IRES2012-029

IRES Working Paper Series

The Hidden Peril: The Role of the Condo Loan Market in the Recent Financial Crisis

Sumit Agarwal, Yongheng Deng, Chenxi Luo, and Wenlan Qian

Mar 2014

The Hidden Peril:
The Role of the Condo Loan Market in the Recent Financial Crisis*

Sumit Agarwal, Yongheng Deng, Chenxi Luo, and Wenlan Qian†
National University of Singapore

This Draft: March 2014

* Acknowledgements: The authors would like to thank Brent Ambrose, Gene Amromin, Zahi Ben-David, Souphala Chomsisengphet, Ben Keys, Paavo Monkkonen, Tim Riddiough, Amit Seru, Tien-Foo Sing, Will Strange, Johannes Strobel, Susan Wachter, Jay Wang, Bernard Yeung, and seminar participants at American Finance Association 2014, China International Finance Conference 2013, AsRES conference 2013, IRES Symposium 2012, and National University Singapore (NUS) for useful discussions. The authors thank Christopher Mayer for generously providing the Zillow house price data.

† Corresponding author, Department of Finance, NUS Business School, 15 Kent Ridge Drive, Singapore 119245, phone: (65) 65163015, email address: wenlan.qian@nus.edu.sg.

The Hidden Peril:

The Role of the Condo Loan Market in the Recent Financial Crisis

This Draft: March 2014

Abstract

This paper studies a largely overlooked and important segment of the mortgage market in explaining the recent financial crisis—the condominium loan market, which experienced a 15-fold increase in origination and constituted 15% of the overall residential loan originations from 2001 to 2007. Condominium loan defaults grow at a faster rate than single family (including subprime) loan defaults. Condo loans originated in 2006 are 12% more likely to default within two years than subprime loans of the same cohort in the single family market. Further analysis suggests that the faster default growth and a greater level of defaults in later loan cohorts are consistent with the investor channel explanation: investor borrowers default more, especially when house prices start to decline. We also show that condo defaults have triggered more defaults of the same cohort subprime mortgages at the same location.

Keywords: Financial Crisis, Condo Market, Default, Mortgages, Household Finance, Investors, Speculators, Subprime mortgages

JEL Classification Codes: G21, G28

1. Introduction

This study is the first to document the unique risk pattern and borrower behavior in the U.S. condominium loan market in the early 2000s. Using a representative dataset of privately securitized loans, we document that the number of condominium (condo) loan originations increased by 15-fold during the 2001–2007 period (Figure 1). Throughout this time period, condo loans accounted for 15% of all U.S. residential loan originations, rising from 9% in 2001 to 16% in 2007. More importantly, condo loans have also exhibited a fast growth in default rates over the years: its within-two-year default rate has increased by more than 30 times from 2003 to 2007. These facts suggest that research has overlooked an important mortgage market segment in understanding the financial crisis.

[Insert Figure 1 about Here]

Using a unique comprehensive loan-level dataset for private securitized loans originated during 2003–2007, we formally study the default behavior of the condominium mortgage market. We model the default behavior of the condo loans relative to single-family mortgages[3] using a logistic specification with a detailed list of loan and borrower characteristics, macroeconomic conditions as well as origination cohort, year and city fixed effects. In the pooled sample, a condo loan, on average, is as likely to default within two years of origination as a single-family loan, after controlling for other loan and borrower characteristics. However, there is a sharp increase in condo loan defaults relative to single-family loan defaults over the years—with the most significant jump in condo loan default rates in 2006 and 2007. All else being equal, a condo loan originated in 2007 is 6.4% more likely to default within two years of origination than a single-family loan originated in the same year.

We further find that condo loan default rate grows at a faster rate, even compared with subprime loans—defined to be mortgages with borrower FICO score < 720—that are known to have a strong vintage effect (Demyanyk and Van Hemert, 2011). Condo loans originated before 2006, relative to single-family subprime loans originated before 2006, are much less likely to default within two years of origination. However, among loans originated in 2006, condo loans are 12% more likely to default than subprime loans in the single-family market. The pattern is

[3] The single-family market in this paper refers to that of the *detached* single family houses.

even more striking if we compare subprime loans in the condo market with subprime single family loans. Given the role of the subprime market in the financial crisis, this comparison thus highlights the possibility that the much overlooked condo loan market is potentially important in understanding the crisis.

There are several competing explanations for the observed evidence on the faster default growth in the condo loan market. Condominiums and single family home markets differ in many ways. For example, compared to the detached single family houses, condominiums are typically concentrated in more urban areas. They provide different types of service flows and have distinct asset characteristics such as price growth and volatility that could lead to different default patterns over time. To address the unobserved heterogeneity issue, we allow location fixed effect at the finer zip code level in a representative subsample and find the same results. We also control for direct measures of price dynamics for condominiums and single family homes using zip code level data from Zillow.com and continue to find the same pattern. Furthermore, we resort to an independent loan-level dataset from Freddie Mac. A consistent result on the Freddie Mac sample provides external validation of our previous findings. In addition, given its uniform, homogeneous nature in loan contract types (i.e., 100% of Freddie Mac loans are 30-year fully amortizing fixed-rate mortgages), the result also suggests that the observed default pattern among condo loans is unlikely driven by different loan contract terms offered to and chosen by condo borrowers.

A more interesting economic question is whether the documented default pattern among condo loans is attributable to the lender (supply side) effect or is due to the borrower (demand side) effect. Some lenders may have expertise or preference for loans in the condo market, who at the same time exhibited an increasingly lax lending standard over time. As a result, the differential default patterns between the two markets reflect the fact that disproportionately riskier borrowers are drawn to the condo loan market over time. Alternatively, condo loan borrowers could be inherently risky and thus on average default more as house prices and economic conditions deteriorate in the later years.

We find that the lender channel is unlikely the driver for the observed faster growth rates of condo loan defaults relative to those of the single family loans. First, if lenders apply less

stringent selection criteria over condo loan cohorts that are unobservable to econometricians, then the proportion of condo loan defaults unexplained by the observed loan and borrower characteristics should increase faster over time (compared to the single family market). We do not find a divergence in the explanatory power of hard observable information in explaining default probabilities between the two markets. Second, we use Freddie Mac data that have information on lender identity, and the condo market's default pattern remains robust even if we allow time varying lender fixed effects (to control for the time trend in lending standard). While there may be a common trend in credit supply that explains the default pattern for both the single family and condo loan market defaults, the supply channel is not able to explain the faster growth trajectory among condo loans. The results thus suggest the (differential) default pattern in the condo market is more associated with inherent condo borrower characteristics.

Condo borrowers are unlikely the low credit quality borrowers who default because they cannot afford to pay or refinance their mortgages as house prices start to decline. In our sample, compared to the single family market, condo borrowers have higher FICO scores, use subprime mortgages less frequently, and on average are charged a lower interest rate. A recent literature highlights the importance of homebuyer expectation and investor behavior in complementing our understanding of the financial crisis (e.g., Case, Shiller and Thompson, 2012). The price run-up in the earlier years of the decade attract more trend-chasing investors, who are more likely to make a pure economic decision of deciding to default after a significant price drop. Real estate investors likely prefer condominium units due to their smaller size (and thus smaller investment commitment), greater rental demand and less maintenance cost. Therefore, we are likely to observe a larger presence of investors in the condo borrower population over time. In our sample, we find a declining share of owner-occupied purchases over time, and the share of non-owner-occupied purchases is greater in the condominium market. We find results consistent with the hypothesis. Investment-purchase condo loans drive the observed condo loan market default pattern. On average, they are 30% more likely to default within two years after origination compared to other non-investment purchase condo loans, and their defaults grow at a much higher rate. Investment-purchase condo loans originated in later cohorts (e.g., 2007) are 88% more likely to default than single family loans, while the same cohort non-investment-purchase loans in the condo market are 19% less likely to default than single family loans. Default option induced by house price movements is likely key: investment purchase condo loans are 141%

more likely to default when the option of default is in the money (i.e., when the house price is lower than the outstanding loan amount).

Lastly, we explore the aggregate implication of the condo loan market defaults. We find that condo loan defaults have triggered more subsequent defaults in the single-family subprime market. Consistent with the notion that more of condo loan borrowers are investors who default sooner, the early default rates (i.e., within-one-year-default rates) of condo loans also grow at a faster rate than single family subprime loans. Put differently, condo loan borrowers default more promptly when house prices started to decrease in 2006 and 2007. More importantly, at the zip code level, first-year defaults among condo loans positively predict second-year defaults of the same cohort's single-family subprime loans. Early condo loan defaults also predict negatively subsequent single family house price growth at the same zip code. Granger causality tests verify the temporal lead-lag relationship: condo defaults precede the subprime mortgage defaults as well as the house price growth in the single family market. This provides new insight on the triggering event of the housing crisis. To better identify the channel, we use the exogenous variation in state foreclosure laws and find the effect of condo loan defaults, on both the subsequent house price growth and the subsequent single family subprime defaults, to concentrate in the non-judicial states in which foreclosure process is more efficient. These results are consistent with the idea that condo defaults prompt more defaults of single family subprime mortgages at the same location, through the channel that foreclosures on the defaulted properties depress neighboring house prices.

We contribute to the literature by first documenting a strong, robust and economically important default pattern in the much ignored condominium loan market. Specifically, the loan origination growth rate and default pattern in the condo market are comparable to the subprime mortgage market (Demyanyk and Van Hemert, 2011). The findings in our paper also add to our understanding of the economic channels that explain the financial crisis. A large strand of the literature has focused on the subprime mortgages[4] and other supply side factors such as the role

[4] These products were designed to help borrowers in markets expecting significant price appreciation. However, they were often marketed to borrowers with relatively poor credit histories as well. As a result, these mortgages are often referred to as subprime mortgages, because they did not meet the underwriting criteria set by the government-sponsored enterprises, e.g. Fannie Mae and Freddie Mac (See Agarwal, Ambrose, Chomsisengphet, and Sanders 2012).

of securitization.[5] On the other hand, recent work (Haughwout, Lee, Tracy, and van der Klaauw, 2011; Case, Shiller and Thompson, 2012) suggests that a less studied but potentially fundamental factor may have triggered the crisis—homebuyer and especially investor expectations. Based on a survey sample in four U.S. cities, Case et al. (2012) report that home price expectations, which reached abnormal levels relative to the mortgage rate at the peak of the boom and have declined sharply since, were highly correlated with the price movements of the housing market. Cheng, Raina, and Xiong (2013) find that mid-level managers in securitized finance business continue to speculate on house prices in their own home purchases during the boom period. Using transaction-level data, recent studies find supportive evidence of housing speculators chasing short-term trends (Bayer, Geissler and Roberts, 2011), leading to price overreaction (Chinco and Mayer, 2012; Fu and Qian, 2013). Haughwout, Lee, Tracy, and van der Klaauw (2011) use unique credit report data to show the important role speculative investors play in contributing to the rise and fall of the U.S housing market in the recent crisis. Specifically, when prices turned downwards, these investors defaulted in large numbers, contributing to the intensity of the housing cycle's downward leg. Amromin, Huang, Sialm, and Zhong (2011) identify another demand-side factor: high credit worth households chose complex mortgage products leading up to the crisis and these households were more likely to default. Other work documents borrowers with unconventional mortgages, or who misrepresented their financial network are risky borrowers and default more (e.g., Garmaise, 2013a, 2013b). Our findings complement the demand-side view by providing evidence that investor behaviour, as manifested in the condo market's loan default pattern in our context, play an important role in explaining mortgage defaults in the crisis. In addition, we relate to the prior literature on the real effect of the housing crisis (e.g., Campbell, et al., 2011; Mian, et al., 2012) and show that condo loan market defaults have aggregate implications on the house prices and default patterns in other segments of the housing market.

The rest of the paper proceeds as follows. In the next section, we describe the data used for this study and our empirical methodology. In Section 3, we present the empirical results that

[5] For a discussion, see Agarwal et al. (2011); Agarwal, Chang, and Yavas (2012); Agarwal and Evanoff, 2013; An, Deng, and Gabriel (2011); Jiang, Nelson, and Vytlacil (2012); Keys, Mukherjee, Seru, and Vig (2010a, 2010b); Mian and Sufi (2009); Mayer, Pence, and Sherlund (2009); Piskorski, Seru, and Vig (2010); and An, Deng, Rosenblatt, and Yao (2012)

document the condo market's default pattern. Section 4 performs analysis to differentiate competing economic explanations. Next we explore the aggregate implication of condo loan defaults by studying its spillover effects in Section 5. Finally, we make concluding remarks in Section 6.

