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Real estate investors, the leverage cycle, and the housing market crisis

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Abstract

We explore a mostly undocumented but important dimension of the housing market crisis: the role played by real estate investors. Using unique credit-report data, we document large increases in the share of purchases, and subsequently delinquencies, by real estate investors. In states that experienced the largest housing booms and busts, at the peak of the market almost half of purchase mortgage originations were associated with investors. In part by apparently misreporting their intentions to occupy the property, investors took on more leverage, contributing to higher rates of default. Our findings have important implications for policies designed to address the consequences and recurrence of housing market bubbles.

Key words: mortgages, leverage

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The U.S. economy is still recovering from the financial crisis that began in the fall of 2007. The collapse of house prices across many markets was a precipitating factor in the financial crisis and adverse feedback effects between financial markets and the real economy led to the most severe recession in the post-war period. Extraordinary interventions by fiscal and monetary authorities both in the U.S. and abroad were required in order to prevent a complete collapse of global markets and the potential onset of another great depression.

Attention has shifted from containing the financial crisis to examining its causes and designing policies to limit both the likelihood and the severity of a similar crisis in the future. Given the central role that housing played as a catalyst to the crisis, it is important to better understand the determinants of the dynamics of house prices and of subsequent mortgage defaults over this recent cycle. While house prices were rising in many parts of the country over the period leading up to the crisis, these increases were particularly pronounced in four states – Arizona, California, Florida and Nevada (the "bubble" states). Figure 1 shows the path of house prices in the US, the bubble states as a whole, and in each of these states from 2000 Q1 to 2010 Q4.Over the period from 2000 to 2006 average house prices more than doubled in each of these states. The pace of house price appreciation accelerated starting in 2004. The peaks in prices across the four states occurred within a couple of months of each other in mid-2006. Following the turn in the markets, house prices declined rapidly in each state with much of the earlier gains given back within just two years.[2]

This rapid run-up and then crash in house prices exacted a terrible cost to homeowners, financial firms and to the economy. Current estimates are that around 23 percent of active mortgages are "under water" in that the balance on the mortgage exceeds the current value of the

[2] California is a bit of an exception in that it appears that average house prices have stabilized at a level 50 percent higher than in 2000.

house.[3] As of 2010 Q4, nearly 2.8 million homes have gone through foreclosure, and another 2 million homes are in the process of foreclosure.[4] Serious delinquencies continue to add new homes to the foreclosure pipeline over time. Nationally distress sales represent around half of all repeat-sale transactions. These distress sales continue to exert downward pressure on house prices making it more difficult for housing markets to recover.

A focus on residential mortgage finance in order to understand what the determinants were of the house price and mortgage default dynamics generated over the recent cycle would inform efforts to enhance financial stability. A more robust system of residential mortgage finance should aim to limit the degree to which house prices rise and fall over a credit cycle. Reducing the amplitude of the house price swings will limit the potential for collateral damage created by housing markets for the real economy.

Related Literature

Given that housing is a durable asset, periods of rising prices are indicative of increasing demand for housing.[5] One strand of the literature on housing demand focuses on the determinants that affect the "user cost" of housing.[6] The user cost of housing (*UC*) is the annual flow cost to the owner per dollar of house price, taking into account after-tax financing costs, property taxes and insurance, maintenance and depreciation costs and the expected risk-adjusted return to owning the house. The value of the housing service flow is proxied by the annual rent (*R*). If we assume that there is arbitrage between owned and rental housing, then the annual rent should equate to the price of housing (*P*) times the user-cost.

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[3] http://www.corelogic.com/About-Us/News/New-CoreLogic-Data-Shows-23-Percent-of-Borrowers-Underwater-with-$750-Billion-Dollars-of-Negative-Equity.aspx
[4] http://www.ots.treas.gov/_files/490069.pdf
[5] That is, with the exception of natural disasters and periods of armed conflict, the supply of housing in a market cannot contract significantly over a short period of time to drive up house prices.
[6] See Hendershott and Slemrod (1983) and Poterba (1984) for early discussions.

$$R(Y, r_m) = P * UC(r_m, \tau, \delta, g^e)$$

where r_m is the mortgage financing rate, τ describes the tax environment, δ the depreciation rate on housing net of that offset by maintenance expenditures, g^e the risk adjusted expected return to housing, and Y is the average income.

