristics* | | | | |
| Quarters Since Origination | 4.0 | 18.4 | 37.0 | 15.3 |
| ARM (=1) | 0% | 44% | 100% | 50% |
| Refinance (=1) | 0% | 87% | 100% | 34% |
| Current Balance | $47,147 | $174,089 | $339,626 | $107,441 |
| Current LTV | 16% | 65% | 133% | 50% |
| *Borrower Characteristics* | | | | |
| Co-Signers (=1) | 0% | 66% | 100% | 47% |
| *Property Characteristics* | | | | |
| 2011 Assessed Value | $107,602 | $294,373 | $517,206 | $217,074 |
| Square Feet | 969 | 1,664 | 2,532 | 884 |
| Year Built | 1925 | 1957 | 1988 | 22 |
| *Block Characteristics* | | | | |
| Block Peers with Mortgages | 9 | 27 | 55 | 18 |
| Newly Conforming Block Peers | 0 | 2 | 6 | 3 |
| Household Had a Newly Conforming Block Peer (=1) | 0 | 0.68 | 1 | 0.47 |
| *Neighborhood Characteristics* | | | | |
| Nbhd Peers with Mortgages | 71 | 185 | 337 | 119 |
| Newly Conforming Nbhd Peers | 2 | 17 | 39 | 20 |
| ZIP Code Walkability | 6 | 52 | 78 | 24 |

**Table 2: Always Conforming Households Are More Likely to Refinance When They Have Newly Conforming Neighbors**

This table reports the estimated relationship between a household's decision of whether or not to refinance in a given quarter and the number of newly conforming block and neighborhood peers it has. Newly Conforming Peers are those with mortgage balances between $417,000 and $729,750. Linear probability models are estimated using the sample described in Table 1. Control variables include whether the household's outstanding loan is an ARM or FRM, whether the outstanding loan is a purchase mortgage or refinance, the current loan-to-value ratio of the outstanding mortgage, the quarters since the loan was originated, the lender, if there were co-signers on the loan, the log of the 2011 assessed value of the home, the log of the square feet of the home, and the age of the home. Standard errors are two-way clustered at the census tract and year-quarter level and reported in parentheses. Coefficients significant at the 10%, 5%, and 1% levels are marked with a *, **, and ***, respectively.

| Dependent Variable | Household Refinanced This Quarter (=100) | | | |
|---|---|---|---|---|
| *Sample* | *Always Conforming Households* | | | |
| *Subsample* | *Pre-ESA (2006-2007)* | | *Post-ESA (2009-2012)* | |
| | *(1)* | *(2)* | *(3)* | *(4)* |
| Newly Conforming Block Peers | 0.007 | 0.008 | 0.0239*** | 0.0247*** |
| | (0.006) | (0.007) | (0.004) | (0.004) |
| Newly Conforming Nbhd Peers | 0.000 | 0.000 | 0.00560*** | 0.00609*** |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Control Variables | Y | Y | Y | Y |
| *Fixed Effects* | | | | |
| Quarter | Y | | Y | |
| Census Tract | Y | | Y | |
| Census Tract × Quarter | | Y | | Y |
| *Sample Means* | | | | |
| Household Refinanced This Quarter | 5.81 | 5.81 | 2.43 | 2.43 |
| Newly Conforming Block Peers | 2.31 | 2.31 | 2.37 | 2.37 |
| Newly Conforming Nbhd Peers | 16.65 | 16.65 | 17.17 | 17.17 |
| N | 5,169,184 | 5,169,126 | 11,375,016 | 11,374,919 |

**Table 3: A Two-Stage Least Squares Estimation**

This table examines the relationship between block peer refinances and a household's decision of whether to not to refinance in a given quarter using a two-stage least squares (2SLS) specification. The sample is described in Table 1. Column (1) reports the first-stage regression which regresses the number of block peers that refinanced in the previous quarter on the number of block peers in the previous quarter with newly conforming loan amounts. The reported F-statistic is the Kleibergen-Paap rK Wald F-statistics from the corresponding 2SLS specification. Column (2) reports the second-stage regression, where the outcome variable is a dummy variable equal to 100 if the household refinanced. In the 2SLS framework, control variables include whether the household's outstanding loan is an ARM or FRM, whether the outstanding loan is a purchase mortgage or refinance, the current loan-to-value ratio of the outstanding mortgage, the quarters since the loan was originated, the lender, if there were co-signers on the loan, the log of the 2011 assessed value of the home, the log of the square feet of the home, and the age of the home. Standard errors are two-way clustered at the census tract and year-quarter level and reported in parentheses. Coefficients significant at the 10%, 5%, and 1% levels are marked with a *, **, and ***, respectively.

