What Role Did Piggyback Lending Play in the Housing Bubble and Mortgage Collapse?

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Abstract

We examine the use of simultaneous close junior lien lending ("piggybacks") over the course of the recent housing bubble and subsequent mortgage market collapse. Using both state-level and Zip code-level data over the period 2001-2008, we find that the fraction of piggyback originations is related to higher foreclosure and default rates in subsequent years. This pattern, however, appears to be limited to the use subprime piggybacks, rather than a more general phenomenon. In addition, in subsequent versions of this paper, we will explore difficult issues of causality: did piggyback lending drive up house prices (the collapse of which then triggered higher foreclosure rates) or did accelerating house prices drive an increase in piggyback lending?

Key words: mortgage, foreclosure, housing, piggyback lending

1. Introduction

The current financial crisis had its origins in 2006 as house prices began to fall and the mortgage market experienced a sharp increase in subprime mortgage defaults and foreclosures. Numerous papers have studied the factors that contributed to the unprecedented increase in default and foreclosure rates. Irrational expectations regarding future house price growth, a proliferation of non-agency mortgage securitization, lax underwriting, and changing economic conditions are among the cited factors (Bajari et al. 2008; Doms et al. 2007; Keys et al. 2008, Mian and Sufi, 2008, Coleman, LaCour-Little, and Vandell 2008, among others).

One particular type of lending that grew rapidly during the recent housing boom is piggyback lending. Piggyback loans, more technically referred to as simultaneous close

seconds, are junior lien mortgage loans taken out concurrently with the first mortgage to finance the home purchase. These are generally used by homebuyers to finance more than 80 percent of the house value without paying private mortgage insurance, at least if the first lien is GSE-financed. Piggyback lending played an important role in home sales, especially from 2004 to 2006, and was involved in about 22 percent of the one-to-four family owner-occupied home purchases (Avery, 2007b). It is particularly popular in high-cost housing areas. For example, between 2004 and 2006, the number of piggyback loans issued in New York city more than tripled, resulting in more than 30 percent of the home purchase borrowers taking out a piggyback loan in 2006 (State of New York City's Housing and Neighborhoods Report, 2007). Similarly, about 37.3 percent of the Californian borrowers also used piggyback loans to finance home purchase in 2006 (Fishbein, 2006).

The rise of piggyback lending during 2000 to 2006 may also have contributed to the rise in default and foreclosure rates. Some have argued that piggyback lending enables households to take on too much debt via the purchase of inflated assets (WSJ, 2009), and therefore helped to further inflate the housing bubble. Once the bubble burst, it makes highly leveraged households at greater risk of negative equity and more vulnerable to default. The use of piggyback loans has been shown to be important in explaining the magnitude of negative equity (LaCour-Little et al., 2009). Piggyback loans also make the loan modification process more complicated because first-lien and junior-lien loans are packaged and sold to different portfolio securitization (Rosengren, 2008). Moreover, junior-lien lenders, if different from first-lien lenders, usually have little incentive in

modifying the loan to avoid foreclosure if there is no equity protecting them (The Washington Post, 2008).

In this paper, we study the relationship between the mortgage performance (delinquency, foreclosure and default rates) and homeowner piggyback borrowing patterns at both the state level and the Zip code level. We ask whether states and Zip codes with higher proportion of piggyback loans issued during 2001 to 2006 are associated with worse mortgage performance. Of particular interest, we distinguish among three types of piggyback lending: (1) prime first lien and prime second lien, (2) prime first lien and subprime second lien, (3) subprime first lien and subprime second lien, and further explore the difference in these three piggyback lending patterns in explaining state-level and Zip code-level mortgage performance.

The plan of the paper is as follows. In the next section, we review the limited research related to this topic. In the third section, we describe our data and empirical methodology, including our method for identifying piggyback loans from HMDA data. In the fourth section we present results of our empirical results. The final section concludes and provides suggestions for future research efforts.

2. Literature Review

Compared to other research on mortgage markets, junior lien lending is a relatively unexplored arena. The still narrower topic of piggyback lending has received even less rigorous research.

Beginning with the broader research on junior lien debt, Canner, Fergus, and Luckett (1988) describe the early stages and growth of the home equity lending segment,

following passage of the 1986 tax law changes which are generally acknowledged to have spurred this segment of consumer lending[1]. Canner and Luckett (1994) and Canner, Durkin, and Luckett (1998) update those findings, including SCF data showing home equity balances outstanding reached $110 billion by 1994. Weicher (1997) reviews the growth of the home equity lending industry during the 1990s, describing it as business based on recapitalizing borrowers with substantial housing equity but impaired credit. The only paper that we have been able to identify that directly addresses the determinants of home equity borrowing is Salandro and Harrison (1997), who use 1989 and 1992 SCF data, well before the dramatic increase in home equity lending occurred.

In more recent work, LaCour-Little (2004) argues that borrower's post-origination home equity borrowing dilutes their equity increasing the risk of default on the senior debt. Ambrose, Agrawal, and Liu (2005) show that patterns of home equity line use are also related to borrower credit quality, as measured by FICO score. Extending that analysis further, Agarwal, Ambrose, Chomsisengphet, and Liu (2006) examine the performance of home equity lines and loans, finding considerable difference in terms of default and prepayment risk. Unfortunately, as in most data on home equity lending, their data does not contain information about the underlying first mortgage loan, since first and junior debt is often held by different lenders, a pattern that may well apply to piggyback lending as well. LaCour-Little, Rosenblatt, and Yao (2009) report that roughly 80% of Southern California borrowers facing foreclosure during 2006-2008 had at least one junior lien outstanding, though information on the loans themselves is limited.

[1] Prior to 1986 most interest on consumer debt was tax-deductible; after 1986 tax law changes, only debt secured by residential mortgage debt remained generally deductible for those who itemize deductions.

Calhoun (2006b) develops a method for identifying piggyback loans from HMDA data. Calhoun (2006a) argues that simultaneous-close or "piggyback" transactions systematically raise risk throughout the mortgage finance system, yet present no loan performance data. Bernstein (2008), as well as others mentioned in the introduction, documents the increase in the use of piggyback lending over the period we study. Using American Housing Survey data, Bernstein (2008) reports that multiple-mortgage financing packages as a percent of newly originated mortgages increased from 14.8% in survey year 2001 to 21.5% in survey year 2007, corroborating the growth in this category documented by others.

Clearly considerable additional research is necessary to more completely understand this new market phenomenon, its causes, and its effects. Our effort here addresses this gap in the literature.

3. Data and Empirical Methodology

Data

To calculate the proportion of piggyback loans to total home purchase loan originations for each state and Zip code, we use Home Mortgage Disclosure Act (HMDA) data from 2001 to 2006. We first identify piggyback loans[2] from 204,523,725 loan applications obtained from the 2001-2006 HMDA Loan Application Register (LAR), using each of the methods proposed by Avery et al. (2007a) and Calhoun (2006a). To

[2] Details of the identification method are addressed later.

calculate the proportion of piggyback originations at the state level for a given year, we aggregate the number of piggybacks by state and year and divide it by the total number of home purchase loan originations. For Zip code-level piggyback originations, we calculate the piggyback originations at the census tract level first and then aggregate it to the Zip code using a database that matches census tract numbers with Zip codes from Missouri Census Data Center.[3] Because a given census tract can correspond to more than one Zip codes, we create a weight variable based on the share of housing units in each census tract that lie within a given Zip codes. Using this weight variable, we can calculate the weighted average piggyback originations at the Zip code level.[4]

For state-level loan performance measures, we use the state-level percentage of mortgage foreclosure inventory from 2001 to 2008, obtained from the Mortgage Banker's Association, as our proxy for state foreclosure rates. For Zip code-level loan performance measures, we use the Zip code proportion of noncurrent (delinquent and default) mortgages and the proportion of mortgages in default[5] from 2001 to 2008, obtained from the Equifax, as out proxy for Zip code delinquency and default rates.

We supplement the data with additional economic variables that may also affect loan performance. First, our state-level house price data from 2001 to 2008 come from

[3] We recognize that the HMDA data uses the 1990 census tract definitions before 2003 and the 2000 census tract definitions starting 2003. Therefore, we use a database that matches 1990 census tract numbers with Zip codes for data before 2003 and another database that matches 2000 census tract numbers with Zip codes for data on and after 2003. Both databases are available from Missouri Census Data Center.

[4] For example, census tract 1 has 500 housing units and 20% of the housing units are within Zip code A. Census tract 2 has 1,000 housing units and 15% of the housing units are within Zip code A. Census tract 1 has 100 piggyback originations and census tract 2 has 200 piggyback originations. For simplicity, Zip code A are solely composed of census tract 1 and 2. To calculate the piggyback origination for Zip code A, we first create a weight variable for census tract 1 and 2 based on the number of housing units of each census tract that lie within Zip code A. The weight for census tract 1 is 40% (500*20%/(500*20%+1,000*15%)) and the weight for census tract 2 is 60% (1,000*15%/(500*20%+1,000*15%)). We then calculate the weighted average piggyback originations for Zip code A as 100*40%+200*60%=160.

[5] A mortgage is coded as in default if it is more than 90 days past due, in bankruptcy status or in severe derogatory status.

Office of Federal Housing Enterprise Oversight (OFHEO, now the Federal Housing Finance Agency or FHFA). We use this data to calculate an annual house price appreciation rate. At Zip code level, we use First American Loan Performance Zip code Single Family Detached House Price Index to calculate house price appreciation rate. The Loan Performance House Price Index covers about 7,600 Zip Codes in the United States. Second, we use per capita income data from the Bureau of Economic Analysis. Third, we obtained state unemployment data from the Department of Labor Statistics. Since Zip code per capita income and unemployment data are unavailable, we use the MSA data as a proxy for the Zip code income and unemployment rate. Fourth, we supplement the Zip code level data with Zip code credit risk data obtained from Equifax.

Lastly, we use the Department of Housing and Urban Development's (HUD) list of subprime lenders to identify subprime loans in the HMDA data. We then aggregate the subprime loans by state and Zip code and calculate the proportion of subprime loan originations to total loan originations in a given year. Use of the HUD list is a somewhat crude proxy[6] and a better way to identify subprime loans is to use the spread-reportable threshold under the 2002 amendment to Regulation C. But, because the rate spread information was not available prior to 2004, we use the HUD list as alternative to measure the relative magnitude of subprime shares in different states. In our robustness tests, we will revisit our analysis for the periods 2004 and later using the rate-spread reportable definition for subprime loans. Detailed definitions of the key variables used in state-level and Zip code-level regressions and their sources are listed in Table 1.