2. Data and Methodology

2.1 Data sources

The first and primary source for the study is the loan-level data furnished by BlackBox Logic (BBX). The loan-level data from BBX cover loans originated in 2003–2007 (we leave out loans originated earlier due to better data coverage in the later sample period). BBX aggregates data from mortgage servicing companies that participate in their servicing agreement. The most recent BBX data cover about 18 million mortgages throughout the United States, making it a comprehensive source for both the prime and subprime mortgages.[6] For example, based on a comparison with HMDA data that include a near complete universe of U.S. mortgage applications and originations, we estimate that the BBX data cover about 70% of the prime market during the period. A representative sample of the subprime mortgage market allows us to compare the default behavior of the condominium loans with that of the subprime mortgages that plays a key role in triggering the financial crisis.

In addition to monthly data on loan performance, BBX contains information on borrower and loan characteristics at origination, including the borrower's FICO credit score, the loan amount and interest rate, whether the loan is a fixed- or adjustable rate mortgage, LTV, and whether the loan was intended for home purchase or refinancing, among other characteristics. The outcome variable that we focus on is whether the loan becomes 60 days or more past due within the 24 months following origination. We also merge BBX loan-level data with macro variables, including the slope of the yield curve and the credit spread from Federal Reserve Bank of St. Louis, the state-level unemployment rate from Bureau of Labor Statistics, and the MSA-

[6] BBX define subprime mortgages as those with borrower FICO score < 720.

level quarterly housing index from the Office of Federal Housing Enterprise Oversight (OFHEO), which was succeeded by the Federal Housing Finance Agency (FHFA).[7]

Despite its market coverage as well as richness in many loan and borrower characteristics, the BBX dataset has limitations. For example, it does not contain lender information. In the later analysis where we examine sources of the default pattern in the condominium market, we introduce a second dataset – loan-level performance data from Freddie Mac. This dataset, recently made publicly available, includes loan-level origination and monthly loan performance data on approximately 15.7 million fully amortizing 30-year fixed-rate mortgages that Freddie Mac acquired. While the Freddie Mac sample does not cover the subprime mortgage market, it serves as a great supplementary dataset for our analysis for the following reasons. First, Freddie Mac loan-level data contain lender identity information, which allows us to differentiate between the borrower channel and the lender-related effect. Second, loans in the Freddie Mac sample are fixed-rate 30-year agency mortgages with full documentation. This stands in contrast to the BBX sample where condo loans are much more likely to have exotic contract terms and have little or no documentation. Analysis based on this more homogeneous sample of loans thus helps establish robustness of our results and distinguish from alternative interpretations. In addition, the Freddie Mac data allow us to explore in depth the specific channel of the observed default pattern in the condo market. To ensure consistency on the condo vs. single family loans comparison across the two datasets, we note that both datasets have a comprehensive coverage of loans in their focus markets and the fractions of condominium loans are comparable (14% in BBX vs. 11% in Freddie Mac).

2.2 Descriptive statistics of condo versus single-family loans

We keep loans in the BBX dataset that were originated between 2003 and 2007 in the single-family and condominium markets. We restrict to purchase loans with original loan balances smaller than $10 million. Since condos likely concentrate in larger urban areas, we restrict our sample to the top 2000 cities, which cover 98% of the entire condo market in the BBX dataset. We further require each zip code to have more than 5 loans originated per year to

[7] Established in 2008, FHFA is a successor agency that resulted from the statutory merger of the Federal Housing Finance Board (FHFB), the Office of Federal Housing Enterprise Oversight (OFHEO), and the U.S. Department of Housing and Urban Development's government-sponsored enterprise mission team.

be included in our sample. The final sample contains 5,000,241 observations, with 909,564 condo loan observations (18.2%) and 4,090,677 single family loans observations (81.8%). [8]

Table 1, Panel A shows summary statistics of the major variables in the pooled sample for the 2003–2007 period. Among all the loans, 40% are fixed-rate mortgages and 26% are subprime mortgages. Borrowers have an average FICO credit score of 683, and take out up to 73% of the property value (LTV). Overall, the probability of default within two years of loan origination is 6% on average.

[Insert Table 1 about here]

Loan and borrower characteristics in the condo and single-family home mortgage market differ. On the one hand, condo loans appear safer along many dimensions. Condo borrowers have higher FICO credit scores than single-family borrowers (by 20 points). The number of subprime loans in the condo market is one-third smaller than in the single-family loan market. The average condo borrower's interest rate is significantly lower than that of single-family borrowers.

On the other hand, condo loans typically involve less conventional contract terms. In the condo loan market, we observe much fewer fixed-rate mortgages and considerably more option ARMs, interest-only loans, and low or no documentation loans than in the single-family market. In addition, fewer condo borrowers purchase for owner-occupancy, and they tend to buy in more expensive areas (i.e., those with a higher FHFA/OFHEO House Price Index, or HPI).

To further examine the differences between the two markets among different origination cohorts, we decompose the pooled sample averages by each origination year cohort for both the condo and single-family loans in the period 2003–2007 (Table 1, Panel B). The number of both single-family and condo loans peaked in 2005 and then sharply declined in 2007. The number of risky loan contracts such as option ARMs, interest-only rate mortgages, and low or no documentation mortgages have risen over the years, and the increase is faster among condo loans than among single-family loans. On the other hand, the difference in the fraction of subprime

[8] We follow the same rules to construct the sample from our supplementary data source Freddie Mac and for brevity we leave the summary statistics for the Freddie Mac sample in the Appendix.

mortgages between the condo and single family loans remains steady during the four year period. The FICO score difference even increases: the average condo borrower has an even higher FICO score than the average single family borrower in the later cohorts of our sample period. In addition, the gap in non-owner-occupied purchases between the condo and single family loans shrinks: owner-occupancy decreases in both markets but the decrease is faster in the single family loan market. To the extent that loan contract terms, borrower credit worthiness, and owner occupancy status potentially capture different aspects of the risk associated with a mortgage, it remains ambiguous whether the loans in the condo market become more or less risky in the later origination cohorts relative to the single family loans.

Next we compare the loan and borrower characteristic in the condo loan market to the subprime segment of the single family market (Table 1, Panel C). Since subprime mortgages are riskier loans than prime mortgages, the comparison between condo loans and subprime loans is more informative about the characteristics and risk profiles of condo loans. Most of the differences in the loan and borrower characteristics observed in the full sample (Table 1, Panel A) remain to hold. Condo borrowers are much more creditworthy by the conventional measures. However, even compared to the subprime mortgages in the single family market, condo loans are much more likely to have non-conventional contract terms or have low or no documentation. Similarly, the condo purchases are less likely to be owner-occupied. We also study the borrower and loan characteristics in the subprime segment of the condo loan market in comparison to those in the subprime segment of the single family market. The subprime market is relatively homogeneous across the condo and single-family markets: although we still observe a robust pattern of riskier loan terms in the condo subprime market, the differences in borrower and loan characteristics between these two markets are much smaller than between all condo loans and single-family subprime loans. This suggests that it is not simply subprime mortgages that explain the distinct characteristics of the condo loan market. On the contrary, condo loans in the prime market are particularly associated with riskier contract terms, low or no documentation, and are more likely to have risky borrowers (e.g., investors).

2.3 Methodology

Our null hypothesis is that the condo and single-family markets are similar. Hence, the default rates (as well as default growth patterns) for condo and single-family loans should exhibit

similar patterns. Our main empirical specification is a logistic model of the default decision of loans originated between 2003 and 2007.[9] We define a loan to be in default if it becomes delinquent by at least 60 days[10] within two years of origination. The main independent variable, $Condo_{is}$, is a binary variable that is set to one if the loan is a condo mortgage. Other explanatory variables include both loan-level and macro-level variables. We include city, and year fixed effects to control for unobservable factors at the city level and at the year level. Loan *i* enters the study in month t_{is}, which is the first occurrence of that loan. The same loan exits the study in month T_{is}, which is the earliest occurrence of one of the "exit" events (default or prepay or the end of the sample period). Finally, all the standard errors reported in main default analysis, unless otherwise stated, are clustered at the city level, in addition to being robust to heteroskedasticity.

Loan-level controls are motivated by the literature. They include indicators for FICO credit scores, indicators for fixed-rate and interest-only loans, indicators for low- and no-documentation (low/no doc) loans, an indicator for owner-occupancy status, an indicator for subprime mortgages, and an indicator for home equity lines of credit (HELOC). Following the literature, we also include an indicator variable for LTV at origination of 80% as a proxy for the existence of a second lien on the property. Continuous loan-level variables include (log of) the loan amount, the first interest rate observed, the time elapsed from origination to the end of the sample period or to the first classification as being prepaid or delinquent at least 60 days, and LTV at the time of origination. We also include the current level of the residential home price index, the state-level unemployment rate, the slope of the yield curve, and the credit spread as control variables.

3. Empirical Analysis on Condo Default

3.1 Unconditional result of the default behavior of the condo market

The default rates within two years of origination in both markets increased over the years in our sample (Figure 2.1). More importantly, the increase in the condo loan default rate is much faster. Among the 2003 cohort loans, the default rate in the single-family market is more than

[9] For robustness, we replicate our analysis using a linear probability model and find consistent results as well.
[10] More specifically, we define default as a loan that is delinquent by at least 60 days, or that is in foreclosure, is in bankruptcy, is REO (real estate owned), or is in the liquidation stage.

double that of the condo market. However, among loans originated in 2007, the two-year condo default rate is 10.1%, which is comparable with 12.6% in the single-family market.

[Insert Figure 2 about here]

Figure 2.2 shows a decomposition of the default patterns in the condo and single-family markets, by subprime and non-subprime status. Within the subprime and non-subprime sub-markets, condo loan defaults start at a much lower rate than single-family loan defaults, but grow more quickly over the sample period. Specifically, the rate of condo subprime loan defaults exceeds that of the single-family market by 0.7 percentage points among loans originated in 2007. These results, in combination with our previous findings, imply that condo loans have distinct features that make them riskier and more vulnerable to default, especially during times of market distress.

3.2 Regression analysis of condo loan default behavior

Option-based theoretical and empirical models for mortgage default analysis have been well developed during the past two decades (e.g., Kau, Keenan, Muller, and Epperson, 1992; Kau and Keenan, 1999; Deng, Quigley and Van Order, 1996, 2000), and they have increased in realism and sophistication in the past decade (e.g., Ambrose, Capone and Deng, 2001; Deng and Gabriel, 2006). Clapp, Deng, and An (2006) provide a comprehensive review of these modeling frameworks. Following Clapp et al. (2006), we perform logistic regressions to formally study the default behavior of the condo market relative to the single-family market. Because condo loans differ substantially from single-family loans in their loan and borrower characteristics in our BBX dataset, we include observables on loan and borrower characteristics as controls in the logistic analysis. We also include macroeconomic variables as well as origination cohort, year, and city fixed effects in the regression. Table 2 reports odds ratios in the full sample analysis: an odds ratio greater (smaller) than one indicates a positive (negative) effect. Consistent with the literature, FICO scores, LTV, FRM loan type, and owner-occupancy status are strong predictors of default. Second lien loans and low/no doc loans are risky, as they are associated with higher default rates within two years of origination.

Although condo loans have a lower average default rate in the summary statistics (Table 1, Panel A), the logistic analysis of Table 2 shows that after controlling for loan and borrower characteristics, condo loans do not differ much from single-family loans in their two-year default probability. The Condo dummy coefficient is economically and statistically indistinguishable from 1 (i.e., the odds of observing a condo loan default are as high as observing a single family loan default). Furthermore, separating default behavior by origination year reveals a significant time trend in the condo market defaults that is consistent with the time-series pattern shown in Panel B of Table 1 and Figure 2. Coefficient on the interaction term between the condo dummy and the origination year *t* captures the difference in odds ratio between condo loans' and single family loans' default rates in origination year *t*, relative to the odds ratio difference between the two submarket's loan defaults in the origination year 2003 (i.e., the absorbed origination year). Therefore, those coefficients in Table 2, which are greater than one, suggest that there is a sharper increase in condo loan defaults relative to single-family loan defaults over the years—with the most significant jump in condo loan default rates in 2006 and 2007. As a result, condo loans default more than single family loans in later cohorts. While condo loans originated in 2003 are 44% less likely to default, condo loans originated in 2007 are 6.4%[11] more likely to default within two years of origination than single-family loans in the same cohort.