This framework suggests several possible candidates for explaining the rise in house prices in the early to mid-2000s. A rise in income in a housing market will increase area rental rates to a degree that reflects the elasticity of supply of rental housing in that local market. Higher rents will translate into higher house prices by a factor given by the reciprocal of the user-cost in that market. As a consequence, house prices will vary more with changes in rents in markets with low user-costs of housing.[7] The accommodative monetary policy following the bursting of the tech bubble lowered mortgage interest rates by over 300 basis points from mid-2001 to mid-2003, and facilitated a resumption of income growth after the end of the recession.[8] Lower financing costs for housing reduces the user-cost of housing which would lead to higher prices holding rents constant. However, if some of the benefits of lower financing costs to landlords are passed on to renters, then the impact of lower mortgage rates on house prices will be attenuated. The Bush tax cuts were enacted during this period which lowered marginal tax rates. These lower marginal tax rates would raise the user-cost by reducing the benefit from the mortgage interest deduction. These lower marginal tax rates would have led to lower house prices, all else the same, with the magnitude of the reduction reflecting in part expectations over whether the tax cuts would be made permanent.

[7] See Himmelberg *et al* (2005) for a detailed discussion.
[8] http://www.mortgage-x.com/general/historical_rates.asp

While income, monetary policy and tax rates each underwent some changes in the first half of the 2000s, the term in the user-cost that has received the most attention in trying to explain the house price boom is the expected return to housing, g^e. The higher the risk-adjusted expected return, the lower the user-cost and the higher house prices will be in a market. As Himmelberg *et al* (2005) explain, the sensitivity of house prices to house price expectations increases with the degree to which house prices are expected to rise. The expected return to housing is the only forward-looking aspect to the user-cost of housing framework. The arbitrage condition listed above has a potential self-fulfilling characteristic. If owners expect house prices to rise in the future, then the user-cost of housing will fall and, given a constant rent, the value of houses will rise.[9] This rise in the value of housing can serve to confirm the earlier belief. This may lead to "irrational exuberance" in the housing market as argued by Shiller (2005).

Himmelberg *et al* (2005) apply the user-cost formulation to assess the degree to which house prices dynamics track changes in fundamental demand determinants for housing. They calculate user-cost estimates for 46 metropolitan areas over a twenty-five year period ending in 2004. Their analysis identified only a few metropolitan areas where by 2004 house prices appeared to have risen significantly more than what would be predicted by average rents and estimated user-costs. It is unfortunate that their analysis ended in 2004 since the rapid acceleration in house price appreciation as shown in Figure 1 began in that year. Given their argument that the sensitivity of prices to user-costs increases at low values of the user-cost, it is possible that their methodology if extended through 2006 would have explained some of this acceleration in price appreciation. However, it is important to note that the average 30-year fixed-rate mortgage rate increased from 5.74 in January

[9] Rents would not be expected to rise since the value of the current flow of housing services has not changed.

2004 to 6.14 in December 2006, so that any further declines in the user-cost was not being driven by lower financing costs during this period.[10]

Glaeser *et al* (2010) argue that the empirical connection between mortgage rates and house prices is not strong enough to explain the dynamics of house prices during the housing boom. On a conceptual level, they argue that the impact of any shift in housing demand on house prices depends on the housing supply elasticity in that market. For markets with inelastic housing supply, increases in housing demand will mainly result in higher house prices instead of increased production of new homes. In contrast, in housing markets with elastic housing supply, increases in housing demand will mainly result in the production of new homes. House prices in these markets are determined by the cost of building a new home.[11] Furthermore, they argue that expected future mortgage rates are important in addition to the current mortgage rate. If mortgage rates are expected to rise, then the effect of a low current mortgage rate on house prices will be attenuated. This argument can be captured in the user-cost arbitrage condition shown earlier by factoring the expected rise in financing costs into the expected house price appreciation term.[12]

Credit conditions enter into the standard user-cost formulation solely through the mortgage interest rate. However, a second important aspect is the required downpayment by the borrower. The interest rate and the required downpayment reflect the two underwriting constraints on a borrower when bidding on a property. The minimum downpayment percentage is also referred to as the "collateral rate" on the mortgage.[13] For a given mortgage balance, the mortgage interest rate impacts the monthly payment that the borrower will have to make. Underwriting standards will