[6] Because all loans made by a subprime lender will be classified as subprime loans and all loans made by a prime lender will be classified as prime loans.

[Table 1 about here]

Identification of Piggyback Loans

We use two methods to identify piggyback loans in the HMDA data. The first method is based on Avery et al. (2007a). Since information about lien status is only available starting in 2004, the identification process is a little different before 2004 and after 2004. Before 2004, we sort home purchase loans each year by state, county, census tract number, lender ID, owner-occupancy status, borrower income, race and sex. If we find two identical duplicates according to this set of matching factors, then the one with the smaller loan amount is identified as a piggyback loan. The basic assumption underlying this method is that if two home purchase loans involves a property in the same census tract and same owner occupancy status, borrowers with identical income, race and sex, and was issued by the same lender, then most likely these two loans are used for the purchase of the same home. After 2004, with the addition of lien status in HMDA, we separate the home purchase loans into two samples. The first sample includes all junior-lien purchase loans and the second sample includes all first-lien purchase loans. We then match the second sample to the first sample by census tract, lender ID, owner occupancy status, borrower income, race and ethnicity, and sex. If there is a match, then the matched junior-lien loan is identified as piggyback loans. One limitation of the Avery method is that it may underestimate the number of piggyback loans because it can not identify piggyback loans that are issued by different lenders from the first-lien lenders.

The second method follows Calhoun (2006b). The Calhoun approach is similar to that of Avery but recognizes the following two potential problems. First, piggyback loans may be issued by a different lender from the first-lien lender. Second, the lien statuses for loans that are purchased by the secondary market are usually missing. Calhoun (2006b) proposed a two-step matching procedure. The first step is similar to Avery et al. (2007a), that is, to find duplicates according to a set of matching factors. The duplicates are identified as piggyback combinations and are removed from the original data. In the second step, if the lien status is not missing, then the remaining data is sorted by state, county, census tract, borrower income, lien status, and loan amount. Duplicates with identical values of applicant income are identified as piggyback combinations and removed from the data. If the lien status is missing, then the remaining data is sorted by state, county, census tract, borrower income, and loan amount. Calhoun then calculated the ratio of the lower loan amount to higher loan amount for the duplicates. If the ratio falls into certain range that are consistent with the piggyback loan structure (such as 80-20-0 structure, or 80-10-10 structure, etc), then the duplicates are identified as piggyback combinations. In the second step of this two-step matching, the matching factors do not include lender ID. The relaxation of the same lender assumption helps to identify additional piggyback combinations that are issued by different lenders.

After identifying the piggyback loans, we use HMDA data to further distinguish among three different types of piggyback combinations: first-lien prime and second-lien prime, first-lien prime and second-lien subprime, first-lien subprime and second-lien subprime.[7] A loan is coded as subprime if it is a spread-reportable under HMDA.[8]

[7] While theoretically there could be a fourth type (first-lien subprime and second-lien prime), we do not examine these separately given their very low frequency.

Because the spread-reportable information is not available prior to 2004, we can distinguish among different types of piggyback loans only after 2004.

Regression Model

We use both a simple OLS regression model and logistic regression to examine the relationship between loan performance and percentage of piggyback originations. Both regressions are conducted at the state level and Zip code level. The state-level OLS regression model may be specified as follows.

$$Foreclosure_{i,t} = \alpha + \beta Piggylag_{i,t} + \delta Lnincome_{i,t} + \varphi Unemploy_{i,t} + \lambda Pctsubprime_{i,t} + \eta Hpigrowthlag_{i,t} + \varepsilon_{i,t} \quad (1)$$

Where the dependant variable $Foreclosure_{i,t}$ is the foreclosure rate in state i in year t. The first explanatory variable, *Piggylag,* is the lagged percentage of piggyback loan originations to total purchase loan originations in the state. We employ different lags for states with non-judicial versus judicial foreclosure procedures. Because the national average time between the due date of last mortgage payment and the foreclosure sale is about one year (Crew Cutts and Merrill, 2008) and default rates peak around 30 months after subprime loan origination (Pennington-Cross and Ho, 2006), we choose a minimum of two-year lag for the piggyback loan originations. Moreover, studies (Pence, 2006; and Wood, 1997) have shown that judicial foreclosure takes much longer than non-judicial foreclosure. Wood (1997) finds that judicial foreclosure takes about 148 days longer, on

[8] Spread-reportable loans are loans for which the difference between the loan's estimated APR and a comparable maturity U.S. Treasury security is equal to or greater than 3 percentage points for first-lien loans or 5 percentage points for subordinate-lien loans.

average, than non-judicial procedures. To address this difference, we choose a two-year lag for the effect of piggyback loan originations for states with non-judicial foreclosure procedures and a three-year lag for states with judicial foreclosure procedures. Other explanatory variables in the regression model include: (2) *Lnincome*, the log of state per-capita income; (3) *Unemploy*, state unemployment rate; (4) *Pctsubpirmelag,* lagged percentage of subprime loan originations to total loan originations in the state; and (5) *Hpigrowthlag*, one-year lagged state house price appreciation rate.

The Zip code-level OLS regression model is similar to the state-level model and is specified as follows.

$$\begin{aligned} Performance_{i,t} = \alpha + \beta Piggylag_{i,t} + \delta Lnincome_{i,t} + \varphi Unemploy_{i,t} \\ + \lambda Pctsubprime_{i,t} + \eta Hpigrowthlag_{i,t} \\ + \gamma_1 PCT740 + \gamma_2 PCT680to739 + \gamma_3 PCT620to679 + \varepsilon_{i,t} \end{aligned} \quad (2)$$

Where the dependant variable $Performance_{i,t}$ is the proportion of noncurrent mortgages, or the proportion of defaulted mortgages in Zip code *i* in year *t*. The explanatory variables are similar as those in the state-level regressions, except that we added three more variables to capture the Zip code credit risk. The three credit risk variables are: (6) *PCT740*, the proportion of consumers in the Zip code with credit score above 740; (7) *PCT680to739*, the proportion of consumers in the Zip code with credit score between 680 and 739; and (8) *PCT620to679*, the proportion of consumers in the Zip code with credit score between 620 and 679. The inclusion of Zip code credit risk variables will make the results more convincing.

Because the dependant variable measures the frequency of occurrence, $Foreclosure_{i,t}$ and $Performance_{i,t}$, are bounded at 0 and 100 percent, coefficients estimated by the OLS regression model may be biased. To address this issue, we employ a logit transformation of the dependent variable. The state-level logistic regression model is specified as follows.

$$\log\left(\frac{Foreclosure_{i,t}}{1-Foreclosure_{i,t}}\right) = \alpha + \beta Piggylag_{i,t} + \delta Lnincome_{i,t} + \varphi Unemploy_{i,t} + \lambda Pctsubprime_{i,t} + \eta Hpigrowthlag_{i,t} + \varepsilon_{i,t} \quad (3)$$

The Zip code-level logistic regression model is specified as follows.

$$\log\left(\frac{Performance_{i,t}}{1-Performance_{i,t}}\right) = \alpha + \beta Piggylag_{i,t} + \delta Lnincome_{i,t} + \varphi Unemploy_{i,t} + \lambda Pctsubprime_{i,t} + \eta Hpigrowthlag_{i,t} + \gamma_1 PCT740 + \gamma_2 PCT680to739 + \gamma_3 PCT620to679 + \varepsilon_{i,t} \quad (4)$$

In the empirical results discussed in the next section, we estimate models using both the OLS and logit approaches. While coefficient magnitudes vary, qualitative results are generally similar.

4. Empirical Results

Descriptive Statistics

Table 2 reports summary statistics for our dependent and key control variables. We report the summary statistics for variables used in the state-level regressions in panel A and the summary statistics for variables used in the Zip code-level regressions in Panel B.

[Table 2 about here]

The average state foreclosure rate is 1.435% from 2001-2008 based on Mortgage Banker's Association state foreclosure rates. Using the Equifax loan performance data, the average percentage of noncurrent mortgage loans and the average percentage of defaulted mortgage loans at the Zip code level are 4.16% and 2.32% respectively. In both panels, we find that the proportions of piggyback originations calculated using the Avery (2007a) method and Calhoun (2006) method are similar, with the Calhoun piggyback measure slightly higher than the Avery measure. We also included three credit risk control variables at the Zip code level. On average, the Zip code proportions of consumers with Equifax credit score higher than 740, between 680 and 739, between 620 and 679 are 44.98%, 17.48% and 13.33% respectively over the 2001-2008 period.

Panel C and D of table 2 show the changes in loan performance measures and piggyback originations before and after 2004 at the state and Zip code level. The average state foreclosure rate and average Zip code proportion of noncurrent and default loans are

much higher in the 2005-2008 period than in the 2001-2004 period. Examining the proportion of piggyback originations, we find that there is a rapid growth in piggyback originations after 2004. Using the Calhoun measure, the average proportion of state piggyback originations more than doubled from 5.030% in the 2001-2004 period to 10.396% in the 2005-2008 period, and the average proportion of Zip code piggyback originations also more than doubled from 4.602% in the 2001-2004 period to 9.828% in the 2005-2008 period.

To explore the correlations among the variables, we present a correlation matrix in Table 3. Panel A shows the correlation coefficients of variables used in the state-level regressions and Panel B shows the correlation coefficients of the variables used in the Zip code-level regressions. We use both the Avery and Calhoun methods to calculate the proportion of piggyback originations. At the state level, we find that lagged piggyback origination is significantly positively correlated with foreclosure rates. At the Zip code level, we find that the lagged piggyback origination is significantly positively correlated with the Zip code proportion of noncurrent mortgages and defaulted mortgages. These coefficients suggest that states and Zip codes with higher proportion of piggyback originations are associated with worse mortgage performance in later years. Interestingly, examining the correlation coefficients between house price appreciation (*Hpigrowth*) and percentage of piggyback originations, we find that the correlation coefficients between the house price appreciation and current piggyback origination are significantly positive, while the correlation coefficients between the house price appreciation and lagged piggyback origination are significantly negative at both the state and Zip code levels.