[Insert Table 2 about here]

3.3 Comparison of default behavior between condo loans and single family subprime loans

Next, we explore the dynamics of condo loan default behavior relative to subprime loan default behavior. Previous literature has documented a dramatic growth in the subprime loan market during the housing boom, which played a significant role in triggering the recent financial crisis (e.g., Demyanyk and Van Hemert 2011). The condo loan market and the subprime market have similar magnitudes of growth leading up to the housing bubble burst (Figure 1), and we find a rapid increase in condo loan defaults in more recent vintages. Therefore, we compare the dynamics of condo market default behavior with that of the subprime market.

[11] We multiply the coefficient on condo dummy with the coefficient on condo x origination year 2007 interactive term (0.562 x 1.894 = 1.064) to compute the odds ratio of a 2007-originated condo loan default relative to a 2007-originated single family loan default.

We perform a subsample analysis of all condo loans and all single-family subprime loans. The result in Column (1) of Table 3 show that, on average, condo loans are slightly less likely to default compared to single family subprime mortgages. In earlier vintages, single-family subprime loans are consistently more likely to default than condo loans of the same vintage. To the extent that we are comparing condo loans to a riskier segment of the mortgage market, the test is constructed against finding a significant result. However, condo loan defaults grow at a faster rate and over time condo loans begin to default more than single-family subprime loans (Column (2) of Table 3). Condo loans originated in 2006 are 12% more likely to default within two years of origination than single-family subprime loans originated in the same year, after controlling for all the observed loan and borrower characteristics. Given the role of the subprime mortgages in the financial crisis, this comparison thus highlights the possibility that the much overlooked condo loan market is potentially important in understanding the crisis.

[Insert Table 3 about here]

The pattern becomes more apparent when we compare condo and single family loans within the subprime market. In our sample, condo subprime loans are riskier than single-family subprime loans—a condo subprime loan is 13% more likely to default than a single-family subprime loan (Column (3) of Table 3). The higher default probability among condo subprime loans is driven by later vintages. Condo subprime loans originated in 2006 and 2007 are 29% and 81% more likely to default than single-family subprime loans originated in the same years.

4 What Drives the Default Pattern in the Condo Loan Market?

Condo markets differ from the single family in many aspects. As a result, there are several competing explanations for the observed evidence in Table 2 and 3 that the condo loan default rate grows at a faster speed and its level eventually exceeds that in the single family market, including the riskier subprime market segment. Compared to the single family market, condominiums are typically concentrated in more urban areas. They provide different types of service flows and have distinct asset characteristics such as price growth and volatility that could lead to different default patterns over time. Alternatively, lenders have different preference and/or expertise with loans in the condo market and the single family market, and the differential default patterns between the two markets reflect the lender (or supply-side) effect. Lastly, condo

loan borrowers could be inherently riskier. We use several approaches to distinguish these explanations.

4.1 Unobserved characteristics of the condo market

First, we perform a subsample analysis to better control for the location fixed effects. In the previous analysis, we remove any time-invariant characteristics at the city level. However, we need finer geographical boundaries to address the concern that condo loans are simply located in different, potentially riskier areas. To do so, we include zip code fixed effects in an analysis based on the subsample of the top 50 cities in our sample (based on the number of total loans in our entire period). The choice of the subsample analysis (instead of full sample regression) is motivated by the following considerations. There are 6,914 zip codes in our sample, which imposes significant computational challenge in our logistic regression. In addition, the top 50 city subsample constitutes 34% of the entire condo loans, which is fairly representative of our full sample. Column (1) of Table 4 presents the results using finer zip code fixed effects based on the subsample analysis. The result exhibits the same pattern as before. Condo loan defaults are increasing over the origination cohort years, and in particular, condo loans originated in later cohorts (e.g., 2006) default more than their single family counterparts.

[Insert Table 4 About Here]

Condominiums arguably provide different types of service flows to owners, compared to detached single family houses. As a result, the two types of housing markets will have distinct asset characteristics (e.g., growth rate and volatility). The option pricing theory implies that the observed differences in mortgage defaults could result from differences in the underlying asset volatility. Therefore, if condo properties have a different return generating processes from single family properties, then this would lead to the observed differences in default risk between condo and single family mortgages. The analysis in Table 2 and 3 includes MSA-level HPI index, which is primarily based on transactions in the single family market, and is thus not able to address this issue. We examine this possibility by including specific asset characteristics for the condominium and single family market respectively. Specifically, we study in a subsample where we have detailed information about price dynamics in the condominium market using Zillow house price data which contain monthly transaction price at the zip code level for the

condo and single family markets separately. Consistent with the analysis in Column (1) of Table 4, we focus on the top 50 cities subsample after merging Zillow with BBX, which covers 33% of the entire condo loans in our sample.

We include the zip code-level average transaction price and the growth rate of the average transaction price for both the condo and the single family market in the regression to control for the asset market dynamics in these two markets (Column (2), Table 4). We also use the zip code fixed effects to control for any unobserved location effects at the zip code level. Our results continue to hold. In Column (3) of Table 4, we further include location-specific time trend in the analysis to better control for the dynamics of local markets (e.g., local trend in supply of condominiums relative to the single family houses). [12] We still obtain the same results: condo loans default faster and their later cohorts default more than single family loans in the same cohort, after controlling for asset dynamics in the two markets and a location-specific time trend.[13]

We also test condo loan default patterns in several "sand states" (i.e., California, Florida, Nevada, and Arizona), which exhibit more striking default patterns during the crisis. In unreported analyses, we confirm that the condo loan default level and growth patterns are qualitatively the same among sand states as in the full sample.[14] Another potential sample selection bias could arise from a few super star cities whose condo markets have unique characteristics that could confound our interpretation. We perform robustness tests of our key default analysis (Table 2 and 3) by removing New York and Los Angeles from our sample. The results remain qualitatively the same and we do not report them in the paper (but are available upon request).

4.2 Lender or borrower effect

[12] In the specifications that we include location-specific time fixed effects, we modify our standard error clustering at the location time level. This is to allow correlation in defaults within each location at a given year.

[13] The weaker effect after we control for asset market characteristics suggests that the difference in asset attributes may account for part of the difference in default patterns. It may also be due to lack of power as we restrict to a more limited sample in this analysis .

[14] They do not appear to be stronger in these sands states, likely because there are other important determinants of condo loan presence and growth (e.g., supply constraints and demographic distribution) that make the four states a crude and noisy identification (of cross-sectional heterogeneity).

The previous analysis suggests that the results in Table 2 and 3 are unlikely driven by location or asset market differences. However, it still remains an open question as to whether lenders or borrowers account for the observed default pattern difference. For example, different lenders may specialize in one particular asset market in loan origination, and there exists different screening standards across lenders (see, Rajan, Seru and Vig, 2013). As a result, the differential default patterns between the two markets reflect the fact that riskier borrowers are drawn to the condo loan market over time. Unfortunately, BBX does not contain lender information. We first approach the question in an indirect way. We regress, using OLS, loan default on all the observables (as in Table 2 and 3) for condo and single family market separately for each cohort year. We obtain the R-square statistics for each of the 10 regressions, and compare the trend in R-squares between the condo market and the single family market (Figure 3). The rationale is as follows. The null hypothesis is that faster condo loan defaults over origination cohorts are due to the increasingly lax screening by some lenders who happen to originate more condo loans. Even though we are able to control for the observable differences in loan characteristics (e.g., riskier contracts among condo loans), lenders may select based on other unobservable information. If lenders apply different selection criteria over loan cohorts that are unobservable to econometricians, then the proportion of loan defaults unexplained by observed loan and borrower characteristics should increase in later origination cohorts, especially for condo loans. In other words, the null hypothesis implies a diverging R-square trend between the condo and single family loans. However, the pattern in Figure 3 reveals a similar trend in the R-squares in the two markets. In particular, the R-squares of the origination cohort 2006 and 2007 in two markets are observationally indistinguishable from each other. Since condo loan defaults peaked (relative to the single family loan defaults) in these two cohorts, these results provide the first piece of evidence that lenders and the associated time trend in credit supply may not be an important reason underlying the (differential) condo default pattern.

[Insert Figure 3 About Here]

4.3 Disentangling competing explanations: further evidence using Freddie Mac data

The previous analysis cannot completely eliminate concerns of a supply-driven channel. We do not have lender information in the BBX sample, and the fact that many loan

characteristics are (increasingly) riskier over time for condo loans presents another identification challenge.

In this section, we introduce another data source—loan-level performance data from Freddie Mac—to complement our analysis. Freddie Mac does not cover the subprime mortgage market, so our main analysis on the condo and the single market subprime market comparison and interaction is not feasible based on the Freddie Mac sample. However, it serves as a great supplementary dataset for the following reasons. Freddie Mac loan-level data contain lender identity information, which allows us to better differentiate between the borrower channel and the lender-specific effect. Homogeneity among Freddie Mac loans (e.g. in contract terms) also facilitates a better identification against observed or unobserved heterogeneity in the condo loan market. We apply the same filtering rule to the Freddie Mac loan dataset, and the final Freddie Mac sample covers 3.79 million loans, out of which 11% are condo loans. Although smaller than the BBX sample, Freddie Mac's condo loan fraction is economically significant which ensures a meaningful comparison. We leave the detailed summary statistics of the final Freddie Mac sample in the Appendix.

Table 5 presents logistic regression results using the Freddie Mac sample. We include the available borrower and loan characteristics as control variables (e.g., FICO, LTV, owner occupancy status, and loan balance). Consistent with the analysis using BBX data, we include aggregate macroeconomic variables. All specifications include zip area, origination cohort, and year fixed effects, and standard errors are clustered at the zip area level.[15]

[Insert Table 5 About Here]

The baseline specification in Column (1) of Table 5 is closest to our BBX analysis in Table 2. We find consistent results. On average, condo loans have a smaller likelihood of defaulting within two years after origination. However, the default rate in the condo loan grows at a far greater speed and eventually exceeds that in the single family market. The economic magnitude is comparable to that documented in Table 2: condo loans originated in 2007 are 10% (vs. 6.4% in Table 2) more likely to default than single family loans in the Freddie Mac sample.

[15] Freddie Mac only releases the location for each loan up to the first three digits of the exact zip code. We use this "zip area" as our location fixed effects for all analysis using the Freddie Mac sample.

This result first provides external validity to our main analysis in Table 2 by using an independent data source. Furthermore, it sheds light on the interpretation of the observed default pattern in the condo loan market. Freddie Mac loans are homogenous: they are 30-year fully amortizing fixed rate mortgages for both condo and single family loans, in contrast to the prominent differences between the two types of loans in contract terms and subprime status in the BBX dataset. The observation that the default difference in the two markets is both qualitatively and quantitatively similar in a homogeneous sample of loans complements the previous evidence by ruling out riskier contract terms or other unobserved heterogeneity among condo loans as the potential explanation.

In Column (2) of Table 5, we make use of lender information provided by Freddie Mac and include lender fixed effects in the logistic regression. The results hardly differ from Column (1). We further allow a time-varying lender effect in Column (3) to control for a potential time trend in lending standard and results remain almost the same as in Column (1). In addition, the R-square improvement when we add lender-related fixed effects is negligible. This is consistent with the observation that the credit quality of approved condo borrowers (e.g., FICO score, LTV) does not deteriorate over time (Table A1, Panel B). While there still may be a common trend in credit supply that explains the default pattern for both the single family and condo loan market, the supply channel is not able to explain the faster growth trajectory among condo loans. Taken together, results in Column (2) and (3) add support to evidence in Figure 3: the lender or credit supply channel is unlikely an important factor in explaining the faster default growth pattern of condo loans.

4.4 Why are condo borrowers riskier?

We show, using different approaches on multiple datasets, that the default likelihood of condo loans increases at a greater speed and exceeds that of the single family loans for later origination cohorts, *even* after controlling differences in locations, asset market dynamics, contract terms and lending practice between the condo and the single family market. Therefore, riskier borrowers in the condo market emerge as the leading explanation. In this section, we investigate why borrowers in the condo market are riskier. Condo borrowers are unlikely the low credit quality borrowers who default because they cannot pay or refinance their mortgages as house prices start to decline. In our sample, compared to the single family market, condo

borrowers have higher FICO scores, use subprime mortgages less frequently, and on average are charged a lower interest rate.