| *Sample* | *Always Conforming Households, Post-ESA (2009-2012)* | |
|---|---|---|
| | (1) | (2) |
| | First Stage | 2SLS |
| Newly Conforming Block Peers | .075*** | |
| | (0.008) | |
| Block Peers Refi'd Last Qtr | | .638*** |
| | | (0.089) |
| Control Variables | Y | Y |
| *Fixed Effects* | | |
| Census Tract × Quarter | Y | Y |
| rk Wald F-statistic | 89.3 | |
| N | 11,324,137 | 11,324,137 |

**Table 4: Identifying Spillovers Using Difference-in-Differences**

This table reports the estimated relationship between a household's decision of whether or not to refinance in a given quarter and the number of newly conforming block interacted with a dummy for time period. The post period is the years strictly after the passage of the Economic Stimulus Act of 2008, i.e., 2009 through 2012. The pre period is the years strictly before, i.e., 2006 and 2007. A household had a Newly Conforming Nbr if they had a block peer with a loan amount between $417,000 and $729,750. Control variables include whether the household's outstanding loan is an ARM or FRM, whether the outstanding loan is a purchase mortgage or refinance, the current loan-to-value ratio of the outstanding mortgage, the quarters since the loan was originated, the lender, if there were co-signers on the loan, the log of the 2011 assessed value of the home, the log of the square feet of the home, and the age of the home. Standard errors are two-way clustered at the census tract and year-quarter level and reported in parentheses. Coefficients significant at the 10%, 5%, and 1% levels are marked with a *, **, and ***, respectively.

| Dependent Variable | Household Refinanced This Quarter (=100) | | |
|---|---|---|---|
| *Sample* | *Always Conforming Households* | | |
| | (1) | (2) | (3) |
| *Interaction Effect* | | | |
| Had a Newly Conforming Block Peer × Post Period | 2.028*** | 1.650*** | 1.669*** |
| | (0.222) | (0.204) | (0.205) |
| *Main Effects* | | | |
| Post Period | -4.446*** | -3.312*** | -3.370*** |
| | (0.484) | (0.456) | (0.445) |
| Had a Newly Conforming Nbr | -1.111*** | -1.153*** | -1.220*** |
| | (0.206) | (0.193) | (0.237) |
| Control Variables | | Y | Y |
| *Fixed Effects* | | | |
| Census Tract | | | Y |
| *Sample Means* | | | |
| Household Refinanced this Quarter | 3.01 | 3.03 | 3.03 |
| Had a Newly Conforming Block Peer | 0.66 | 0.67 | 0.67 |
| N | 16,815,778 | 16,465,521 | 16,465,520 |

**Table 5: Heterogeneity Across Walkability**

This table estimates the same model estimated in column (3) of Table 2 but without the census tract fixed effect. The sample is then split into five quintiles based on the walkability of the ZIP code in which the household is located. Standard errors are two-way clustered at the census tract and year-quarter level and reported in parentheses. Coefficients significant at the 10%, 5%, and 1% levels are marked with a *, **, and ***, respectively.

| Dependent Variable | Household Refinanced This Quarter (=100) | | | | |
|---|---|---|---|---|---|
| *Sample* | *Always Conforming Households, Post-ESA (2009-2012)* | | | | |
| *Walkability Quintile* | *Least* | *2* | *3* | *4* | *Most* |
| Newly Conforming Block Peers | 0.0353*** | 0.0292*** | 0.0458*** | 0.0582*** | 0.0234* |
| | (0.007) | (0.009) | (0.014) | (0.013) | (0.011) |
| Newly Conforming Nbhd Peers | 0.00950*** | 0.0104*** | 0.0193*** | 0.0174*** | 0.0251*** |
| | (0.002) | (0.002) | (0.004) | (0.004) | (0.004) |
| Control Variables | Y | Y | Y | Y | Y |
| *Fixed Effects* | | | | | |
| Quarter | Y | Y | Y | Y | Y |
| *Sample Means* | | | | | |
| Walkability Score | 13 | 47 | 58 | 67 | 79 |
| Household Refinanced this Quarter | 2.57 | 2.77 | 2.45 | 2.29 | 2.03 |
| Newly Conforming Block Peers | 2.66 | 2.70 | 2.13 | 1.96 | 2.35 |
| Newly Conforming Nbhd Peers | 20.48 | 19.81 | 15.17 | 14.06 | 15.91 |
| N | 2,454,050 | 2,282,383 | 2,265,105 | 2,243,084 | 2,130,309 |