This suggests that piggyback originations may temporarily support housing prices but are associated with lower house price appreciation rate over a longer period.

[Table 3 about here]

To further explore the relationship between foreclosure rates and piggyback originations, we present scatter plots in Figure 1. We sort the 50 states and D.C. into five quintiles based on the average proportion of piggyback originations from 2004-2006, to see whether there is any difference in states with low concentration of piggyback originations and high concentration of piggyback originations. Figure 1 plots the state foreclosure rates on lagged percentage of piggyback originations. For all states and five quintiles of states, there seems to be a positive relationship between foreclosure rates and piggyback originations. Comparing quintile 1 (states with lowest percentage of piggyback originations) with quintile 5 (states with highest percentage of piggyback originations), it is evident that the slope of quintile 5 is much steeper than the slope of quintile 1. This may suggest that the positive relationship between foreclosure rates and piggyback originations are much stronger for states with large piggyback originations than for states with low piggyback originations.

[Figure 1 about here]

We then examine the pattern of state foreclosure rates during 2001-2008 in Figure 2. For all states and all five quintiles, foreclosure rates declined from 2001 to 2005 and

then sharply increased after 2006. Comparing quintile 1 with quintile 5, we find that the foreclosure rate for quintile 5 was generally lower than that for quintile 1 before 2006. However, the increase in foreclosure rate starting 2006 is much larger for quintile 5 than for quintile 1, suggesting that states with large piggyback originations experience a much sharper rise in foreclosure rates than states with low piggyback originations.

[Figure 2 about here]

To summarize, the descriptive statistics shows a large increase in piggyback originations. The correlation matrix and the figures further show that previous years' high level of piggyback originations is associated with worse loan performance in subsequent years. In the next subsection, we employ regression method to further investigate the strength of this relationship.

Regression Results

Overall Piggyback Originations and Mortgage Performance

We examine how overall (all types of) piggyback originations is related to mortgage performance at both the state and Zip code levels. Table 4 shows how the percentage of overall piggyback originations is related to the state foreclosure rates. Panel A and B present results where the piggyback loans are identified using the Avery method and the Calhoun method, respectively. There are six specifications for each

panel. Specification 1 and 2 only include lagged percentage of piggyback originations as the independent variable. Specification 3 and 4 include log per capita income, unemployment rate, and proportion of subprime originations as additional explanatory variables. Specification 5 and 6 add one more variable -- lagged house price appreciation rate. Specification 1, 3, and 5 use OLS regression models, while specification 2, 4 and 6 use Logistic regression models.

[Table 4 about here]

For all six specifications and measures of piggyback originations, the coefficients on lagged percentage of piggyback originations are significantly positive, though the magnitude of the coefficients varies. In Panel A specification 5, the coefficient on lagged percentage of piggyback originations is 0.061 and significant at 1% level, suggesting that a 1% increase in piggyback originations will lead to a 0.061% increase in foreclosure rates. If one state has a 5% piggyback originations and another has a 15% piggyback originations in previous 2 or 3 years, this will imply a 0.61% difference in foreclosure rates in 2008. Given the average foreclosure rates in 2008 is 2.49%, this is also an economically significant difference. In Panel A specification 6, the coefficient on lagged percentage of piggyback origination represents the difference in log odds of foreclosure rates. Since the coefficient is 0.021 and significant at 5% level, it can be interpreted that a 1% increase in piggyback originations in the previous years will increase the foreclosure log odds by 2.1%, or increase the foreclosure odds ratio by 2.1% (exp(0.021)=1.021). Therefore, if one state has a 5% piggyback originations and another

has a 15% piggyback originations in previous 2 or 3 years, the state with 15% piggyback originations will have a 23.37% (exp(0.21)=1.2337) increase in foreclosure odds ratio than the state with 5% piggyback originations. Examining the other explanatory variables, we find that foreclosure rates are higher in states with higher unemployment rate, higher percentage of subprime originations, and lower house price appreciation in the previous year. These results seem intuitive.

Table 5 shows how the Zip code overall piggyback originations is related to the mortgage performance measures, the proportion of noncurrent mortgages and the proportion of default mortgages. We use Avery piggyback measures in Panel A and Calhoun piggyback measures in Panel B.

[Table 5 about here]

The Zip code-level regression results are qualitatively similar to the state-level results. For all specifications, higher proportion of piggyback originations is associated with higher proportion of noncurrent mortgages and higher proportion of default mortgages in subsequent years. Moreover, the coefficients on the credit risk measures suggest that Zip codes with better credit quality, as measured by higher proportion of consumers with credit score above 620, 680 or 740, have lower proportions of noncurrent and default mortgages.

Different Types of Piggyback Originations and Mortgage Performance

Last but not least, we examine whether different types of piggyback lending have different impact on foreclosure rates. We distinguish between three types of piggyback lending: first-lien prime and second-lien prime, first-lien prime and second-lien subprime, and first-lien subprime and second-lien subprime. Figure 3 shows the relative size and trend in these three types of piggyback lending from 2004 to 2006.

[Figure 3 about here]

The state-level regression results are summarized in Table 6 and Table 7. Table 6 uses the Avery method to identify piggyback loans and Table 7 uses the Calhoun method to identify piggyback loans. Both tables include three panels (A, B and C) which present results for the three types of piggyback lending.

[Table 6 about here]

[Table 7 about here]

In general, the results from Table 6 and Table 7 are very similar. Therefore, we only discuss the results in Table 7 using the Calhoun method. We find that the coefficients on the lagged percentage of piggyback originations are significant and negative for first-lien prime and second-lien prime piggyback lending across all

specifications in Panel A of Table 7. This suggests that piggyback lending itself is not necessarily associated with higher foreclosure rates. If both the first- and second-lien loans are carefully underwritten low-cost prime loans, piggyback lending is not associated with higher foreclosure rates in later years.

However, Panel B and C of Table 7 present a very different picture. In specification 5 and 6 of Panel B, higher proportion of piggyback lending to first-lien prime and second-lien subprime borrowers are associated with higher foreclosure rates in later years. In Panel C, the coefficients on lagged percentage of piggyback originations for first-lien subprime and second-lien subprime are significant and positive across all six specifications. Interestingly, the magnitude of the coefficient is much larger for first-lien prime second-lien subprime piggyback loans than for first-lien subprime second-lien subprime piggyback loans. In specification 5 and 6 of Panel B, the coefficients on *Piggylag* are 0.392 and 0.096, suggesting that a 1% increase in first-lien prime and second-lien subprime piggyback originations will lead to a 0.392% increase in foreclosure rates and a 10.08% increase in foreclosure odds ratio two or three years later. In specification 5 and 6 of Panel C, the coefficients on *Piggylag* are 0.143 and 0.054, suggesting that a 1% increase in first-lien subprime and second-lien subprime piggyback originations will lead to a 0.143% increase in foreclosure rates and a 5.5% increase in foreclosure odds ratio two or three years later. Therefore, it is first-lien prime and second-lien subprime piggyback loans that seem to have the strongest association with foreclosure rates. One interpretation might be that subprime seconds allowed otherwise prime borrowers to over leverage using piggybacks. We speculate that such loans might have been used for investment purposes further elevating default risk. Using the HMDA

data, we do find that a much higher proportion of first-lien prime and second-lien subprime piggybacks were used to purchase non-owner occupied housing units than the other two types of piggybacks. For example, for the total number of first-lien prime and second-lien subprime piggyback originations during 2005 and 2006, about 16.39% of these loans were used for non-owner occupied housing purchase.[9] However, only 8.22% of the first-lien prime and second-lien prime and 6.97% of the first-lien subprime and second-lien subprime piggybacks were used for non-owner occupied housing purchase during the same period.

We also examine the relationship between different types of piggyback lending and loan performance at the Zip code level. Tables 8 and 9 present Zip code regression results using the Avery and Calhoun piggyback measures.

[Table 8 about here]

[Table 9 about here]

Similar to the state level results, higher proportions of first-lien prime second-lien subprime and first-lien subprime second-lien subprime piggyback originations are associated with higher percentage of noncurrent and default mortgages in later years. This association is strongest for first-lien prime second-line subprime piggybacks. However, first-lien prime and second-lien prime piggyback originations are not associated with worse loan performance, further confirming the state-level results.

[9] The remaining 83.61% of the first-lien prime and second-lien subprime piggyback originations were either used for owner-occupied housing purchase or had "not applicable" status.

Results in tables 6, 7, 8 and 9 provide strong evidence that piggyback lending to subprime second-lien borrowers, but not to prime second-lien borrowers, is related to high foreclosure rates in subsequent years. Therefore, it is not the piggyback structure itself, but the relatively high risk and high cost subprime piggyback lending that is related to higher foreclosure rates in the future. Of course, the nature of the causality is at this point unclear. Did use of piggyback loans drive up housing prices the subsequent collapse of which triggered higher foreclosure rates? Or was piggyback lending merely a response to rapidly rising house prices? We have more work to do on these questions.

Robustness Tests

To check the robustness of our regression results, we conduct the following tests. First, we revisit our state and Zip code level analysis for periods 2004 and later using the rate-spread reportable definition for subprime loans. Second, we reran our Zip code level regressions by replacing the MSA per capita income and unemployment rate with the state per capita income and unemployment rate. This is because we lost many observations while matching the MSA per capita income and unemployment rate to the Zip codes.[10] By replacing the MSA income and unemployment data with state data, we reduce the missing observations to a minimum. Third, in the Zip code regressions, we do not distinguish between judicial and non-judicial states and use a 2-year lag for all Zip codes. Fourth, instead of using the lagged piggyback originations based on the judicial status of the state, we examine the relationship between loan performance of 2007-2008

[10] According to a database that matches Zip codes to MSA numbers provided by Missouri Census Data Center, about 28% of the Zip codes cannot be matched to MSAs.

and piggyback originations during 2001-2006, at both the state level and Zip code level. All our previous results hold in any of the four robustness tests. The robustness results are available upon request.