The recent literature highlights the role of investors in understanding defaults during the housing bust. Haughwout, et al. (2011) suggest that real estate investors rely on financial leverage in their purchases and default more ruthlessly when the housing market condition deteriorates. The price run-up in the earlier years of the decade attract more trend-chasing investors (e.g., Bayer, Geissler and Roberts, 2011; Fu and Qian, 2013), who are more likely to make a pure economic decision of deciding to default after a significant price drop. Real estate investors likely prefer condominium units due to their smaller size (and thus smaller investment), greater rental demand and less maintenance cost. Therefore, we are likely to observe a larger presence of investors in the condo borrower population over time. In our data, condominiums are indeed more likely to be investment properties; a larger proportion of condominium purchases are for non-owner-occupancy purposes (31% in BBX and 22% in Freddie Mac) compared to single family purchases (27% in BBX and 10% in Freddie Mac). In addition, the share of owner-occupied loans decreased over time in both datasets. We thus hypothesize the investor channel to explain the observed default patterns in the condo market.

We study whether investment-driven loans have a higher likelihood of default than non-investment-driven loans. We perform the analysis on the more homogeneous Freddie Mac sample that allows us to better control for heterogeneity among condo loans (e.g., in contract terms). In addition, we can identify investment-driven purchases with better precision in the Freddie Mac data: such information is incomplete and inaccurate in the BBX data where 41% of the loans have low or no documentation, compared to all Freddie Mac loans that have full documentation. Thus we use investment purchase dummy provided in the Freddie Mac data as our key independent variable in the analysis.

Panel A of Table 6 examines whether investment-associated condominium loans are associated with a higher likelihood default. The interaction between the condominium loan dummy and the investment purchase dummy in Column (1) supports the hypothesis: investment-associated condominium loans are on average 30.3% more likely to default than non-investment-associated condominium loans during the 2003-2007 origination period. Furthermore, within the

condominium loan market, investment-associated loans' defaults grow at a much faster rate over origination cohorts (Column (2)). Importantly, while we show in Table 5 that condo loans of later cohorts (e.g., originated in 2007) on average are 10% more likely to default within two years than the same cohort single family loans, the higher default level among condo loans in that cohort is driven by investment-associated condo loans. Non-investment-associated condo loans originated in 2007 are 19.4% less likely to default than the same cohort single family loans, and investment-associated condo loans originated in 2007 are 88.7% more likely to default than the same cohort single family loans. This is strong evidence supporting the investor channel explanation for the observed default pattern in the condominium market.

[Insert Table 6 About Here]

In Panel B of Table 6, we further test the hypothesis by taking a closer look at the default behavior within the condo market. Again, the first column in Panel B suggests a strong investor effect: the investment-driven condo loan is 24% more likely to default within two years during our sample period, compared to condo loans not intended for investment purchases. We seek to further understand the investor channel by interacting the investment dummy with an *Option_to_default* variable that captures the moneyness of the default option (Column (2), Table 6).[16] Investors should be more responsive in their default behavior when the current loan amount is greater than the value of the property. Results in Column (2) show that default likelihood significantly increases when the default option is in the money (as proxied by our *Option_to_default* dummy). Conditional on the default option being in the money, investment condos are 141% more likely to default within two years after origination than non-investment condos. On the other hand, when the default option is not in the money, there is no difference in default probability between the investment and non-investment condo loans. Overall, the evidence suggests that investors play an important role in explaining condo defaults. In

[16] Specifically, among the condo loan that have defaulted within two years in our sample, we define *Option_to_default* to be 1 if the current loan amount one month before default is greater than the average condo transaction prices (obtained from Zillow) in the same zip area during the same month. For those that have not defaulted within two years during our sample, *Option_to_default* is equal to 1 if, in at least one month during the first 24 months after origination, the loan amount in the current month is greater than the same-month average condo transaction price in the local area (i.e., =1 if borrower ever has one in-the-money default option during the first 2 year period after origination).

particular, condo investors (more) ruthlessly default when the current loan amount is greater than the property value.

5 The Aggregate Implications of Condo Loan Defaults

We document strong and robust evidence that condo loans are inherently riskier than single-family loans. In particular, condo loan default rate grows at a fast rate and those loans in later origination cohorts default more even compared with subprime loans in the single-family market. Does the higher risk have aggregate implications for the recent housing crisis? Our evidence suggests that investment-driven, riskier borrowers in the condo market are the most plausible driver for the observed default patterns in this market. Furthermore, investors are more responsive to market conditions in their default behavior. Given such, we conjecture that condo loans potentially default earlier than single family loans, and their earlier defaults potentially spill over by prompting more subsequent defaults in the single-family sector of the same geographic area.

We examine this hypothesis in two steps. First, we study whether the within one year default likelihood among condo loans exhibit the same trend over time. Second, we examine whether early condo defaults predicts subsequent defaults among single family loans with the same origination cohort located in the same local area. In the analysis, we focus on the potential spillover effects to the subprime sector of the single family loan market. Since we study the implication of condo loan defaults on the single family subprime market, we use the BBX sample for the analysis in the section.

5.1 Within-one-year default analysis

We explicitly study the within-one-year default decision, defined to be one if the loan is at least 60 days delinquent within the first year of loan origination. We compare the one-year default probability of condo loans with that of subprime loans in the single-family market (Table 7, Panel A). Similar as the finding in Table 3, condo loans' within-one-year default rate grows faster; in particular, condo loans' within-one-year default rate is greater than that in the single family subprime market for the later origination vintages. Condo loans originated in 2007 are 8.8% more likely to default within the first year of origination than single-family subprime loans of the same cohort. Next, we compare the one-year default rate of condo and single family loans

within the subprime sector (Table 7, Panel B). We find similar evidence. Particularly, within the subprime market, condo loans originated in 2007 are 87% more likely to default within one year of origination than single-family loans originated in 2007 (Column 2). Overall, the evidence in Table 7 is consistent with the argument that condo borrowers are more responsive to the market condition and experience more early defaults when the housing market condition deteriorates (i.e., in the later origination cohorts).

[Insert Table 7 about here]

5.2 Do (early) condo defaults predict the single family subprime market's subsequent default rate?

Next, we investigate the effect of condo loan defaults on the same-cohort single-family subprime loan market within the same zip code. Specifically, we study whether the one-year defaults of condo loans positively predicts second-year defaults of the same-cohort single family subprime loans in the same zip code.

From the BBX loan-level sample of all the condo and single-family subprime loans, we compute the dependent variable, $SF\ subprime\ \ 2nd\ year\ default\ (\%)_{j,t}$, as the proportion of single-family subprime loans in the zip code j originated in year t that defaulted during the second year after origination. The main independent variable is $Condo\ within\ 1\ year\ default\ (\%)_{j,t}$, the proportion of condo loans in zip code j originated in year t that defaulted in the first year after origination. To control for the within-subprime-market dynamics, we include $SF\ subprime\ within\ 1\ year\ default\ (\%)_{j,t}$, the proportion of single family subprime loans in zip code j originated in year t that defaulted in the first year after origination, in our regression. We also control for the MSA level HPI and the fraction of condo loans originated in the same year in the same zip code in the regression. We include zip code fixed effects to allow any time-invariant location effects at the zip code level, and state-origination year fixed effects to control for any time-varying macroeconomic conditions at the state level. We cluster the standard error to allow correlation among zip codes within the same state in a given year.

In Column (1) of Table 8, we report the full sample result of regressing the proportion of the second-year defaults of single-family subprime loans originated in year *t* in zip code *j* on the proportion of first-year defaults of the same-cohort condo loans in the same zip code. Within the same cohort, a higher level of within-one-year defaults in the condo loan market positively predicts subsequent defaults of the single-family subprime loans in the second year after origination. (Unreported) granger causality tests verify the temporal lead-lag relationship: condo defaults precede the subprime mortgage defaults in the single family market. Intuitively, more of the condo loan borrowers are investors who are more likely to default strategically and at lower levels of negative equity. In addition, they may be less attached to the neighborhood (e.g., school district) and therefore more inclined to walk away earlier. This provides new insight on the triggering event of the housing crisis.

To increase the power of the test and to better identify the channel of the lead-lag effect, we perform further analysis. Specifically, we use the exogenous variation in state foreclosure laws to better identify the spillover effect of condo market defaults. Due to a faster foreclosure process, loan defaults in the non-judicial states lead to more foreclosures through which they have a greater impact on local house prices (Mian, Sufi, and Trebbi, 2012). Given this intuition, early condo loan defaults likely have a greater impact on the subsequent single family subprime loan defaults in the non-judicial states. The subsample analysis based on judicial and non-judicial states subsamples are reported in Columns (2) and (3) of Table 8. The within-one-year defaults in the condo market *only* positively and significantly predict second-year defaults among single-family subprime loans of the same origination cohort in the same zip code in the non-judicial foreclosure states. In judicial foreclosure states, the coefficient is insignificant.

[Insert Table 8 About Here]

Next we directly study whether condo loan defaults predict subsequent house prices in the single family market. If our economic intuition on the channel of the spillover effect is correct, we should observe a negative relationship between current loan defaults in the condo market and subsequent house price growth in the single family market within the same zip code. Using data from Zillow, we compute the (log) annual change in the zip code-level average transaction price in the single family market in year *t+1* to be our dependent variable. The key

explanatory variable is the fraction of (two-year) loan defaults by condo borrowers in the same zip code in year *t*. We include, as our control variables, the condo loan share, single family house price level in year *t* at the same zip code, as well as zip code and state-year fixed effects. The standard errors are clustered at the state-year level to allow correlation among zip codes in the same state at a given year. Results provide consistent evidence (Table 9). A higher level of the current year's condo default rate is associated with a significant drop in the next year's single family house price growth in the same zip code. Furthermore, the negative association is stronger in the non-judicial states (coefficient = -0.083) than in the judicial states (coefficient = -0.053). Though we cannot reject the null hypothesis that the two coefficients are statistically the same, we note that the difference is economically large: the predictability of condo defaults on single family house price growth is 50% larger in the non-judicial states than that in the judicial states.

[Insert Table 9 About Here]

The observed difference in the predictive power of earlier condo defaults between the judicial and non-judicial foreclosure states may be associated with other unobservable factors that lead to higher default rates for both the condo and single family subprime loans. For example, in the non-judicial states that have stronger creditor rights, lenders may screen less as a result of which the average borrower is riskier. A cleaner identification to isolate the house price externality channel would be to focus on locations near the borders of adjacent states that only differ on their foreclosure laws. Unfortunately, in our data sample, there are very few condo loan originations at the state borders in general, making the analysis infeasible.[17] This is perhaps unsurprising given that condominiums are typically located in more urban areas. Nevertheless, we argue that the selection issue is unlikely driving our results for the following two reasons. First, in our data (BBX and Freddie Mac), the share of condo loans is similar among judicial and non-judicial states (17.09% vs. 13.36%), whereas the selection argument would imply a higher concentration of (risky) condo loans in the non-judicial states. Second, we compare the default pattern, for all loans, between the judicial and non-judicial states in a regression analysis and we do not find systematic differences. These pieces of evidence, albeit suggestive, are indeed consistent with Mian, et al. (2012): there are no systematic differences between non-judicial and

[17] Using the same identification of state borders as in Mian, et al. (2012), the identified condo loans constitutes only 1.3% of loans near the state borders.

judicial states (including at the state borders) in default rates, house price growth, leverage, fraction subprime, income, unemployment rate, racial mix, poverty, or education.

Overall, the results in Tables 7-9 are consistent with our hypothesis that condo loan defaults have aggregate implications beyond the condo loan market itself. Condo borrowers are more responsive to housing market conditions, leading to a faster growth in their within-one-year default likelihoods, compared to the single family subprime loans. The early condo loan defaults predict a higher subsequent default rate of the same-cohort single-family subprime loans in the same zip code, primarily in non-judicial states with an efficient foreclosure process.[18] This suggests that the predictability largely works through the mechanism of house price externality. Indeed we find condo loan defaults strongly predict future single family house prices in the same zip code, especially in the non-judicial states.