**Table 6: Walkability – A Fully Interacted Model**

This table estimates the same model estimated in Table 5 but, instead of splitting the sample, fully interacts the peer effects with the walkability categorical variable. Standard errors are two-way clustered at the census tract and year-quarter level and reported in parentheses. Coefficients significant at the 10%, 5%, and 1% levels are marked with a *, **, and ***, respectively.

| Dependent Variable | Household Refinanced This Quarter (=100) |
|---|---|
| *Sample* | *Always Conforming Households, Post-ESA (2009-2012)* |
| | (1) |
| *Block Interactions* | |
| Newly Conforming Block Peers × Walkability Quintile 2 | -0.0105 |
| | (0.013) |
| Newly Conforming Block Peers × Walkability Quintile 3 | 0.00528 |
| | (0.015) |
| Newly Conforming Block Peers × Walkability Quintile 4 | 0.0193 |
| | (0.014) |
| Newly Conforming Block Peers × Walkability Quintile 5 | -0.0245 |
| | (0.014) |
| *Nbhd Interactions* | |
| Newly Conforming Nbhd Peers × Walkability Quintile 2 | 0.0002 |
| | (0.002) |
| Newly Conforming Nbhd Peers × Walkability Quintile 3 | 0.00870** |
| | (0.003) |
| Newly Conforming Nbhd Peers × Walkability Quintile 4 | 0.00736* |
| | (0.004) |
| Newly Conforming Nbhd Peers × Walkability Quintile 5 | 0.0107*** |
| | (0.004) |
| *Main Effects* | |
| Newly Conforming Block Peers | 0.0440*** |
| | (0.008) |
| Newly Conforming Nbhd Peers | 0.0108*** |
| | (0.002) |
| Walkability Quintile 2 | -0.0329 |
| | (0.068) |
| Walkability Quintile 3 | -0.328*** |
| | (0.063) |
| Walkability Quintile 4 | -0.406*** |
| | (0.071) |
| Walkability Quintile 5 | -0.565*** |
| | (0.082) |
| Control Variables | Y |
| *Fixed Effects* | |
| Quarter | Y |
| *Sample Means* | |
| Household Refinanced this Quarter | 2.43 |
| Newly Conforming Block Peers | 2.37 |
| Newly Conforming Nbhd Peers | 17.17 |
| N | 11,375,016 |

# A Online Appendix - Supplemental Figures and Tables

**Figure A1: The Walkability of ZIP Codes in Los Angeles**

This figure shades each ZIP Code in Los Angeles County according to its walkability score. The least walkable ZIP Codes are shaded pale orange and the most walkable are shaded a deep purple. We use data from www.walkscore.com to define the walkability of every ZIP Code in Los Angeles county.