5. Conclusions and Future Research

Although the results of this study are far from conclusive, they nonetheless suggest that piggyback lending is associated with higher default and foreclosure rates in later years. Moreover, not all types of piggyback lending have the same impact on default or foreclosure rates. The relatively low risk and low-cost piggyback loans issued to prime first-lien and prime second-lien borrowers are not associated with high default or foreclosure rates. It is the high-cost piggyback loans issued to subprime second-lien borrowers that are related to higher default or foreclosure rates in subsequent years, regardless of whether the first-lien loan is prime or subprime. Specifically, a 1% increase in first-lien prime and second-lien subprime piggyback originations are associated with a 0.392% increase in foreclosure rates and a 10.08% increase in foreclosure odds ratio in later years. Furthermore, a 1% increase in first-lien subprime and second-lien subprime piggyback originations are associated with a 0.143% increase in foreclosure rates and a 5.5% increase in foreclosure odds ratio in later years. Similar results are found default rates. The strong association between prime first-lien subprime second-lien piggybacks and worse loan performance suggests that subprime seconds allowed prime borrowers to over leverage using piggybacks. There is some evidence that this may be related to purchase of non-owner occupied housing, as well.

We plan to extend the current study in the following ways. First, we will supplement the current data with more variables that may affect the foreclosure rates, such as the proportion of owner-occupied housing units, etc. Second, we plan to further explore the dynamics among foreclosure rates, house price appreciation and piggyback loan originations and use the appropriate econometric technique to disentangle the lead-lag relationships among these variables.

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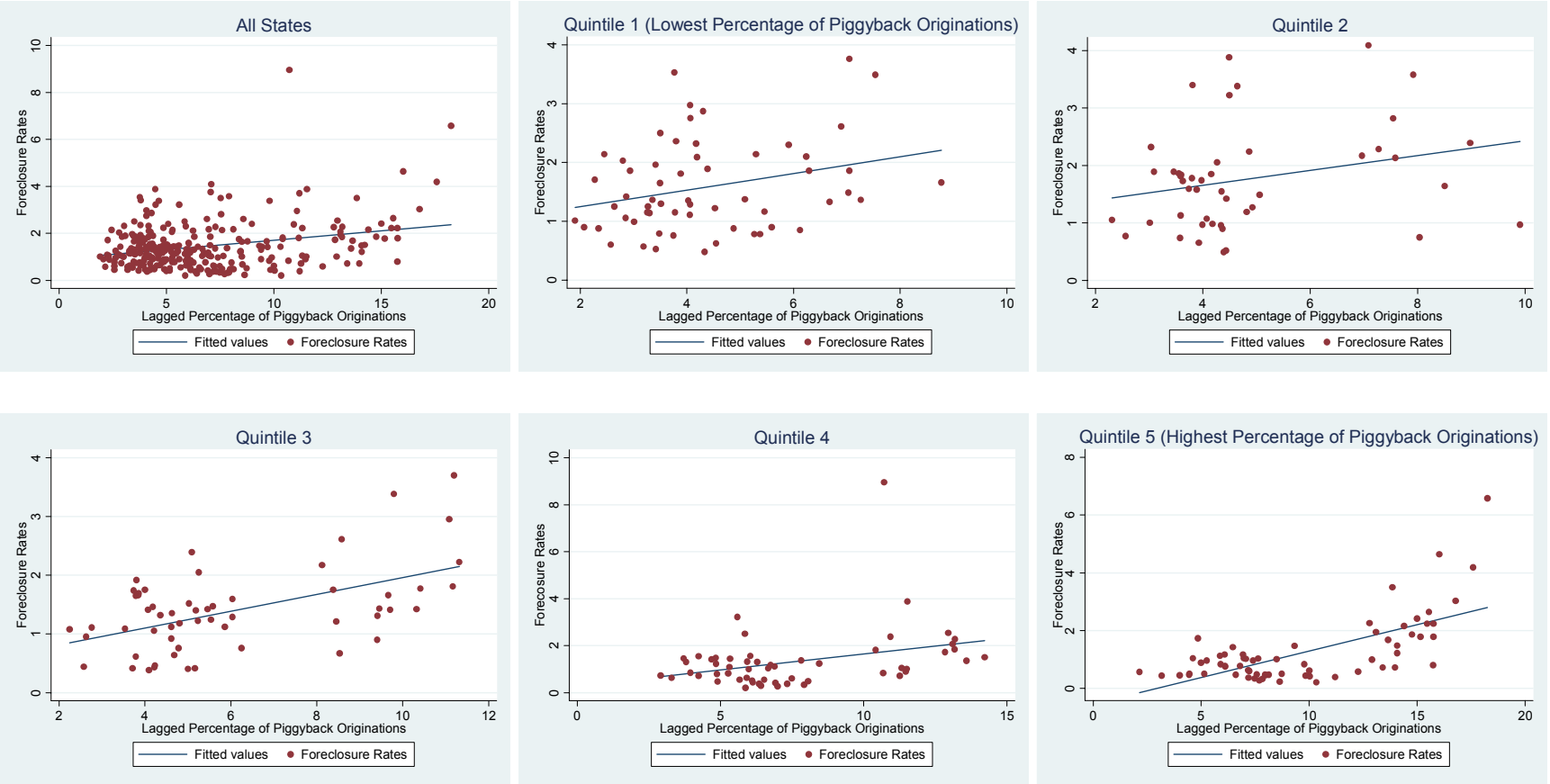
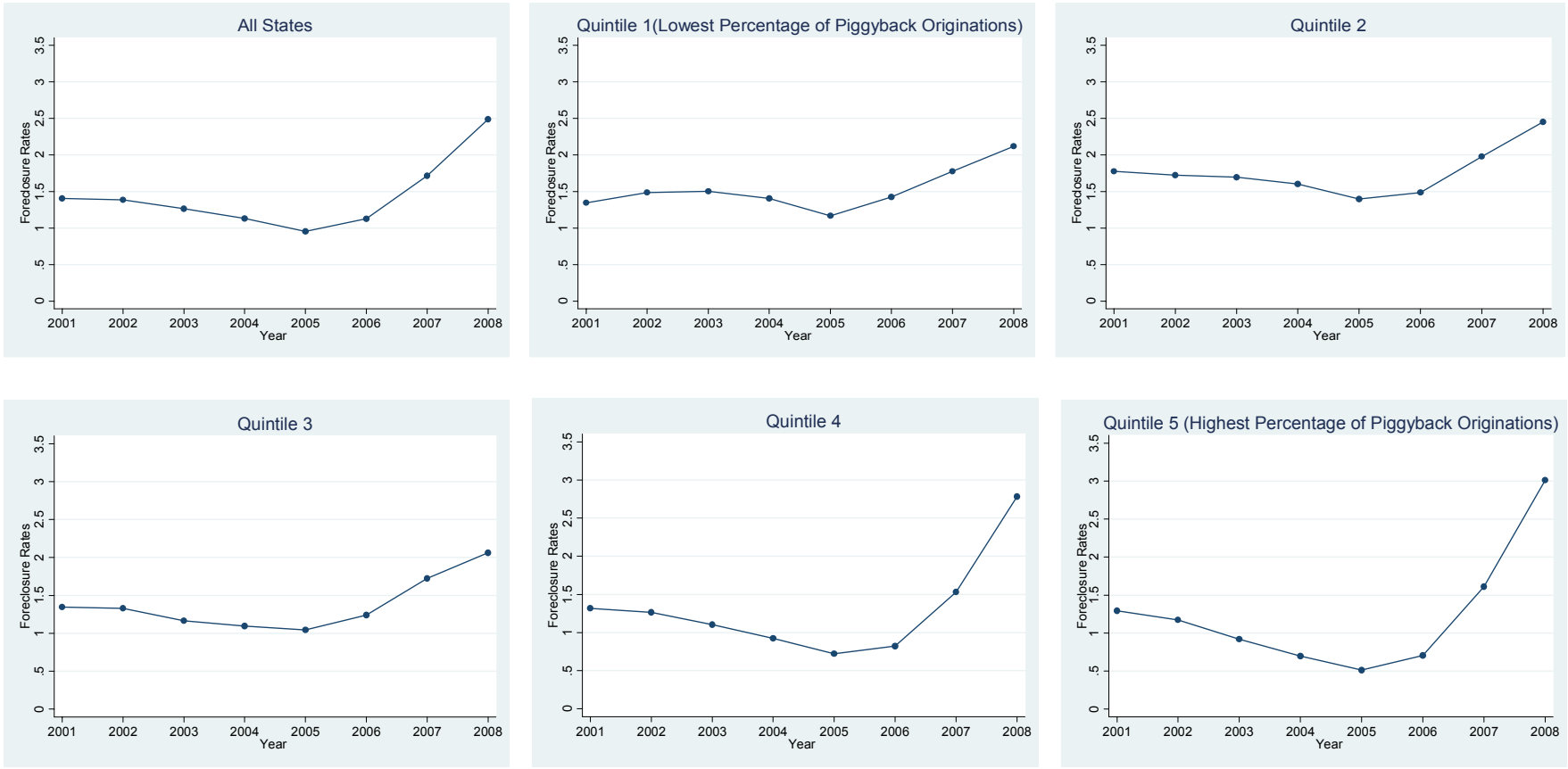
Figure 1
State Foreclosure Rates and Lagged Piggyback Originations