6 Conclusion

In this paper we identify an overlooked yet potentially important segment of the mortgage market—the condominium loan market—in understanding the recent financial crisis. The number of condominium loan origination has increased by 15-fold between 2001 and 2007. During this time period, condo loans accounted for 15% of all U.S. residential loan originations, rising from 9% in 2001 to 16% in 2007. Moreover, condo loan defaults grows at a faster rate than single family loan defaults, even after controlling for observed loan and borrower characteristics. For loans originated in year 2006, condo loans are 6.4% more likely to default than single family loans of the same cohort, and 12% more likely to default than subprime mortgages – presumably the riskier loans—in the single family market.

Despite the fact that condo asset and loan market differs considerably from the single family market, we find that the observed default pattern among condo loans is not explained away by observed and unobserved heterogeneity associated with condo loans (such as location, asset characteristics, or loan contract term or contract type differences). We further show that our results remain robust after we control for (time-varying) lender fixed effects, which suggest

[18] As a further robustness check, we confirm that the within-one-year condo defaults granger-cause the subsequent same-cohort single family subprime loan defaults at the same location.

riskier condo borrowers as the main explanation for the faster default growth among condo loans.

Condo borrowers are unlikely the low credit quality borrowers who default because they cannot pay or refinance their mortgages as house prices start to decline; in our sample, condo borrowers have better creditworthiness than single family borrowers. We hypothesize the investor channel to play a more important role in our context: the price run-up in the earlier years of the decade attract more investors who are also more likely to make a pure economic decision of deciding to default soon after a significant price drop (Haughwout, et al., 2011). Given that real estate investors are more present in the condominium market, the observed default pattern in the condo loan market thus may be associated with the investor behavior. Consistent with the hypothesis, we find that investment-purchase condo loans are much more likely to default compared to other condo loans, and the effect is strengthened when the option to default is more in the money.

Lastly, we show the effect of condo loan defaults on the subsequent subprime loan defaults in the single family market. Specifically, early condo defaults within the same zip code positively predict subsequent defaults by subprime mortgages of the same origination cohort in the single family market. In addition, condo loan defaults are negatively associated with subsequent single family house price growth in the same zip code. This result provides new insight of the triggering event of the housing crisis. Using exogenous variation in state foreclosure laws, we confirm that the predictive effects of condo loan defaults concentrate in judicial foreclosure states, consistent with the explanation that earlier condo loan foreclosures prompted more defaults among subprime mortgages within the same location by exerting downward price pressure on the neighborhood house prices.

Results in this paper imply that condo loan market is an important channel to understand the cause and transmission mechanism of the recent financial crisis especially from the perspective of borrowers and investors' behavior. Our findings that condo borrowers, especially investors, are riskier also suggest that lenders need to exercise more scrutiny in their lending practice in the condominium mortgage market. From a public policy point of view, we also learn that simply requiring more skin-in-the-game regulations for lenders and lower LTV for the borrowers under the Dodd-Frank law is only a partial solution from avoiding a similar crisis in

the future. Our evidence provides the first step in studying the cause and aggregate implications of the condo loan defaults. Future research is required to understand the role of borrowers, especially investors in that market in fueling and potentially exacerbating the crisis.

References

Agarwal, S., Ambrose, B., Chomsisengphet, S., Sanders, A., 2012. The neighbor's mortgage: does living in a subprime neighborhood impact your probability of default? *Real Estate Economics,* 40(1), 1-22

Agarwal, S., Amromin, G., Ben-David, I., Chomsisengphet, S., Evanoff, D., 2013. Predatory Lending and the Subprime Crisis. Forthcoming, *Journal of Financial Economics*

Agarwal, S., Amromin, G., Ben-David, I., Chomsisengphet, S., Evanoff, D., 2011. The role of securitization in mortgage renegotiation. *Journal of Financial Economics*, 102(3), 559-578

Agarwal, S., Chang, Y., Yavas, A., 2012. Adverse selection in mortgage securitization. *Journal of Financial Economics,* 105(3), 640-660.

Ambrose, B.W., Capone, C.A., Deng, Y. 2001. Optimal put exercise: an empirical examination of conditions for mortgage foreclosure. *Journal of Real Estate Finance and Economics*, 23, 213-234.

Amromin, G., Huang, J., Sialm, C., Zhong, E., 2011. Complex mortgages. Working paper, Federal Reserve Bank of Chicago.

An, X., Deng, Y., Gabriel, S., 2011. Asymmetric information, adverse selection, and the pricing of CMBS. *Journal of Financial Economics,* 100 (2), 304-325.

An, X., Deng, Y., Rosenblatt, E., Yao, V.W., 2012. Model stability and the subprime mortgage crisis. *Journal of Real Estate Finance and Economics*, 45 (3), 545-568.

Campbell, J.Y., Gilio, S., Pathak, P., 2011. Forced sales and house prices. *American Economic Review*, 101(5): 2108–2131

Case, K.E., Shiller, R.J., Thompson, A., 2012. What have they been thinking? home buyer behavior in hot and cold markets. NBER working paper w18400

Cheng, I., S. Raina, and W. Xiong, 2013. Wall Street and the housing bubble. Working paper.

Chinco, A., Mayer, 2012. Distant speculators and asset bubbles in the housing market. Working paper.

C. Clapp, J., Deng, Y., An, X., 2006. Unobserved heterogeneity in models of competing mortgage termination risks. *Real Estate Economics,* 34 (2), 243-273.

Demyanyk, Y., Van Hemert, O., 2011. Understanding the subprime mortgage crisis. *Review of Financial Studies,* 24, 1848-1880.

Deng, Y., Gabriel, S.A., 2006. Risk-based pricing and the enhancement of mortgage credit availability among underserved and higher credit-risk populations. *Journal of Money, Credit and Banking*, 38(6), 1431-1460.

Deng, Y., Quigley, J.M., Van Order, R., 1996. Mortgage default and low downpayment loans: the costs of public subsidy. *Regional Science and Urban Economics*, 26(3-4), 263–287.

Deng, Y., Quigley, J.M., Van Order, R., 2000. Mortgage terminations, heterogeneity and the exercise of mortgage options. *Econometrica*, 68(2), 275–307.

Duchin, R., Sosyura, D., 2010, TARP consequences: lending and risk taking. Working paper, Ross School of Business, University of Michigan.

Fu, Y., Qian, W., 2012. Speculators and price overreaction in the housing market. *Real Estate Economics*, forthcoming.

Fu, Y., Qian, W., Yeung, B., 2012. Housing Market Speculators and Transaction tax. NBER working paper w19400.

Garmaise, Mark, 2013a. The Attractions and Perils of Flexible Mortgage Lending, forthcoming, *Review of Financial Studies*

Garmaise, Mark, 2013b. Borrower Misreporting and Loan Performance, forthcoming, *Journal of Finance*

Haughwout, A.F., Lee, D., Tracy, J., van der Klaauw, W., 2011. Real estate investors, the leverage cycle, and the housing market crisis. Working paper, Federal Reserve Bank of New York.

Igan, D., Mishra, P., Tressel, T., 2009. A fistful of dollars: lobbying and the financial crisis. International Monetary Fund working paper.

Jiang, W., Nelson, A., Vytlacil, E., 2012. Liar's loan? effects of origination channel and information falsification on mortgage loan delinquency. *Review of Economics and Statistics*, forthcoming.

Kau, J.B., Keenan, D.C., 1999. Patterns of rational default. *Regional Science and Urban Economics*, 29(6), 765-785.

Kau, J.B, Keenan, D.C., Muller, W.J., Epperson, J.F., 1992. A generalized valuation model for fixed-rate residential mortgages. *Journal of Money, Credit and Banking*, 24(3), 279-299.

Keys, B., Mukherjee, T., Seru, A., Vig, V., 2010a. Did securitization lead to lax screening? evidence from subprime loans. *Quarterly Journal of Economics*, 125, 307-362.

Keys, B., Mukherjee, T., Seru, A., Vig, V., 2010b. 620 FICO, take II: securitization and screening in the subprime mortgage. *Review of Financial Studies*, forthcoming.

Mayer, C., Pence, K., Sherlund, S.M., 2009. The rise in mortgage defaults. *Journal of Economic Perspectives*, 23(1), 27-50.

Mian, A., Sufi, A., 2009. The consequences of mortgage credit expansion: evidence from the U.S. mortgage default crisis. *Quarterly Journal of Economics*, 124, 1449-1496.

Mian, A., Sufi, A., Trebbi, F., 2010. The political economy of the U.S. mortgage default crisis. *American Economic Review*, 100(5), 1967-1998.

Mian, A., Sufi, A., Trebbi, F., 2012. Foreclosures, House Prices, and the Real Economy. Working paper.

Piskorski, T., Seru, A., Vig, V., 2010. Securitization and distressed loan renegotiation: evidence from the subprime mortgage crisis. *Journal of Financial Economics*, 97(3), 369-397.

Rajan, U., Seru, A., Vig, V., 2013. The Failure of Models That Predict Failure: Distance, Incentives and Defaults. *Journal of Financial Economics, forthcoming.*

Figure 1 Frequency Distribution of Condo Loans Originated in 2001–2007

This figure shows the frequency distribution of condo loan originations for all U.S. states from the BlackBox dataset. We include purchase loans and loans smaller than $10 million. All the loans are originated during the period 2001–2007. Fig. 1.1 shows the number of condo loan originations in 2001–2007 (in thousands), and Fig. 1.2 presents the percentage of condo loan originations as the share of single-family loan originations plus condo loan originations in 2001–2007.

Fig. 1.1 Number of condo loans originated in 2001-2007 (in thousands)

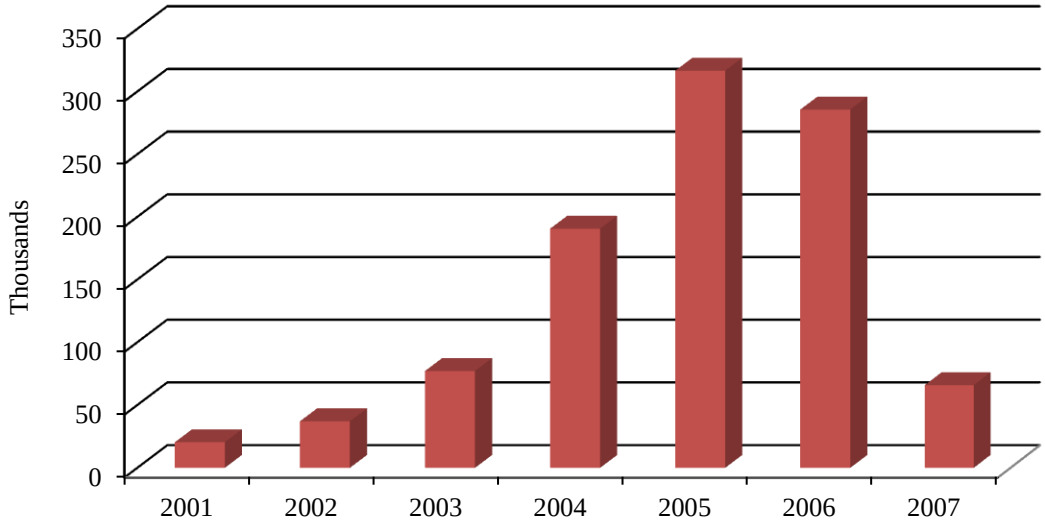

Fig. 1.2 Percentage of condo loans originated in 2001–2007

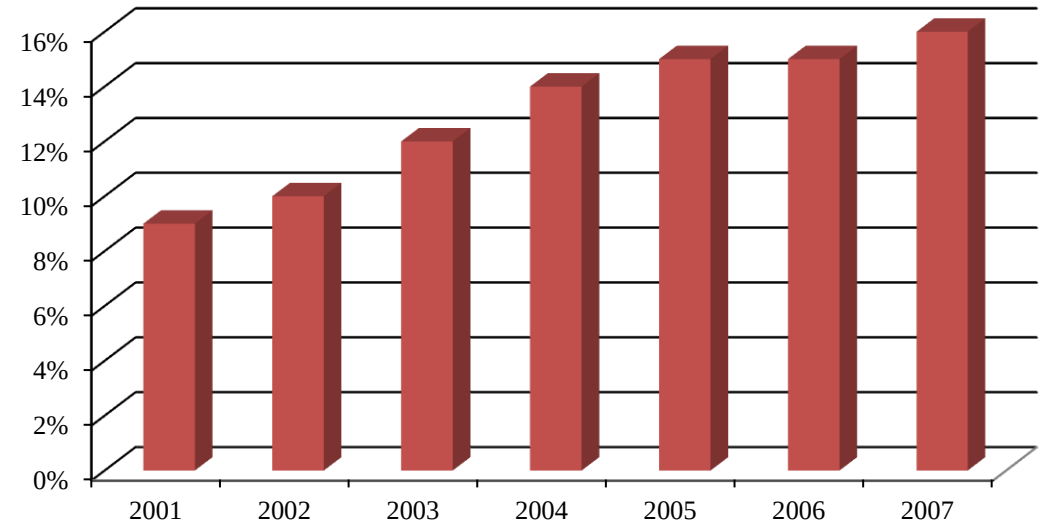

Figure 2 Frequency Distribution of Defaults within Two Years of Origination: Condo vs. Single-Family

This figure shows the frequency distribution of loan defaults within two years of origination (in percentages). All the loans are originated during the period 2003–2007 and are separated by property type: condo and single-family. Fig. 2.1 shows the frequency distribution of within-two-year default rates for the full sample; Fig. 2.1 presents the distribution by comparing subprime and non-subprime loans. The Y-axis indicates the percentage of default probability within two years of origination, and the X-axis indicates the origination year of the loan.