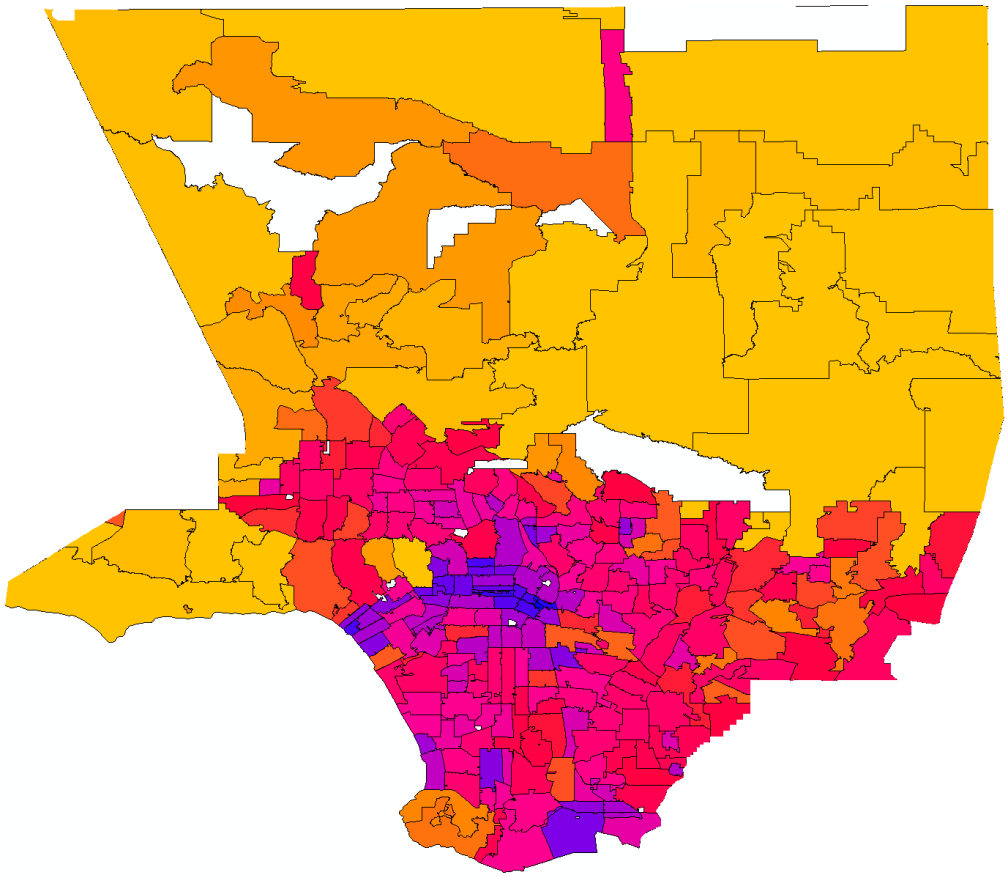

**Figure A2: Refinance Rates of Always- versus Newly-Conforming Borrowers**

The left panel of this figure splits the sample of owner-occupied households with mortgages into those with always conforming amounts, less than $417,000, and those with newly conforming amounts, between $417,000 and $729,750. We then calculate the share of each of these groups that refinanced their outstanding mortgage in a given quarter. The right panel looks within the subsample of always conforming households and splits them into those who have a block neighbor whose loan amount, between $417,000 and $729,750, makes them newly conforming and those who do not. The right panel is identical to Figure 2.