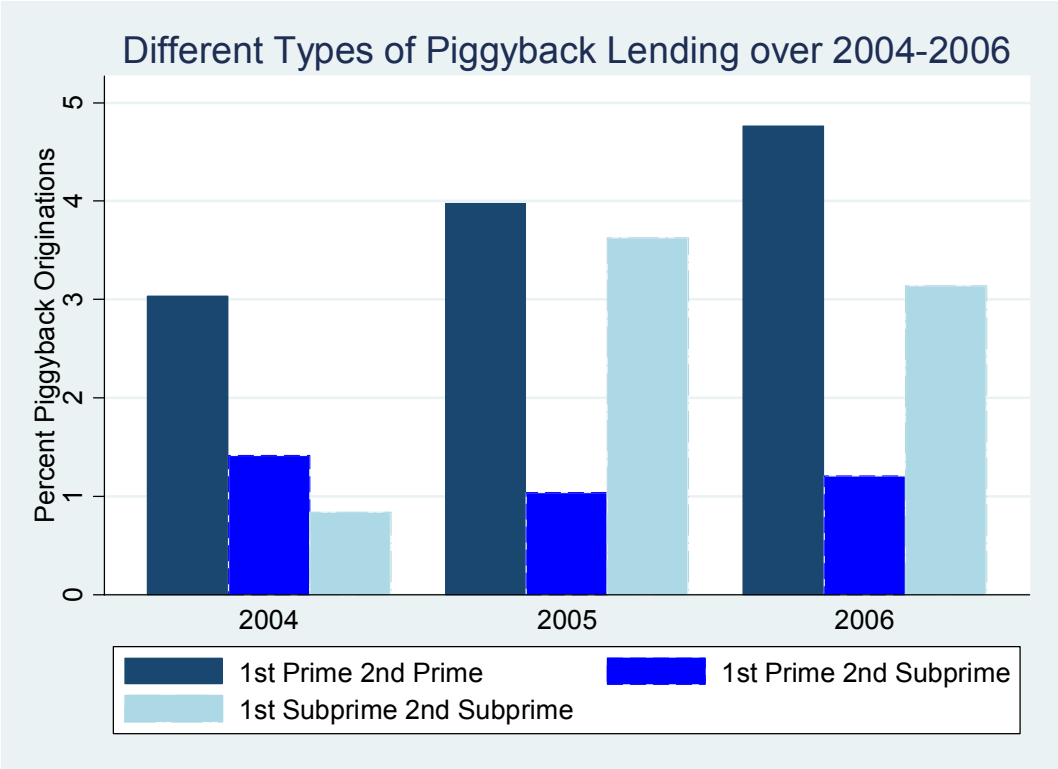
These figures present correlations between state foreclosure rates from 2001 to 2008 and lagged percentage of piggyback originations to total purchase loan originations from 2001 to 2006 for all states and five quintiles of states. We use a two year lag for states with non-judicial foreclosure procedures and a three year lag for states with judicial foreclosure procedures. The five quintiles of states are constructed based on the average percentage of piggyback loan originations from 2004 and 2006. Quintile 1 has the lowest percentage of piggyback originations and quintile 5 has the highest percentage of piggyback originations.

Figure 2
State Foreclosure Rates from 2001 to 2008



These figures present state foreclosure rates during the time period 2001 to 2008 for all states and five quintiles of states. The five quintiles of states are constructed based on the average percentage of piggyback loan originations from 2004 and 2006. Quintile 1 has the lowest percentage of piggyback originations and quintile 5 has the highest percentage of piggyback originations.

Figure 3
Different Types of Piggyback Lending over 2004-2006



This figure presents the percentage of piggyback originations to total purchase originations for three types of piggyback lending: (1) first-lien prime and second-lien prime; (2) first-lien prime and second-lien subprime; and (3) first-lien subprime and second-lien subprime, over the time period 2004-2006.

Table 1: Variable Definitions

Panel A: State-level Regression

Variable	Definition	Source
Foreclosure	State foreclosure rate	Mortgage Banker's Association
Piggyback	Proportion of piggyback loan originations to total purchase loan originations	HMDA
Piggylag	Two-year lag of piggyback for states with non-judicial foreclosure procedures and three-year lag of piggyback for states with judicial foreclosure procedures	HMDA
Hpigrowth	House price appreciation rate	OFHEO
Hpigrowthlag	One-year lag of house price appreciation rate	OFHEO
Lnincome	Log of state per capita income	Bureau of Economic Analysis
Unemploy	State unemployment rate	Bureau of Labor Statistics
Pctsubprimelag	Two-year lag of the proportion of subprime loan originations to total loan originations	HMDA and HUD

Panel B: Zip Code-level Regression

Variable	Definition	Source
Noncurrent	Proportion of noncurrent (delinquent and default) mortgage loans to total number of mortgage loans in a given Zip Code	Equifax
Default	Proportion of defaulted mortgage loans to total number of mortgage loans in a given Zip Code	Equifax
Piggyback	Proportion of piggyback loan originations to total purchase loan originations in a given Zip Code	HMDA
Piggylag	Two-year lag of piggyback for states with non-judicial foreclosure procedures and three-year lag of piggyback for states with judicial foreclosure procedures[11]	HMDA
Hpigrowth	Zip Code house price appreciation rate	First American Loan Performance
Hpigrowthlag	One-year lag of house price appreciation rate	First American Loan Performance
Lnincome	Log of MSA per capita income	Bureau of Economic Analysis
Unemploy	MSA unemployment rate[12]	Bureau of Labor Statistics
Pctsubprimelag	Two-year lag of the proportion of subprime loan originations to total loan originations in a given Zip Code	HMDA and HUD
Pct740	Proportion of consumers with credit score above 740 in a given Zip Code	Equifax
Pct680to739	Proportion of consumers with credit score between 680 and 739 in a given Zip Code	Equifax
Pct620to679	Proportion of consumers with credit score between 620 and 679 in a given Zip Code	Equifax

This table summarizes the key variables and data sources used in our regression analysis. Panel A summarizes the key variables and data sources used in our state-level regressions. Panel B summarizes the key variables and data sources used in our Zip code-level regressions.

[11] We also used a 2-year lag for all Zip codes in the robustness tests.
[12] We also tried state per capita income and unemployment rate in the robustness tests.

Table 2: Summary Statistics

Panel A: Summary Statistics for Variables used in State-level Regressions

Variables	N	Mean	SD	10th	50th	90th
Foreclosure	408	1.435	0.894	0.520	1.300	2.380
Piggyback (Avery)	306	6.373	3.001	3.271	5.676	11.360
Piggyback (Calhoun)	306	6.818	3.470	3.412	5.930	12.267
Piggylag (Avery)	284	6.267	3.059	3.243	5.380	11.416
Piggylag (Calhoun)	284	6.658	3.519	3.299	5.557	12.796
Hpigrowth	408	5.914	6.465	-0.546	5.219	13.141
Hpigrowthlag	357	7.201	5.495	2.080	5.761	13.457
Lnincome	408	10.401	0.180	10.173	10.390	10.632
Unemploy	408	4.961	1.131	3.500	4.900	6.500
Pctsubprimelag	306	19.431	4.825	13.676	19.244	26.375

Panel B: Summary Statistics for Variables used in Zip Code-level Regressions

Variables	N	Mean	SD	10th	50th	90th
Noncurrent	36,592	4.16	3.32	1.08	3.28	8.31
Default	36,592	2.32	2.28	0.35	1.70	4.93
Piggyback (Avery)	22,959	5.87	3.51	2.06	5.16	10.78
Piggyback (Calhoun)	22,959	6.25	3.91	2.10	5.35	11.89
Piggylag (Avery)	21,146	5.75	3.54	2.00	4.95	10.74
Piggylag (Calhoun)	21,146	6.07	3.92	2.04	5.08	11.83
Hpigrowth	36,592	5.08	8.79	-5.47	4.46	17.21
Hpigrowthlag	32,018	6.46	8.28	-2.71	5.49	18.22
Lnincome	36,592	10.42	0.18	10.20	10.42	10.64
Unemploy	36,592	5.17	1.33	3.70	5.00	6.60
Pctsubprimelag	22,378	18.59	8.96	8.51	17.34	30.60
Pct740	36,592	44.98	13.32	26.68	45.63	61.90
Pct680to739	36,592	17.48	2.92	13.92	17.44	21.10
Pct620to679	36,592	13.33	3.13	9.36	13.33	17.24

Panel C: State Mortgage Performance and Piggyback Originations before and after 2004

2001-2004

Variables	N	Mean	SD	10th	50th	90th
Foreclosure	204	1.297	0.605	0.590	1.270	2.020
Piggyback (Avery)	204	4.905	1.746	3.009	4.476	7.409
Piggyback (Calhoun)	204	5.030	1.872	3.009	4.538	7.648

2005-2008

Variables	N	Mean	SD	10th	50th	90th
Foreclosure	204	1.572	1.095	0.470	1.355	2.820
Piggyback (Avery)	102	9.308	2.833	6.299	9.057	13.584
Piggyback (Calhoun)	102	10.396	3.150	6.968	9.854	14.997

Panel D: Zip Code Mortgage Performance and Piggyback Originations before and after 2004

2001-2004

Variables	N	Mean	SD	10th	50th	90th
Noncurrent	18,296	3.776	2.776	1.038	3.092	7.368
Default	18,296	1.991	1.872	0.283	1.519	4.203
Piggyback (Avery)	15,701	4.506	2.439	1.770	4.101	7.824
Piggyback (Calhoun)	15,701	4.602	2.524	1.798	4.159	8.016

2005-2008

Variables	N	Mean	SD	10th	50th	90th
Noncurrent	18,296	4.540	3.741	1.133	3.498	9.228
Default	18,296	2.640	2.576	0.426	1.909	5.713
Piggyback (Avery)	7,258	8.829	3.661	4.442	8.575	13.636
Piggyback (Calhoun)	7,258	9.828	3.998	5.019	9.593	15.188

This table presents summary statistics for the key variables used in our analysis. Panel A reports summary statistics for the variables used in the state-level regressions and Panel B report the summary statistics used in the Zip code-level regressions. Panel C reports the state-level mortgage performance and piggyback originations during the 2001-2004 and 2005-2008 periods. Panel D reports Zip code-level mortgage performance and piggyback originations during 2001-2004 and 2005-2008, respectively.

Table 3: Correlation Matrix

Panel A: Correlation Matrix for State level Variables

	Foreclosure	*Piggyback (Avery)*	*Piggyback* (Calhoun)	*Piggylag* (Avery)	*Piggylag (Calhoun)*	*Hpigrowth*	*Hpigrowthlag*	*Lnincome*	*Unemploy*	*Pctsubprimelag*
Foreclosure	1.000									
Piggyback (Avery)	-0.405*** *0.000*	1.000								
Piggyback (Calhoun)	-0.398*** *0.000*	0.992*** *0.000*	1.000							
Piggylag (Avery)	0.259*** *0.000*	0.746*** *0.000*	0.736*** *0.000*	1.000						
Piggylag (Calhoun)	0.283*** *0.000*	0.757*** *0.000*	0.753*** *0.000*	0.993*** *0.000*	1.000					
Hpigrowth	-0.689*** *0.000*	0.272*** *0.000*	0.275*** *0.000*	-0.395*** *0.000*	-0.434*** *0.000*	1.000				
Hpigrowthlag	-0.635*** *0.000*	0.537*** *0.000*	0.547*** *0.000*	-0.133** *0.025*	-0.148** *0.012*	0.698*** *0.000*	1.000			
Lnincome	-0.002 *0.962*	0.485*** *0.000*	0.480*** *0.000*	0.406*** *0.000*	0.396*** *0.000*	-0.069 *0.164*	0.189*** *0.000*	1.000		
Unemploy	0.336*** *0.000*	-0.104* *0.069*	-0.128** *0.026*	-0.020 *0.735*	-0.026 *0.660*	-0.155*** *0.002*	-0.293*** *0.000*	-0.093* *0.061*	1.000	
Pctsubprimelag	0.246*** *0.000*	0.059 *0.406*	0.105 *0.136*	-0.151** *0.011*	-0.144** *0.016*	-0.115** *0.045*	-0.001 *0.993*	-0.135** *0.018*	-0.026 *0.654*	1.000

This table shows the correlation coefficient estimates with the relevant *p*-values in italic for the key variables in our state-level regression analysis. The variables *Piggyback* and *Piggylag* are calculated using the method proposed by Avery (2007a) and Calhoun (2006). We use ***, **, and * to denote significance at the 1%, 5%, and 10% level.