Fig. 2.1 Frequency distribution of defaults within two years: Full sample

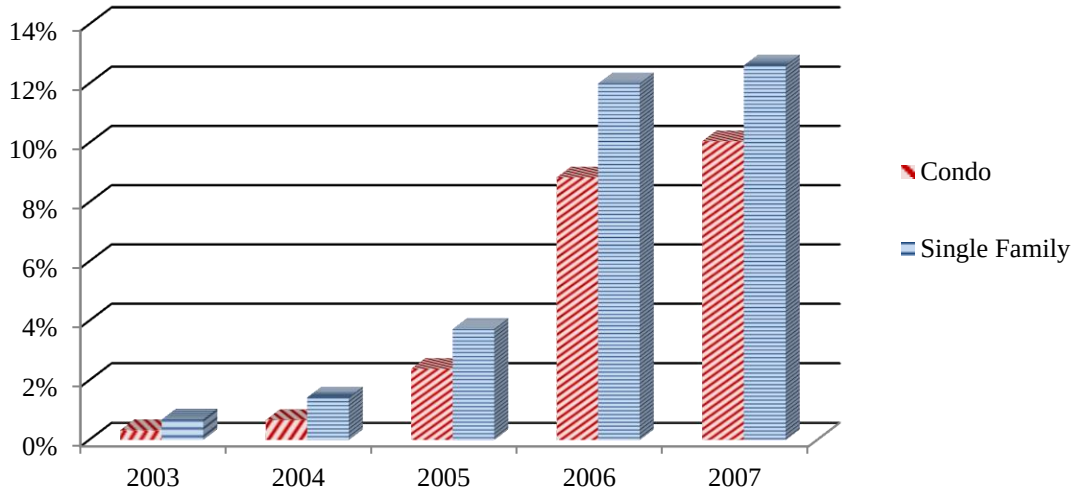

Fig. 2.2 Frequency distributions of defaults within two years: Subprime and non-subprime

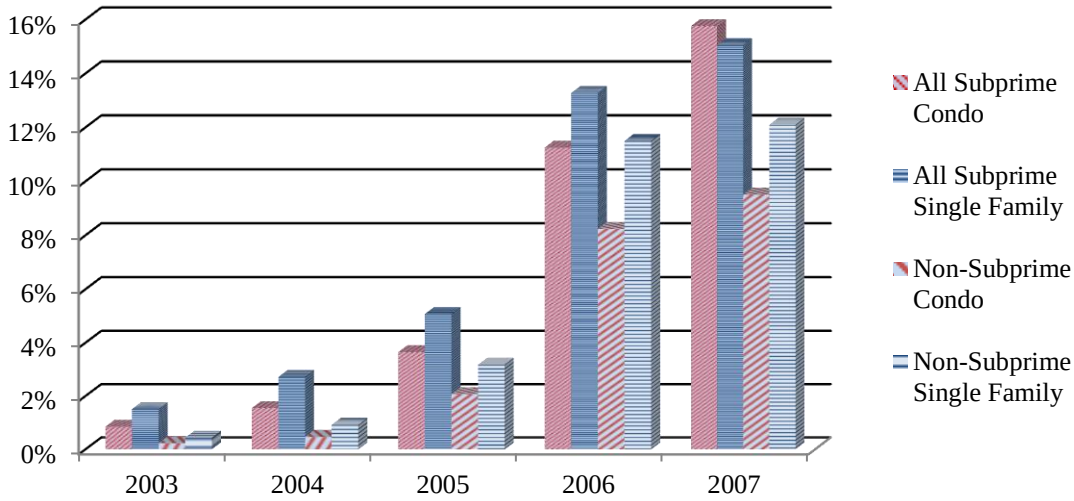

Figure 3 R square compassion from OLS regressions: condo and single family by year

This figure shows the trend in R-square statistics for condo and single family market separately for each loan origination year (over the period of 2003-2007). The R-squares are obtained from 10 (OLS) regressions, using the same independent and explanatory variables as in Table 2, by restricting to condo loans (or single family loans) within each origination year. The Y-axis indicates the R-square statistics, and the X-axis indicates the origination year of the loan.

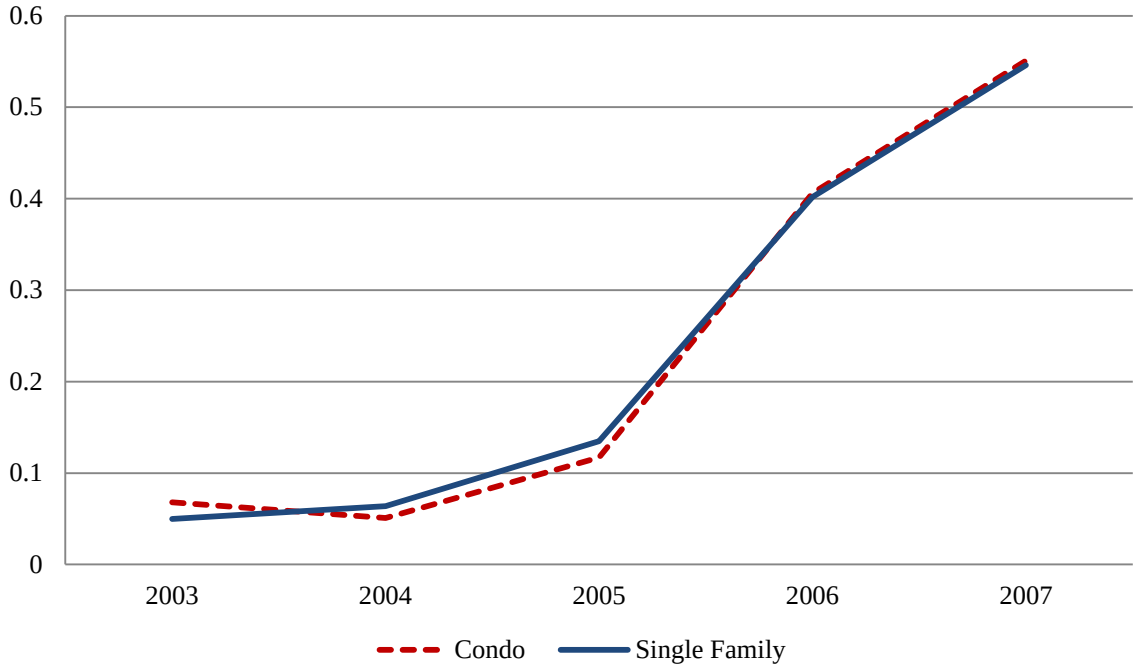

Table 1 Summary Statistics of BlackBox Full Sample

This table presents the summary statistics of the BlackBox Logic (BBX) dataset. This dataset includes only single-family and condominium (condo) loans originated during the period 2003–2007. For this paper, we define refer to single family as the *detached* single family houses. Panel A reports the results from aggregate-level summary statistics of the loans and compares the average values of the variables by full sample, single-family loans, and condo loans, respectively. Panel B shows the full sample summary statistics results by origination year. Panel C shows the comparison of the single family subprime loan market and the condo loan market (full and subprime). *D_default within 2 yrs* is equal to one for defaulting within two years of the loan origination date. *Current interest rate* refers to the coupon rate charged to the borrower for the most recent remittance period. *Original loan balance* is defined as the amount of principal on the closing date of the mortgage. *FICO score* refers to the FICO (formerly the Fair Isaac Corporation) borrower credit score at the time of the loan closing. *Original LTV* means the ratio of the original loan amount to the property value at loan origination. *D_FRM* is equal to one for fixed-rate mortgages. *D_Owner occupied* takes one if the property is owner occupied. *D_Second lien* is equivalent to one for a second lien loan that is subservient to the main or first mortgage on a piece of real estate. *D_Option ARM* is equal to one if it is an adjustable rate mortgage with added flexibility of making one of several possible payments on your mortgage every month. *D_Interest only loan* is one if it is a loan in which, for a set term, the borrower pays only the interest on the principal balance with the principal balance unchanged. *D_Heloc* is equivalent to one if it is a loan in which the lender agrees to lend a maximum amount within an agreed term, where the collateral is the borrower's equity in his/her house (HELOC is short for home equity line of credit). *D_Low/No doc* takes one if the borrower is required to provide low or no documentation. *D_Subprime* equals one if it is a subprime loan (i.e., loans with FICO score lower than 720). *Margin* is the difference between the interest rate charged to the borrower and the applicable ARM index, as measured in number of percentage points. *Log_HPI* is log of the quarterly FHFA/OFHEO House Price Index. *Log_Duration* is the log of the elapsed time from origination to the end of the sample period or to the first classification as being prepaid or delinquent at least 60 days. Note that ***, ** and * indicate 1%, 5% and 10% significance, respectively.

Panel A: Summary statistics for BlackBox (BBX): from 2003 to 2007

	Total	Condo	Single-Family (SF)	Diff. (Condo-SF)
D_default within 2 yrs	6%	4%	6%	-2%***
FICO score	683	699	679	20***
Original LTV	73%	73%	73%	0***
Original loan balance (*1000)	230	220	232	-12***
Current interest rate	7.45	7.11	7.53	-0.42***
Margin	2.27	2.21	2.28	-0.07***
D_Subprime	26%	19%	27%	-8%***
D_FRM	40%	35%	41%	-6%***
D_Second lien	19%	18%	20%	-2%***
D_Option ARM	5%	8%	4%	4%***
D_Interest only loan	22%	29%	21%	8%***
D_Heloc	2%	2%	2%	0%***
D_Low/No doc	35%	41%	34%	7%***
D_Owner occupied	73%	69%	74%	-5%***
Log_HPI	5.33	5.36	5.32	0.04***
Log_duration	6.86	6.94	6.84	0.10***
Sample Size (in thousands)	5,000	909	4,091	

Panel B: Summary statistics for BlackBox (BBX) by loan origination year (2003–2007)

	Condo	Single-Family	Diff.	Condo	Single-Family	Diff.	Condo	Single-Family	Diff.	Condo	Single-Family	Diff.	Condo	Single-Family	Diff.
Original Year	**2003**			**2004**			**2005**			**2006**			**2007**		
D_default within 2 yrs	0%	1%	-1%***	1%	1%	0%***	2%	4%	-2%***	9%	12%	-3%***	10%	13%	-3%***
FICO score	697	683	14***	701	680	21***	700	679	21***	694	674	20***	710	689	21***
Original LTV	73%	73%	0%	74%	75%	-1%***	73%	73%	0%***	70%	71%	-1%***	76%	79%	-3%***
Original loan balance （*1000）	212	234	-22***	211	221	-10***	214	224	-10***	212	228	-16***	324	325	-1
Current interest rate	6.93	7.26	-0.33***	6.69	7.22	-0.53***	6.93	7.47	-0.54***	7.58	7.94	-0.36***	7.32	7.46	-0.14***
Margin	1.58	1.72	-0.14***	2.21	2.29	-0.08***	2.45	2.52	-0.07***	2.24	2.38	-0.14***	1.58	1.55	0.03
D_Subprime	16%	23%	-7%***	19%	28%	-9%***	20%	29%	-9%***	20%	29%	-9%***	9%	18%	-9%***
D_FRM	38%	46%	-8%***	27%	33%	-6%***	32%	38%	-6%***	41%	45%	-3%***	47%	51%	-4%***
D_Second lien	14%	14%	0%	13%	14%	-1%***	18%	21%	-3%***	24%	25%	-1%***	16%	16%	0%
D_Option ARM	1%	0%	1%***	5%	3%	2%***	9%	5%	4%***	9%	5%	4%***	10%	5%	5%***
D_Interest only loan	11%	5%	6%***	25%	17%	8%***	34%	25%	9%***	31%	24%	7%***	34%	26%	8%***
D_Heloc	0%	0%	0%	1%	1%	0%***	3%	3%	0%***	2%	2%	0%***	0%	0%	0%
D_Low/No doc	24%	24%	0%***	29%	25%	4%***	42%	35%	7%***	48%	40%	8%***	53%	43%	10%***
D_Owner occupied	78%	82%	-4%***	75%	78%	-3%***	68%	74%	-6%***	65%	69%	-4%***	60%	61%	-1%**
Log_HPI	5.41	5.34	0.07***	5.43	5.38	0.05***	5.37	5.33	0.04***	5.31	5.27	0.04***	5.3	5.25	0.05***
Log_Duration	6.85	6.85	0	6.86	6.77	0.09***	6.96	6.86	0.1***	6.98	6.86	0.12***	6.96	6.9	0.06***
Sample Size (in thousands）	75	441		185	901		317	1,758		278	1,159		63	265	