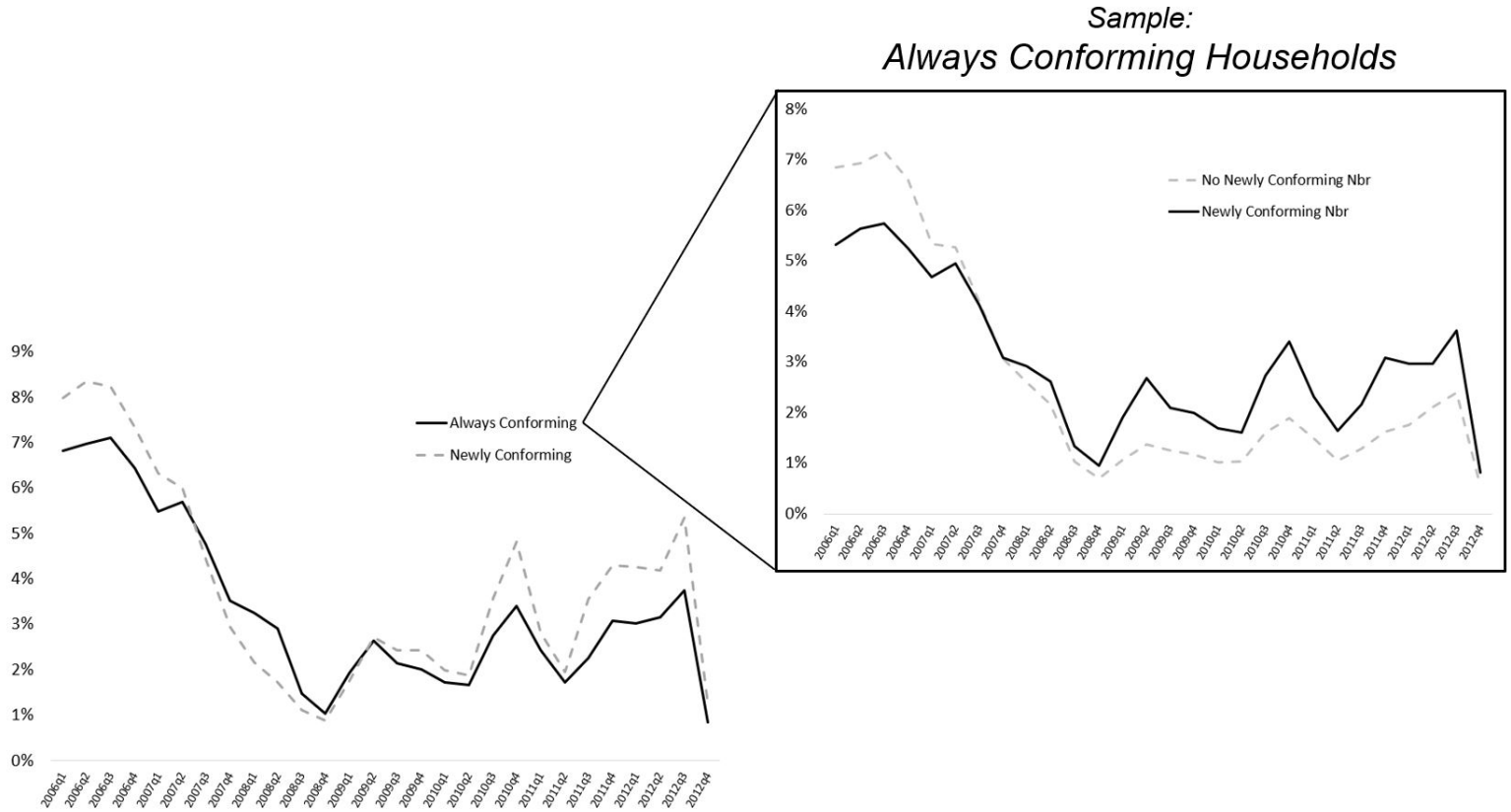

**Table A1: The Effect of Having Neighbors Who Refinanced versus Having Newly-Conforming Neighbors**

This table reports the estimated relationship between a household's decision of whether or not to refinance in a given quarter, the number of block and neighborhood peers who recently refinance it has, and the number of newly conforming block and neighborhood peers who recently refinanced it has. Newly Conforming Peers are those with mortgage balances between $417,000 and $729,750. Control variables include whether the household's outstanding loan is an ARM or FRM, whether the outstanding loan is a purchase mortgage or refinance, the current loan-to-value ratio of the outstanding mortgage, the quarters since the loan was originated, the lender, if there were co-signers on the loan, the log of the 2011 assessed value of the home, the log of the square feet of the home, and the age of the home. Standard errors are two-way clustered at the census tract and year-quarter level and reported in parentheses. Coefficients significant at the 10%, 5%, and 1% levels are marked with a *, **, and ***, respectively.

| Dependent Variable | Household Refinanced This Quarter (=100) | | |
|---|---|---|---|
| *Sample* | *Always Conforming Households, Post-ESA (2009-2012)* | | |
| | (1) | (2) | (3) |
| Block Peers Refinanced Last Quarter | 0.0751*** | | |
| | (0.013) | | |
| Nbhd Peers Refinanced Last Quarter | 0.0281*** | | |
| | (0.004) | | |
| Newly Conforming Block Peers Who Refinanced Last Quarter | | 0.0763** | 0.0410* |
| | | (0.029) | (0.024) |
| Newly Conforming Nbhd Peers Who Refinanced Last Quarter | | 0.0928*** | 0.0410*** |
| | | (0.016) | (0.011) |
| Newly Conforming Block Peers | | | 0.0236*** |
| | | | (0.004) |
| Newly Conforming Nbhd Peers | | | 0.00450*** |
| | | | (0.001) |
| Control Variables | Y | Y | Y |
| *Fixed Effects* | | | |
| Census Tract × Quarter | Y | Y | Y |
| *Sample Means* | | | |
| Household Refinanced This Quarter | 2.43 | 2.43 | 2.43 |
| Block Peers Refinanced Last Quarter | 0.65 | | |
| Nbhd Peers Refinanced Last Quarter | 4.64 | | |
| Newly Conforming Block Peers Who Refinanced Last Quarter | | 0.07 | 0.07 |
| Newly Conforming Nbhd Peers Who Refinanced Last Quarter | | 0.50 | 0.50 |
| Newly Conforming Block Peers | | | 2.37 |
| Newly Conforming Nbhd Peers | | | 17.17 |
| N | 11,374,919 | 11,374,919 | 11,374,919 |

**Table A2: Correlations of Property and Mortgage Characteristics with Walkability**

To create this sample we use the sample used to estimate Table 6 and calculate pairwise correlations between the each household's ZIP Code's walkability score and select loan and property characteristics. Significance at the 10%, 5%, and 1% levels are marked with a *, **, and ***, respectively.

| *Correlations* | Walkability Score | Current LTV | 2011 Assessed Value | Year Built | Mortgage Balance |
|---|---|---|---|---|---|
| Walkability Score | 1.00 | | | | |
| Current LTV | -0.04*** | 1.00 | | | |
| 2011 Assessed Value | 0.04*** | -0.35*** | 1.00 | | |
| Year Built | -0.08*** | -0.17*** | 0.50*** | 1.00 | |
| Mortgage Balance | -0.40*** | -0.06*** | 0.10*** | 0.17*** | 1.00 |