Panel B: Correlation Matrix for Zip Code-level Variables

	Noncurrent	*Default*	*Piggyback (Avery)*	*Piggyback (Calhoun)*	*Piggylag (Avery)*	*Piggylag (Calhoun)*	*Hpigrowth*	*Hpigrowthlag*	*Lnincome*	*Unemploy*	*Pctsubprimelag*	*Pct740*	*Pct680to739*	*Pct620to679*
Noncurrent	1.000													
Default	0.879***	1.000												
	0.000													
Piggyback	-0.118***	-0.100***	1.000											
(Avery)	*0.000*	*0.000*												
Piggyback	-0.126***	-0.105***	0.984***	1.000										
(Calhoun)	*0.000*	*0.000*	*0.000*											
Piggylag	0.133***	0.090***	0.587***	0.607***	1.000									
(Avery)	*0.000*	*0.000*	*0.000*	*0.000*										
Piggylag	0.138***	0.094***	0.594***	0.620***	0.986***	1.000								
(Calhoun)	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*									
Hpigrowth	-0.350***	-0.346***	0.106***	0.106***	-0.259***	-0.293***	1.000							
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*								
Hpigrowthlag	-0.354***	-0.382***	0.231***	0.249***	-0.164***	-0.180***	0.585***	1.000						
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*							
Lnincome	-0.014***	0.010**	0.344***	0.363***	0.307***	0.321***	-0.238***	-0.122***	1.000					
	0.006	*0.058*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*						
Unemploy	0.154***	0.154***	-0.078***	-0.099***	-0.025***	-0.032***	-0.088***	-0.228***	-0.312***	1.000				
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*					
Pctsubprimelag	0.579***	0.533***	0.095***	0.098***	-0.005	-0.012*	-0.089***	0.005	-0.031***	-0.014**	1.000			
	0.000	*0.000*	*0.000*	*0.000*	*0.460*	*0.076*	*0.000*	*0.484*	*0.000*	*0.036*				
Pct740	-0.634***	-0.538***	0.011*	0.026***	0.014**	0.027***	-0.060***	-0.045***	0.226***	-0.065***	-0.651***	1.000		
	0.000	*0.000*	*0.090*	*0.000*	*0.041*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*			
Pct680to739	-0.349***	-0.355***	0.060***	0.049***	0.018**	0.002	0.231***	0.219***	-0.155***	-0.025***	-0.294***	-0.014***	1.000	
	0.000	*0.000*	*0.000*	*0.000*	*0.011*	*0.780*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.008*		
Pct620to679	0.342***	0.265***	0.071***	0.060***	-0.004	-0.016**	0.175***	0.166***	-0.239***	0.072***	0.422***	-0.790***	0.152***	1.000
	0.000	*0.000*	*0.000*	*0.000*	*0.604*	*0.019*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	

This table shows the correlation coefficient estimates with the relevant *p*-values in italic for the key variables in our Zip code-level regression analysis. The variables *Piggyback* and *Piggylag* are calculated using the method proposed by Avery (2007a) and Calhoun (2006). We use ***, **, and * to denote significance at the 1%, 5%, and 10% level.

Table 4: State Piggyback Lending and Foreclosure Rates

Panel A: Percentage Piggyback Originations Calculated using Avery et al. (2007a)

	(1) OLS	(2) LOGIT	(3) OLS	(4) LOGIT	(5) OLS	(6) LOGIT
Piggylag	0.085***	0.037***	0.103***	0.055***	0.061***	0.021**
	(3.39)	(2.90)	(4.44)	(4.46)	(3.74)	(2.40)
Lnincome			-0.081	-0.236	0.554**	0.282**
			(0.31)	(1.20)	(2.46)	(2.00)
Unemploy			0.308***	0.188***	0.153***	0.061***
			(6.52)	(6.35)	(4.99)	(3.01)
Pctsubprimelag			0.060***	0.048***	0.057***	0.045***
			(6.22)	(7.04)	(7.63)	(9.50)
Hpigrowthlag					-0.098***	-0.080***
					(8.82)	(14.22)
Constant	0.909***	-4.659***	-1.042	-4.156**	-5.875**	-8.105***
	(6.53)	(57.95)	(0.37)	(2.02)	(2.51)	(5.56)
Observations	284	284	284	284	284	284
R-squared[13]	0.067	0.029	0.268	0.257	0.559	0.705

Panel B: Percentage Piggyback Originations Calculated using Calhoun (2006)

	(1) OLS	(2) LOGIT	(3) OLS	(4) LOGIT	(5) OLS	(6) LOGIT
Piggylag	0.080***	0.038***	0.097***	0.054***	0.059***	0.022***
	(3.64)	(3.54)	(4.77)	(5.29)	(4.04)	(3.08)
Lnincome			-0.122	-0.278	0.520**	0.249*
			(0.47)	(1.44)	(2.32)	(1.80)
Unemploy			0.309***	0.189***	0.155***	0.063***
			(6.65)	(6.49)	(5.10)	(3.10)
Pctsubprimelag			0.060***	0.048***	0.057***	0.046***
			(6.28)	(7.16)	(7.70)	(9.65)
Hpigrowthlag					-0.097***	-0.079***
					(8.81)	(14.24)
Constant	0.905***	-4.681***	-0.624	-3.751*	-5.550**	-7.789***
	(6.90)	(62.68)	(0.23)	(1.86)	(2.39)	(5.45)
Observations	284	284	284	284	284	284
R-squared	0.080	0.040	0.283	0.273	0.564	0.709

This table presents regression results of state annual foreclosure rate, *Foreclosure*, on lagged percentage piggyback originations, *Piggylag*, and other explanatory variables. In Panel A, *Piggylag* is calculated using the method proposed by Avery et al. (2007a). In Panel B, *Piggylag* is calculated using the method proposed by Calhoun (2006). Robust standard errors are reported. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level.

[13] The *R-squared* for Logistic regression is a *Pseudo R-squared*. Unlike *R-squared* in OLS regression models, a higher *Pseudo R-squared* in Logistic regression does not necessarily mean one model is better in predicting the outcomes than the other.

Table 5: Zip Code Piggyback Lending and Mortgage Performance

Panel A: Percentage Piggyback Originations Calculated using Avery et al. (2007a)

	Noncurrent		Default	
	(1)	(2)	(3)	(4)
	OLS	LOGIT	OLS	LOGIT
Piggylag	0.090***	0.013***	0.029***	0.005***
	(17.45)	(12.24)	(7.11)	(3.99)
Lnincome	1.129***	0.036	0.644***	-0.014
	(9.80)	(1.24)	(7.33)	(0.38)
Unemploy	0.183***	0.022***	0.118***	0.017***
	(14.14)	(6.43)	(11.72)	(4.06)
Pctsubprimelag	0.039***	0.014***	0.032***	0.015***
	(14.18)	(20.87)	(14.93)	(20.64)
Hpigrowthlag	-0.096***	-0.029***	-0.076***	-0.037***
	(44.65)	(55.98)	(45.29)	(56.54)
Pct740	-0.193***	-0.038***	-0.115***	-0.038***
	(64.61)	(68.56)	(48.24)	(58.98)
Pct680to739	-0.304***	-0.057***	-0.195***	-0.060***
	(48.06)	(37.45)	(38.05)	(33.34)
Pct620to679	-0.252***	-0.020***	-0.166***	-0.019***
	(24.07)	(9.73)	(19.75)	(7.65)
Constant	8.099***	-1.068***	5.559***	-1.067***
	(6.52)	(3.35)	(5.89)	(2.71)
Observations	20,449	20,234	20,449	19,498
R-squared	0.676	0.641	0.574	0.562

Panel B: Percentage Piggyback Originations Calculated using Calhoun (2006)

	Noncurrent		Default	
	(1)	(2)	(3)	(4)
	OLS	LOGIT	OLS	LOGIT
Piggylag	0.087***	0.015***	0.028***	0.007***
	(18.55)	(14.98)	(7.68)	(6.34)
Lnincome	1.067***	0.007	0.619***	-0.040
	(9.23)	(0.25)	(7.01)	(1.11)
Unemploy	0.185***	0.022***	0.118***	0.017***
	(14.28)	(6.41)	(11.75)	(3.98)
Pctsubprimelag	0.039***	0.014***	0.032***	0.015***
	(14.13)	(20.56)	(14.91)	(20.54)
Hpigrowthlag	-0.095***	-0.029***	-0.076***	-0.036***
	(44.15)	(55.29)	(45.11)	(56.06)
Pct740	-0.193***	-0.038***	-0.116***	-0.038***
	(64.52)	(68.18)	(48.22)	(58.91)
Pct680to739	-0.302***	-0.057***	-0.194***	-0.060***
	(47.96)	(37.49)	(38.05)	(33.42)
Pct620to679	-0.253***	-0.021***	-0.167***	-0.019***
	(24.17)	(9.94)	(19.80)	(7.80)
Constant	8.726***	-0.773**	5.807***	-0.793**
	(7.01)	(2.42)	(6.12)	(2.01)
Observations	20449	20234	20449	19498
R-squared	0.677	0.643	0.574	0.563

This table presents regression results of two Zip Code loan performance measures, proportion of noncurrent mortgage loans (*Noncurrent*) and proportion of defaulted mortgage loans (*Default*), on lagged percentage piggyback originations, *Piggylag*, and other explanatory variables. In Panel A, *Piggylag* is calculated using the method proposed by Avery et al. (2007a). In Panel B, *Piggylag* is calculated using the method proposed by Calhoun (2006). Robust standard errors are reported. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level.