Panel C: Comparison of Single Family Subprime Loan Market and Condo Loan Market (Full and Subprime)					
	SF Subprime	**Condo**	**Diff. (Condo-SF Subprime)**	**Subprime Condo**	**Diff. (Subprime Condo- Subprime SF)**
D_default within 2 yrs	7%	4%	-3%***	6%	-1%***
FICO score	578	699	122***	579	1***
Original LTV	78%	73%	-6%***	77%	-1%***
Original loan balance (in thousands）	165	220	68***	161	-4***
Current interest rate	8.22	7.11	-1.19***	8.19	-0.03***
Margin	3.74	2.21	-1.59***	3.86	0.12***
D_FRM	29%	35%	6%***	28%	-1%***
D_Second lien	11%	18%	7%***	10%	-1%***
D_Option ARM	0%	8%	8%***	0%	0%***
D_Interest only loan	9%	29%	21%***	12%	3%***
D_Heloc	1%	2%	1%***	3%	2%***
D_Low/No doc	14%	41%	27%***	17%	3%***
D_Owner occupied	80%	69%	-11%***	80%	0%**
Log_HPI	5.29	5.36	0.09***	5.36	0.07***
Log_Duration	6.80	6.94	0.06***	6.85	0.05***
Sample Size (in thousands）	1,123	909		170	

Table 2 Logistic Analysis of Borrower within-two-year Default: Condo vs. Single-Family

This table presents the result of logistic regression analysis for the refined 2000-city BBX sample. This dataset includes only single-family and condominium (condo) purchase loans (<10million USD in origination amount) from all states originated during the period 2003–2007. The dependent variable *D_default within 2* yrs takes the value of one for defaulting within two years of the loan origination date. The definitions of the independent variables are shown in Table 1. Standard errors are clustered at city level. City fixed effects, current year fixed effects and origination year fixed effects are included in the regression but not reported. Odds ratios are reported and robust z-statistics are included in the parentheses. Note that ***, ** and * indicate 1%, 5% and 10% significance, respectively.

	(1) **D_default within 2yrs**	(2) **D_default within 2yrs**
D_Condo	0.992	0.562***
	(-0.26)	(-5.97)
D_Condo * D_OrigYear2004		1.097
		(0.84)
D_Condo * D_OrigYear2005		1.536***
		(4.30)
D_Condo * D_OrigYear2006		1.920***
		(6.18)
D_Condo * D_OrigYear2007		1.894***
		(5.06)
D_Owner occupied	0.595***	0.595***
	(-30.43)	(-30.43)
D_Second lien	6.834***	6.822***
	(44.02)	(44.07)
D_FRM	0.706***	0.705***
	(-23.69)	(-23.80)
D_Option ARM	0.441***	0.440***
	(-13.90)	(-13.86)
D_Interest only loan	0.965*	0.965*
	(-1.78)	(-1.81)
D_Heloc	0.620***	0.618***
	(-17.54)	(-17.70)
D_Low/No Doc	1.023	1.021
	(1.52)	(1.40)
D_Subprime	0.739***	0.738***
	(-16.95)	(-16.94)
Original LTV	1.002***	1.002***
	(18.05)	(18.04)
Log_FICO score	0.008***	0.008***
	(-45.87)	(-45.95)
Log_Original loan balance	1.383***	1.382***
	(13.90)	(13.94)
Log_HPI	0.290***	0.289***
	(-7.24)	(-7.27)
Log_Duration	0.149***	0.149***
	(-63.63)	(-63.42)
Unemployment rate	0.968	0.967
	(-1.56)	(-1.63)
Yield slope	1.153***	1.154***
	(6.38)	(6.46)
Credit spread	1.635***	1.636***
	(49.42)	(49.47)
Current interest rate	1.049***	1.048***
	(14.75)	(14.61)
Fixed effects	City, current year and origination year	
Observations	2,291,374	2,291,374
Pseudo R-squared	0.418	0.418

Table 3 Logistic Analysis of within-two-year Default: Condo Loans vs. Subprime Loans

This table presents the result of logistic regression analysis that includes all condo loans and subprime loans originated during the period 2003–07 in the BBX sample. Columns (1) and (2) present the logistic regression results of all condo loans and single-family subprime loans, and columns (3) and (4) show results of condo subprime loans and single-family subprime loans. The dependent variable *D_default within 2* yrs takes the value of one for defaulting within two years of the loan origination date. We include the same set of control variables as in Table 2. City fixed effects, current year fixed effects and origination year fixed effects are included in the regression but not reported. Standard errors are clustered at city level. Odds ratios are reported and robust z-statistics are included in the parentheses. Note that ***, ** and * indicate 1%, 5% and 10% significance, respectively.

	(1)	(2)	(3)	(4)
	D_default within 2yrs		**D_default within 2yrs**	
	All Condo vs SF Subprime Loans		**Condo Subprime vs. SF Subprime Loans**	
D_Condo	0.895***	0.301***	1.125***	0.758*
	(-3.20)	(-10.90)	(3.90)	(-1.81)
D_Condo x D_OrigYear2004		1.317**		1.002*
		(2.44)		(0.01)
D_Condo x D_OrigYear2005		2.445***		1.151
		(7.95)		(0.89)
D_Condo x D_OrigYear2006		3.724***		1.700***
		(10.95)		(3.35)
D_Condo x D_OrigYear2007		3.016***		2.384***
		(7.76)		(4.56)
Controls	Yes	Yes	Yes	yes
Fixed effects		City, current year and origination year		City, current year and origination year
Observations	742,517	742,517	402,533	402,533
Pseudo R-squared	0.373	0.375	0.333	0.334

Table 4 Controlling for Location and Asset Dynamics of the Condo Market

This table studies the robustness of our results in Table 2 in subsamples that allow better control for unobservables (e.g., location and condo market price dynamics). Column (1) repeats the analysis in Table 2 in the top 50 cities in the BBX sample with finer zip code fixed effects. Columns (2)-(3) perform the analysis in Table 2 using the merged Zillow-BBX subsample in the top 50 cities, where we replace the state-level HPI information with the zip code level values based on transaction prices obtained from Zillow, for both single family houses and condos. Specifically, *Log_Condo (Single family) Price Level* refers to the log of the monthly zip-level Zillow condo (single family) market average transaction price; *Condo (Single family) Price growth* is the monthly change in log zip-level Zillow condo (single family) price level. The dependent variable *D_default within 2* yrs takes the value of one for defaulting within two years of the loan origination date. We include the same set of control variables and similar fixed effects as in Table 2 (unreported here for brevity). Odds ratios are reported and robust z-statistics are included in the parentheses. Note that ***, ** and * indicate 1%, 5% and 10% significance, respectively.

	(1)	(2)	(3)
	D_default within 2yrs	**D_default within 2yrs**	**D_default within 2yrs**
	BBX subsample (top 50 cities)	**Zillow-BBX merged sample (top 50 cities)**	
D_Condo	0.900	0.947	0.945
	(-0.73)	(-0.31)	(-0.38)
D_Condo * D_OrigYear2004	0.858	0.866	0.843
	(-0.83)	(-0.71)	(-0.80)
D_Condo * D_OrigYear2005	1.214	1.103	1.074
	(1.24)	(0.50)	(0.40)
D_Condo * D_OrigYear2006	1.558**	1.445*	1.358*
	(2.55)	(1.76)	(1.85)
D_Condo * D_OrigYear2007	1.332*	1.328	1.257
	(1.34)	(1.09)	(0.93)
Log_Condo price level		1.971**	1.090
		(2.32)	(1.34)
Log_Single family price level		1.276	0.472***
		(0.59)	(-9.47)
Condo price growth		0.078***	0.227**
		(-4.30)	(-2.28)
Single family price growth		0.000***	0.000***
		(-7.87)	(-5.30)
Controls	Yes	Yes	yes
Fixed effects	zip codes, current year and origination year	zip codes, current year and origination year	City-year and origination year
Cluster	city	city	city-year
Observations	679,483	565,084	539,815
Pseudo R-squared	0.439	0.454	0.449

Table 5 Controlling for Lender and Contract-term Differences: Evidence using Freddie Mac Data

This table presents the result of logistic regression analysis for the Freddie Mac full sample. This dataset includes only single-family and condominium (condo) purchase loans (< 10million USD loan origination amount) from all states originated during the period 2003–2007. Column (1) includes "zip-area" and current year fixed effects, as well as origination year fixed effects. Column (2) includes lender fixed effects, in addition to "zip-area" fixed effects, current year fixed effects, and origination year fixed effects. Column (3) includes the interaction of lender and origination year fixed effects, in addition to "zip-area" fixed effects, current year fixed effects, and origination year fixed effects. The dependent variable *D_default within 2* yrs takes the value of one for defaulting within two years of the loan origination date. Please refer to Table A3 for definitions and summary statistics of the independent variables. Standard errors are clustered at "zip-area" level, and the fixed effects are not reported. Odds ratios are reported and robust z-statistics are included in the parentheses. Note that ***, ** and * indicate 1%, 5% and 10% significance, respectively.

	(1)	(2)	(3)
	D_default within 2yrs	**D_default within 2yrs**	**D_default within 2yrs**
D_Condo	0.439***	0.450***	0.459***
	(-8.01)	(-7.95)	(-7.84)
D_Condo * D_OrigYear2004	1.250*	1.239*	1.222*
	(1.95)	(1.88)	(1.75)
D_Condo * D_OrigYear2005	1.592***	1.625***	1.537***
	(3.68)	(3.89)	(3.39)
D_Condo * D_OrigYear2006	2.069***	2.061***	1.992***
	(5.94)	(5.99)	(5.79)
D_Condo * D_OrigYear2007	2.510***	2.455***	2.435***
	(6.41)	(6.48)	(6.60)
D_Owner occupied	0.914**	0.917**	0.925**
	(-2.29)	(-2.21)	(-2.02)
Original LTV	1.050***	1.049***	1.049***
	(41.94)	(41.00)	(41.24)
Log_FICO score	0.000***	0.000***	0.000***
	(-66.08)	(-66.66)	(-67.38)
Log_Original loan balance	0.752***	0.753***	0.755***
	(-8.41)	(-8.42)	(-8.32)
Log_Duration	0.923***	0.924***	0.923***
	(-30.76)	(-30.62)	(-29.97)
Log_HPI	0.026***	0.028***	0.030***
	(-12.96)	(-13.30)	(-13.15)
Unemployment rate	1.234***	1.233***	1.233***
	(10.52)	(10.91)	(11.23)
Yield slope	0.904***	0.904***	0.906***
	(-3.67)	(-3.74)	(-3.67)
Credit spread	1.401***	1.406***	1.412***
	(19.27)	(19.53)	(19.60)
Current interest rate	1.520***	1.522***	1.499***
	(14.66)	(15.00)	(14.56)
Fixed effects	zip-area, current year and origination year		
		Lender	Lender*origination year
Observations	1,823,656	1,823,656	1,823,656
Pseudo R-squared	0.354	0.358	0.360

Table 6 Investor Channel Analysis: Evidence from Freddie Mac

Panel A of this table presents the result of logistic regression analysis for the Freddie Mac full sample (condominium + single family loans) from all states originated during the period 2003-2007, and Panel B of this table shows the result of logistic regression analysis using only condominium (condo) purchase loans (< 10million USD loan origination amount) out of the full sample. The dependent variable *D_default within 2* yrs takes the value of one for defaulting within two years of the loan origination date. The definitions of the independent variables are same as in the summary statistics of the Freddie Mac sample (Table A3). *D_Investment* equals one if the use of the property if for investment (as recorded in Freddie Mac). Among the condo loans which default within 2 years, *Option_to_Default* is a dummy equal to one if the difference between current loan amount at one month before the defaulting month and Zillow zip-level condo HPI at the same month is larger than 0. For those condo loans which do not default within 2 years, *Option_to_Default* is equal to one if the difference between current loan amount and the current Zillow HPI is positive for at least one month during the first 24 months after origination. *Log_HPI* is log of the MSA-level quarterly FHFA/OFHEO House Price Index. Standard errors are clustered at "zip-area" level. "Zip-area", origination cohort, year, and lender fixed effects are included but not reported. Odds ratios are reported and robust z-statistics are included in the parentheses. Note that ***, ** and * indicate 1%, 5% and 10% significance, respectively.