Table 6: Different Types of State Piggyback Lending and Foreclosure Rates (Avery)

Panel A: First-Lien Prime and Second-Lien Prime Piggybacks and Foreclosure Rates

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	LOGIT	OLS	LOGIT	OLS	LOGIT
Piggylag	-0.066	-0.048	-0.094	-0.070*	-0.018	-0.018
	(0.96)	(1.39)	(1.32)	(1.90)	(0.33)	(0.80)
Lnincome			0.501	0.183	-0.061	-0.200
			(1.01)	(0.61)	(0.17)	(1.17)
Unemploy			0.489***	0.256***	0.242***	0.087***
			(5.95)	(6.60)	(4.50)	(3.06)
Pctsubprimelag			-0.014	-0.015	0.027*	0.013*
			(0.87)	(1.44)	(1.92)	(1.94)
Hpigrowthlag					-0.116***	-0.079***
					(5.75)	(10.02)
Constant	2.094***	-3.972***	-5.126	-6.730**	1.554	-2.176
	(7.36)	(28.67)	(1.00)	(2.15)	(0.42)	(1.21)
Observations	131	131	131	131	131	131
R-squared	0.007	0.013	0.266	0.274	0.553	0.751

Panel B: First-Lien Prime and Second-Lien Subprime and Foreclosure Rates

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	LOGIT	OLS	LOGIT	OLS	LOGIT
Piggylag	-0.111	-0.208**	-0.031	-0.167**	0.353***	0.072*
	(0.68)	(2.49)	(0.20)	(2.13)	(2.91)	(1.75)
Lnincome			0.270	0.142	-0.485	-0.327**
			(0.57)	(0.47)	(1.45)	(2.03)
Unemploy			0.491***	0.247***	0.227***	0.084***
			(5.67)	(6.18)	(4.37)	(2.94)
Pctsubprimelag			-0.003	-0.003	0.025*	0.014**
			(0.16)	(0.35)	(1.84)	(2.28)
Hpigrowthlag					-0.134***	-0.083***
					(5.87)	(10.21)
Constant	1.980***	-3.893***	-3.256	-6.555**	5.714	-0.986
	(10.39)	(39.13)	(0.66)	(2.06)	(1.62)	(0.57)
Observations	131	131	131	131	131	131
R-squared	0.005	0.063	0.256	0.291	0.593	0.755

Panel C: First-Lien Subprime and Second-Lien Subprime and Foreclosure Rates

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	LOGIT	OLS	LOGIT	OLS	LOGIT
Piggylag	0.294***	0.156***	0.244***	0.131***	0.128***	0.047***
	(4.51)	(5.66)	(4.13)	(4.55)	(3.05)	(2.71)
Lnincome			-0.409	-0.357	-0.417	-0.363**
			(1.06)	(1.32)	(1.36)	(2.30)
Unemploy			0.407***	0.213***	0.222***	0.080***
			(6.22)	(5.83)	(4.45)	(2.95)
Pctsubprimelag			0.014	0.002	0.035**	0.017***
			(0.91)	(0.17)	(2.45)	(2.77)
Hpigrowthlag					-0.104***	-0.075***
					(5.72)	(9.76)
Constant	1.100***	-4.553***	3.309	-1.778	4.775	-0.721
	(8.02)	(50.79)	(0.82)	(0.62)	(1.49)	(0.43)
Observations	131	131	131	131	131	131
R-squared	0.194	0.196	0.367	0.368	0.580	0.763

This table presents regression results of state annual foreclosure rate, *Foreclosure*, on lagged percentage piggyback originations, *Piggylag*, and other explanatory variables. The piggyback originations are identified using the Avery method. We examine three types of piggyback lending: (1) first-lien prime and second-lien prime; (2) first-lien prime and second-lien subprime; and (3) first-lien subprime and second-lien subprime. In Panel A, *Piggylag* is defined as two-year lag of the percentage of first-lien prime and second-lien prime piggyback originations to total purchase originations for states with non-judicial foreclosure procedures, and three-year lag for states with judicial foreclosure procedures. In Panel B, *Piggylag* is defined as two-year lag of the percentage of first-lien prime and second-lien subprime piggyback originations to total purchase originations for states with non-judicial foreclosure procedures, and three-year lag for states with judicial foreclosure procedures. In Panel C, *Piggylag* is defined as two-year lag of the percentage of first-lien subprime and second-lien subprime piggyback originations to total purchase originations for states with non-judicial foreclosure procedures, and three-year lag for states with judicial foreclosure procedures. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level.

Table 7: Different Types of State Piggyback Lending and Foreclosure Rates (Calhoun)

Panel A: First-Lien Prime and Second-Lien Prime Piggybacks and Foreclosure Rates

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	LOGIT	OLS	LOGIT	OLS	LOGIT
Piggylag	-0.214***	-0.128***	-0.191***	-0.118***	-0.101***	-0.057***
	(4.43)	(4.78)	(4.07)	(4.35)	(2.69)	(3.04)
Lnincome			0.451	0.121	0.017	-0.179
			(0.98)	(0.43)	(0.05)	(1.16)
Unemploy			0.463***	0.240***	0.238***	0.085***
			(5.91)	(6.46)	(4.52)	(3.10)
Pctsubprimelag			-0.017	-0.016*	0.021	0.010*
			(1.13)	(1.66)	(1.63)	(1.72)
Hpigrowthlag					-0.110***	-0.076***
					(5.56)	(9.94)
Constant	3.412***	-3.222***	-3.388	-5.390*	1.516	-2.006
	(8.42)	(16.15)	(0.68)	(1.80)	(0.44)	(1.21)
Observations	131	131	131	131	131	131
R-squared	0.081	0.103	0.314	0.336	0.568	0.767

Panel B: First-Lien Prime and Second-Lien Subprime Piggybacks and Foreclosure Rates

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	LOGIT	OLS	LOGIT	OLS	LOGIT
Piggylag	-0.012	-0.153*	0.066	-0.110	0.392***	0.096**
	(0.07)	(1.78)	(0.42)	(1.37)	(3.11)	(2.29)
Lnincome			0.193	0.074	-0.451	-0.334**
			(0.42)	(0.24)	(1.37)	(2.11)
Unemploy			0.497***	0.252***	0.231***	0.084***
			(5.84)	(6.35)	(4.43)	(2.98)
Pctsubprimelag			-0.004	-0.006	0.029**	0.015**
			(0.27)	(0.67)	(2.08)	(2.42)
Hpigrowthlag					-0.131***	-0.083***
					(5.83)	(10.28)
Constant	1.856***	-3.928***	-2.582	-5.845*	5.104	-0.977
	(8.66)	(32.84)	(0.53)	(1.82)	(1.49)	(0.58)
Observations	131	131	131	131	131	131
R-squared	0.000	0.029	0.257	0.268	0.599	0.760

Panel C: First-Lien Subprime and Second-Lien Subprime Piggybacks and Foreclosure Rates

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	LOGIT	OLS	LOGIT	OLS	LOGIT
Piggylag	0.364***	0.196***	0.299***	0.165***	0.143***	0.054**
	(4.77)	(5.99)	(4.22)	(4.50)	(2.85)	(2.38)
Lnincome			-0.578	-0.462	-0.470	-0.385**
			(1.43)	(1.62)	(1.46)	(2.30)
Unemploy			0.395***	0.205***	0.219***	0.078***
			(5.89)	(5.47)	(4.32)	(2.87)
Pctsubprimelag			0.010	-0.000	0.033**	0.016***
			(0.68)	(0.02)	(2.32)	(2.62)
Hpigrowthlag					-0.105***	-0.075***
					(5.57)	(9.66)
Constant	1.118***	-4.549***	5.231	-0.601	5.440	-0.451
	(8.70)	(52.56)	(1.23)	(0.20)	(1.61)	(0.26)
Observations	131	131	131	131	131	131
R-squared	0.195	0.202	0.359	0.367	0.573	0.760

This table presents regression results of state annual foreclosure rate, *Foreclosure*, on lagged percentage piggyback originations, *Piggylag*, and other explanatory variables. The piggyback originations are identified using the Calhoun method. We examine three types of piggyback lending: (1) first-lien prime and second-lien prime; (2) first-lien prime and second-lien subprime; and (3) first-lien subprime and second-lien subprime. In Panel A, *Piggylag* is defined as two-year lag of the percentage of first-lien prime and second-lien prime piggyback originations to total purchase originations for states with non-judicial foreclosure procedures, and three-year lag for states with judicial foreclosure procedures. In Panel B, *Piggylag* is defined as two-year lag of the percentage of first-lien prime and second-lien subprime piggyback originations to total purchase originations for states with non-judicial foreclosure procedures, and three-year lag for states with judicial foreclosure procedures. In Panel C, *Piggylag* is defined as two-year lag of the percentage of first-lien subprime and second-lien subprime piggyback originations to total purchase originations for states with non-judicial foreclosure procedures, and three-year lag for states with judicial foreclosure procedures. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level.

Table 8: Zip Code Different Types of Piggyback Lending and Mortgage Performance (Avery)

Panel A: First-Lien Prime and Second-Lien Prime Piggybacks and Mortgage Performance

	Noncurrent		Default	
	(1)	(2)	(3)	(4)
	OLS	LOGIT	OLS	LOGIT
Piggylag	-0.027**	-0.008***	-0.031***	-0.014***
	(2.22)	(2.98)	(3.31)	(4.05)
Lnincome	1.452***	0.097**	0.933***	0.162***
	(6.46)	(2.22)	(5.40)	(3.00)
Unemploy	0.408***	0.092***	0.307***	0.112***
	(15.49)	(17.34)	(14.60)	(16.99)
Pctsubprimelag	0.014***	0.005***	0.008**	0.003***
	(3.42)	(5.50)	(2.35)	(2.79)
Hpigrowthlag	-0.115***	-0.024***	-0.091***	-0.030***
	(26.06)	(28.86)	(26.90)	(29.34)
Pct740	-0.234***	-0.041***	-0.142***	-0.042***
	(47.60)	(52.18)	(36.62)	(46.24)
Pct680to739	-0.296***	-0.042***	-0.185***	-0.045***
	(24.56)	(17.20)	(18.68)	(15.32)
Pct620to679	-0.258***	-0.017***	-0.171***	-0.017***
	(14.03)	(5.16)	(11.55)	(4.52)
Constant	6.961***	-1.823***	3.598*	-3.094***
	(2.81)	(3.77)	(1.90)	(5.21)
Observations	8,608	8,557	8,608	8,374
R-squared	0.671	0.642	0.570	0.563

Panel B: First-Lien Prime and Second-Lien Subprime Piggybacks and Mortgage Performance

	Noncurrent		Default	
	(1)	(2)	(3)	(4)
	OLS	LOGIT	OLS	LOGIT
Piggylag	0.251***	0.050***	0.126***	0.040***
	(7.26)	(7.95)	(4.62)	(5.23)
Lnincome	1.202***	0.040	0.761***	0.095*
	(5.59)	(0.93)	(4.59)	(1.81)
Unemploy	0.416***	0.093***	0.311***	0.113***
	(15.98)	(17.90)	(14.86)	(17.31)
Pctsubprimelag	0.014***	0.005***	0.009***	0.003***
	(3.42)	(5.82)	(2.70)	(3.46)
Hpigrowthlag	-0.116***	-0.025***	-0.092***	-0.030***
	(26.67)	(29.51)	(27.27)	(29.86)
Pct740	-0.232***	-0.041***	-0.142***	-0.042***
	(47.12)	(51.66)	(36.28)	(45.65)
Pct680to739	-0.309***	-0.045***	-0.194***	-0.048***
	(26.15)	(18.53)	(19.95)	(16.57)
Pct620to679	-0.262***	-0.018***	-0.173***	-0.018***
	(14.26)	(5.41)	(11.70)	(4.65)
Constant	9.355***	-1.266***	5.265***	-2.440***
	(3.94)	(2.69)	(2.88)	(4.21)
Observations	8,608	8,557	8,608	8,374
R-squared	0.673	0.645	0.571	0.563

Panel C: First-Lien Subprime and Second-Lien Subprime Piggybacks and Mortgage Performance

	Noncurrent		Default	
	(1)	(2)	(3)	(4)
	OLS	LOGIT	OLS	LOGIT
Piggylag	0.222***	0.036***	0.090***	0.027***
	(14.68)	(15.00)	(7.14)	(9.35)
Lnincome	0.610***	-0.052	0.537***	0.027
	(2.90)	(1.20)	(3.27)	(0.50)
Unemploy	0.376***	0.087***	0.294***	0.108***
	(14.96)	(16.77)	(14.31)	(16.53)
Pctsubprimelag	0.010**	0.004***	0.007**	0.003***
	(2.52)	(5.25)	(2.27)	(3.04)
Hpigrowthlag	-0.101***	-0.022***	-0.086***	-0.028***
	(23.72)	(26.20)	(25.43)	(27.65)
Pct740	-0.222***	-0.039***	-0.138***	-0.040***
	(44.82)	(49.12)	(34.83)	(43.98)
Pct680to739	-0.298***	-0.043***	-0.189***	-0.047***
	(25.66)	(18.09)	(19.40)	(16.19)
Pct620to679	-0.266***	-0.018***	-0.174***	-0.018***
	(14.54)	(5.62)	(11.81)	(4.81)
Constant	14.955***	-0.400	7.381***	-1.791***
	(6.50)	(0.84)	(4.10)	(3.03)
Observations	8,608	8,557	8,608	8,374
R-squared	0.684	0.651	0.574	0.566

This table presents regression results of Zip code loan performance measures, proportion of noncurrent mortgage loans (*Noncurrent*) and proportion of defaulted mortgage loans (*Default*), on lagged percentage piggyback originations, *Piggylag*, and other explanatory variables. The piggyback originations are identified using the Avery method. We examine three types of piggyback lending: (1) first-lien prime and second-lien prime; (2) first-lien prime and second-lien subprime; and (3) first-lien subprime and second-lien subprime. In Panel A, *Piggylag* is defined as two-year lag of the percentage of first-lien prime and second-lien prime piggyback originations to total purchase originations for states with non-judicial foreclosure procedures, and three-year lag for states with judicial foreclosure procedures. In Panel B, *Piggylag* is defined as two-year lag of the percentage of first-lien prime and second-lien subprime piggyback originations to total purchase originations for states with non-judicial foreclosure procedures, and three-year lag for states with judicial foreclosure procedures. In Panel C, *Piggylag* is defined as two-year lag of the percentage of first-lien subprime and second-lien subprime piggyback originations to total purchase originations for states with non-judicial foreclosure procedures, and three-year lag for states with judicial foreclosure procedures. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level.

Table 9: Zip Code Different Types of Piggyback Lending and Mortgage Performance (Calhoun)

Panel A: First-Lien Prime and Second-Lien Prime Piggybacks and Mortgage Performance

	Noncurrent		Default	
	(1)	(2)	(3)	(4)
	OLS	LOGIT	OLS	LOGIT
Piggylag	-0.036***	-0.009***	-0.034***	-0.014***
	(4.42)	(4.21)	(5.36)	(5.47)
Lnincome	1.475***	0.098**	0.940***	0.161***
	(6.70)	(2.28)	(5.57)	(3.03)
Unemploy	0.405***	0.091***	0.304***	0.110***
	(15.44)	(17.24)	(14.50)	(16.82)
Pctsubprimelag	0.013***	0.005***	0.007**	0.002**
	(3.12)	(5.31)	(2.10)	(2.51)
Hpigrowthlag	-0.114***	-0.024***	-0.090***	-0.030***
	(25.75)	(28.49)	(26.61)	(28.84)
Pct740	-0.233***	-0.041***	-0.141***	-0.041***
	(47.10)	(51.30)	(35.99)	(45.10)
Pct680to739	-0.291***	-0.041***	-0.181***	-0.044***
	(24.06)	(16.74)	(18.20)	(14.70)
Pct620to679	-0.255***	-0.016***	-0.169***	-0.016***
	(13.91)	(5.00)	(11.40)	(4.30)
Constant	6.723***	-1.834***	3.525*	-3.087***
	(2.76)	(3.85)	(1.89)	(5.27)
Observations	8,608	8,557	8,608	8,374
R-squared	0.671	0.643	0.570	0.563

Panel B: First-Lien Prime and Second-Lien Subprime Piggybacks and Mortgage Performance

	Noncurrent		Default	
	(1)	(2)	(3)	(4)
	OLS	LOGIT	OLS	LOGIT
Piggylag	0.377***	0.085***	0.179***	0.072***
	(11.81)	(14.47)	(6.77)	(9.74)
Lnincome	1.098***	0.010	0.716***	0.068
	(5.20)	(0.25)	(4.35)	(1.30)
Unemploy	0.413***	0.093***	0.309***	0.113***
	(16.08)	(18.11)	(14.89)	(17.43)
Pctsubprimelag	0.011***	0.004***	0.008**	0.003***
	(2.81)	(5.19)	(2.34)	(2.87)
Hpigrowthlag	-0.113***	-0.024***	-0.091***	-0.030***
	(26.37)	(28.98)	(27.10)	(29.47)
Pct740	-0.233***	-0.041***	-0.142***	-0.042***
	(47.79)	(52.44)	(36.62)	(45.98)
Pct680to739	-0.318***	-0.047***	-0.198***	-0.050***
	(27.11)	(19.59)	(20.43)	(17.22)
Pct620to679	-0.271***	-0.020***	-0.177***	-0.020***
	(14.78)	(6.12)	(11.99)	(5.14)
Constant	10.585***	-0.935**	5.808***	-2.133***
	(4.53)	(2.02)	(3.20)	(3.71)
Observations	8,608	8,557	8,608	8,374
R-squared	0.677	0.651	0.573	0.567

Panel C: First-Lien Subprime and Second-Lien Subprime Piggybacks and Mortgage Performance

	Noncurrent		Default	
	(1)	(2)	(3)	(4)
	OLS	LOGIT	OLS	LOGIT
Piggylag	0.234***	0.036***	0.087***	0.025***
	(12.40)	(12.26)	(5.61)	(7.09)
Lnincome	0.648***	-0.039	0.576***	0.045
	(3.04)	(0.88)	(3.48)	(0.82)
Unemploy	0.377***	0.087***	0.295***	0.108***
	(14.84)	(16.70)	(14.27)	(16.52)
Pctsubprimelag	0.009**	0.004***	0.007**	0.003***
	(2.26)	(5.13)	(2.20)	(3.02)
Hpigrowthlag	-0.103***	-0.023***	-0.087***	-0.029***
	(24.10)	(26.74)	(25.75)	(28.11)
Pct740	-0.223***	-0.039***	-0.138***	-0.041***
	(44.49)	(49.23)	(34.74)	(44.16)
Pct680to739	-0.295***	-0.043***	-0.188***	-0.046***
	(25.28)	(17.82)	(19.28)	(16.08)
Pct620to679	-0.262***	-0.017***	-0.173***	-0.018***
	(14.28)	(5.39)	(11.67)	(4.66)
Constant	14.603***	-0.526	7.014***	-1.958***
	(6.26)	(1.10)	(3.87)	(3.29)
Observations	8,608	8,557	8,608	8,374
R-squared	0.681	0.648	0.572	0.564

This table presents regression results of Zip code loan performance measures, proportion of noncurrent mortgage loans (*Noncurrent*) and proportion of defaulted mortgage loans (*Default*), on lagged percentage piggyback originations, *Piggylag*, and other explanatory variables. The piggyback originations are identified using the Calhoun method. We examine three types of piggyback lending: (1) first-lien prime and second-lien prime; (2) first-lien prime and second-lien subprime; and (3) first-lien subprime and second-lien subprime. In Panel A, *Piggylag* is defined as two-year lag of the percentage of first-lien prime and second-lien prime piggyback originations to total purchase originations for states with non-judicial foreclosure procedures, and three-year lag for states with judicial foreclosure procedures. In Panel B, *Piggylag* is defined as two-year lag of the percentage of first-lien prime and second-lien subprime piggyback originations to total purchase originations for states with non-judicial foreclosure procedures, and three-year lag for states with judicial foreclosure procedures. In Panel C, *Piggylag* is defined as two-year lag of the percentage of first-lien subprime and second-lien subprime piggyback originations to total purchase originations for states with non-judicial foreclosure procedures, and three-year lag for states with judicial foreclosure procedures. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level.