	(1) **D_default within 2yrs**	(2) **D_default within 2yrs**
Panel A: Full sample		
D_Condo	0.850** (-3.32)	0.452** (-7.92)
D_Condo*D_Investment	1.303** (3.06)	
D_Condo * D_OrigYear2004		0.791** (-3.50)
D_Condo * D_OrigYear2005		0.791** (-3.75)
D_Condo * D_OrigYear2006		0.752** (-3.88)
D_Condo * D_OrigYear2007		1.784** (6.68)
D_Condo* D_Investment* D_OrigYear2004		1.225 (1.68)
D_Condo* D_Investment* D_OrigYear2005		1.691** (4.20)
D_Condo* D_Investment* D_OrigYear2006		2.105** (6.12)
D_Condo* D_Investment* D_OrigYear2007		2.340** (6.18)
Fixed effects	zip-area, origination year, current year and lender	
Observations	1,823,656	1,823,656
Pseudo R-squared	0.357	0.358
Panel B: Condo market subsample		
D_Investment	1.242** (2.35)	0.936 (-0.56)
Option_to_Default		2.077*** (9.42)
Option_to_default*D_Investment		2.575*** (4.73)
Fixed effects	zip-area, origination year, current year and lender	
Observations	169,224	167,966
Pseudo R-squared	0.421	0.427

Table 7 Within-One-Year Default Analysis

This table presents the results of the within-one-year default logistic regression analysis. The sample includes all condo loans and subprime loans originated during the period 2003–2007 in the BBX sample. Panel A presents the logistic regression results of all condo loans and single-family subprime loans, and Panel B presents results of condo subprime loans and single-family subprime loans. The dependent variable *D_default within 1 yr* takes a value of one for defaulting within one year of the loan origination date. We do not include the entire list of control variables; refer to Table 2 for the full regression list and Table 1 for the definitions of the variables. Standard errors are clustered at city level. City fixed effects, current year fixed effects and origination year fixed effects are included in the regression but not reported. Standard errors are clustered at the city level. Odds ratios are reported and t-statistics are included in the parentheses. Note that ***, ** and * indicate 1%, 5% and 10% significance, respectively.

Panel A: Logistic analysis of all condo loans and single-family subprime loans

	(1) D_default within 1yr	(2) D_default within 1yr
D_Condo	0.819***	0.595***
	(-3.39)	(-2.84)
D_Condo * D_OrigYear2004		0.779
		(-1.21)
D_Condo * D_OrigYear2005		0.876
		(-0.75)
D_Condo * D_OrigYear2006		1.779***
		(3.24)
D_Condo * D_OrigYear2007		1.829***
		(3.10)
Fixed effects	City, current year and origination year	
Observations	626,419	626,419
Pseudo R-squared	0.445	0.447

Panel B: Logistic analysis of all condo subprime loans and single-family subprime loans

	(1) D_default within 1yr	(2) D_default within 1yr
D_Condo	1.045	0.874
	(0.66)	(-0.47)
D_Condo * D_OrigYear2004		0.862
		(-0.40)
D_Condo * D_OrigYear2005		0.938
		(-0.20)
D_Condo * D_OrigYear2006		1.388
		(1.05)
D_Condo * D_OrigYear2007		2.140**
		(2.10)
Fixed effects	City, current year and origination year	
Observations	343,628	343,628
Pseudo R-squared	0.451	0.452

Table 8 Do Early Condo Defaults Predict Subsequent Single Family Subprime Defaults?

This table reports the zip code level analysis of the single-family subprime market defaults from loans by their origination cohort years (2003–2007). From the loan-level sample with all the condo and single-family subprime loans, we compute $SF\ subprime\ \ 2nd\ year\ default\ (\%)_{j,t}$ as the proportion of single-family subprime loans in the zip code *j* originated in year *t* that default during the second year after origination. $SF\ subprime\ within\ 1\ Year\ default\ (\%)_{j,t}$ ($Condo\ within\ 1\ year\ default\ (\%)_{j,t}$) is defined as the proportion of single-family subprime loans (condo loans) in zip code *j* originated in year *t* that default in the first year after origination. $\%\ Condo\ loans_{j,t}$ is the number of condo loans divided by the total number of single-family subprime and condo loans originated in year *t* in zip code *j*. We also include zip code and state-origination year fixed effects in all specifications and cluster the standard errors at state-origination year level. T-statistics are included in parentheses, and ***, ** and * indicate 1%, 5% and 10% significance, respectively.

	(1)	(2)	(3)
	SF subprime 2nd Year default (%)$_{j,t}$	**SF subprime 2nd year default** (%)$_{j,t}$	**SF subprime 2nd year default** (%)$_{j,t}$
	Full Sample	**Judicial Foreclosure States**	**Non-Judicial Foreclosure States**
SF subprime within 1 year default (%)$_{j,t}$	0.038**	0.026	0.044**
	(2.24)	(0.97)	(2.03)
Condo within 1 year default (%)$_{j,t}$	0.019	-0.024	0.033*
	(1.23)	(-1.38)	(1.80)
% **Condo loans**$_{j,t}$	-0.023***	-0.016**	-0.028***
	(-3.93)	(-2.19)	(-3.38)
Constant	0.041***	0.027***	0.032***
	(17.92)	(10.37)	(10.07)
Fixed effects	Zip code and state-origination year		
Cluster	state-origination year		
Observations	33,564	13,978	19,586
R-squared	0.406	0.344	0.421

Table 9 Do Condo Defaults Predict Single Family House Price Growth?

This table reports the zip code level analysis of the predictability of condo loan defaults on subsequent house price growth in the single family market. The original loan sample includes all condo and single family subprime loans with origination years between 2003 and 2007 in the BBX sample. We obtain the final sample in this analysis by aggregating to the zip code level and merging with zipcode-level price information from Zillow. $SF\ price\ growth\ (\%)_{j,t+1}$ is calculated as the (log) change in the Zillow zip code-level average transaction price in the single family market in year t+1. $Condo\ default\ (\%)_{j,t}$ ($SF\ subprime\ default\ (\%)_{j,t}$) is defined as the fraction of (within-two-year) loan defaults by condo (single family) borrowers in the same zip code in year t. $SF\ price_{j,t}$ refers to Zillow single family house price level in year t at the same zip code. $\%\ Condo\ Loans_{j,t}$ is the number of condo loans divided by the total number of single-family subprime and condo loans originated in year *t* in zip code *j*. We also include zip code and state-origination year fixed effects in all specifications and cluster the standard errors at state-origination year level. T-statistics are included in parentheses, and ***, ** and * indicate 1%, 5% and 10% significance, respectively.

	(1)	(2)	(3)
	SF price growth $(\%)_{j,t+1}$	**SF price growth** $(\%)_{j,t+1}$	**SF price growth** $(\%)_{j,t+1}$
	Full Sample	**Judicial foreclosure states**	**Non-Judicial foreclosure states**
Condo default $(\%)_{j,t}$	-0.075***	-0.053*	-0.083**
	(-2.81)	(-1.79)	(-2.33)
SF subprime default $(\%)_{j,t}$	-0.093***	-0.028	-0.128***
	(-3.41)	(-1.39)	(-3.47)
SF price$_{j,t}$	-0.000***	-0.000***	-0.000***
	(-6.52)	(-7.97)	(-4.01)
% **Condo Loans**$_{j,t}$	-0.001	-0.017	0.015
	(-0.11)	(-1.47)	(0.94)
Constant	0.281***	0.270***	0.216***
	(9.90)	(10.37)	(5.40)
Fixed effects		Zip code and state-origination year	
Cluster		state-origination year	
Observations	35,513	15,237	20,162
R-squared	0.814	0.831	0.803

Appendix

Table A1 Summary Statistics of Freddie Mac Full Sample

This table presents the summary statistics of the Freddie Mac sample. This dataset includes only single-family and condominium (condo) loans originated during the period 2003–2007. Panel A reports the results from aggregate-level summary statistics of the loans and compares the average values of the variables by full sample, single-family loans, and condo loans, respectively. Panel B shows the full sample summary statistics results by origination year. The variables with "D_" represent dummies. *D_default within 2 yrs* is equal to one for defaulting within two years of the loan origination date. *Current interest rate* refers to the coupon rate charged to the borrower for the most recent remittance period. *Log_Original loan balance* is defined as log of the amount of principal on the closing date of the mortgage. *FICO score* refers to the FICO (formerly the Fair Isaac Corporation) borrower credit score at the time of the loan closing. *Original LTV* means the ratio of the original loan amount to the property value at loan origination. *D_FRM* is equal to one for fixed-rate mortgages. *D_Owner occupied* takes one if the property is owner occupied. *Log_HPI* is log of the MSA-level quarterly FHFA/OFHEO House Price Index. *Log_Duration* is the log of the elapsed time from origination to the end of the sample period or to the first classification as being prepaid or delinquent at least 60 days. Note that ***, ** and * indicate 1%, 5% and 10% significance, respectively.

Panel A: Summary statistics for Freddie Mac: from 2003 to 2007				
	Total	**Condo**	**Single-Family (SF)**	**Diff. (Condo-SF)**
D_default within 2 yrs	1%	1%	1%	0%
FICO score	659	660	658	2***
Original LTV	75%	75%	75%	0***
Log_Original loan balance	11.91	11.87	11.91	-0.04***
Current interest rate	6.00	6.08	5.99	0.09***
D_Owner occupied	90%	78%	91%	-13%***
Log_HPI	5.19	5.24	5.18	0.06***
Log_duration	3.79	3.77	3.79	-0.02***
Sample Size (in thousands)	3,792	399	3,393	

Panel B: Summary statistics for Freddie Mac by loan origination year (2003–2007)

	Condo	SF	Diff.	Condo	SF	Diff.	Condo	SF	Diff.	Condo	SF	Diff.	Condo	SF	Diff.
Original Year	**2003**			**2004**			**2005**			**2006**			**2007**		
D_default within 2 yrs	0%	0%	0%***	0%	1%	0%***	0%	1%	0%***	1%	1%	0%***	3%	3%	0%**
FICO score	660	659	1***	659	658	1***	660	659	1***	660	659	1***	660	658	2***
Original LTV	74%	73%	1%***	75%	76%	-1%***	75%	75%	0%***	76%	76%	0%***	77%	77%	0%***
Log_Original loan balance	11.75	11.87	-0.12***	11.80	11.88	-0.08***	11.90	11.94	-0.04***	11.95	11.97	-0.02***	12.00	11.98	0.02***
Current interest rate	5.82	5.76	0.06***	5.89	5.85	0.04***	5.89	5.86	0.03***	6.46	6.44	0.02***	6.40	6.42	-0.02***
D_Owner occupied	82%	94%	-12%***	78%	91%	-13%***	77%	91%	-14%***	77%	90%	-13%***	76%	87%	-11%***
Log_HPI	5.27	5.19	0.08***	5.26	5.19	0.07***	5.22	5.17	0.05***	5.22	5.17	0.05***	5.20	5.15	0.05***
Log_duration	3.79	3.87	-0.08***	3.83	3.87	-0.04***	3.93	3.90	0.03***	3.72	3.64	0.08***	3.59	3.49	0.01***
Sample Size (in thousands）	106	1,153		67	628		75	630		75	494		76	488	