[10] Some authors pointed to the rise in price-rent ratios as likely to be followed by a reduction in subsequent price growth (Gallin 2008, Campbell, et al. 2009).
[11] See Glaeser *et al* (2010) for a detailed discussion.
[12] An implication is that a reduction in interest rates that is perceived to be permanent would be expected to have a greater impact on house prices than a similar reduction in interest rates that is due to accommodative monetary policy and is expected to be transitory. This presents a challenge to those who hold the view that monetary policy was a primary determinant of the house price boom.
[13] The collateral rate is also referred to as the "haircut" or "margin."

stipulate a maximum that the sum of the annual mortgage payments in addition to the taxes and insurance on the property can be as a fraction of the borrower's income.[14] We will refer to this as the "cash-flow constraint". A lender will also require the borrower(s) to make a minimum downpayment. The ratio of the downpayment to the sale or appraised value of the house determines the origination loan-to-value ratio (LTV). We refer to this as the "downpayment constraint." The maximum that a borrower may bid on a house will depend on which of these two constraints first becomes binding given the underwriting standards in use at the time.

The mortgage interest rate and the collateral rate are jointly determined in a credit market (see Fostel and Geanakoplos (2008) and Geanakoplos (2009)). For collateralized loans the collateral rate is determined by volatility of the asset price and the term of the loan. The higher the price volatility and the longer the term, the larger the collateral rate the lender will require (or equivalently the larger the minimum downpayment percentage). The purpose of the collateral rate is to safeguard the lender against defaults by the borrower when there are declines in the value of the collateral. Similarly, for a given level of price volatility, the higher the expected price appreciation for the asset the lower lenders may set the required collateral rate. In this case, the expected price appreciation acts as additional future collateral protecting the lender against losses in the event of a default.

There is an additional channel, not necessarily captured by changes in the average origination LTV and not explicitly addressed by Glaeser *et al* (2010), through which changes in credit conditions may have affected housing prices. Reduced loan documentation requirements may allow those who previously hit the collateral or cash-flow constraint to obtain more leverage, be it possibly at less favorable terms. This could occur when lenders no longer require income documentation or adopt more favorable ways of imputing the borrower's future income from wage earnings, bonuses and

[14] This is the called the front-end PITI (for principal, interest, taxes and insurance as a fraction of income) or DTI (debt-to-income ratio). There is also a back-end ratio that adds to the numerator any recurring non-housing debt payments such as auto loans, student loans, and minimum credit card payments.

possibly rental income. Alternatively, in computing the DTI ratio, debts other than the mortgage loan under consideration may be ignored or incorporated differently.

As shown in Table 1, significant changes in documentation requirements for subprime and Alt-A loans took place during the run-up in house prices. The level of documentation for a new mortgage is reported as a data item on the origination file for that mortgage. The three values are full documentation, limited documentation and no documentation. While no-doc loans remained relatively uncommon, there was a sizeable shift from full-doc to low-doc loans for subprime and especially for Alt-A mortgage loans. By 2006 some 38% of newly originated subprime and 81% of new Alt-A loans were low- or no-doc loans.

We can incorporate changes in underwriting standards into the user-cost framework.

$$R(Y, r_m) = P * UC(r_m, \tau, \delta, g^e) * f(LTV^M, s)$$

where LTV^M is the maximum allowed origination loan-to-value ratio, s captures other prevailing underwriting standards at the time of the home purchase such as DTI and documentation, and *f* captures how changes in the degree of leverage and documentation impact house prices holding constant the user-cost.

Finally, there is a potentially important amplification effect of leverage on house prices which is not fully captured in our augmented user-cost arbitrage conditions. Geanakoplos (2009) posits that there is not a common house price appreciation expectation, g^e, that is shared by all potential buyers of an asset. Rather, he starts with the assumption that there is a distribution of expected appreciation rates across potential buyers. At the high end of the distribution are "optimistic" potential buyers with high values of g^e. Holding constant all of the other factors in our

user-cost arbitrage condition, optimistic buyers will be willing to bid higher prices for housing since their user-costs are lower.

This distribution of buyers in terms of their opinions about the future value of housing can generate an amplification mechanism for house price dynamics. In normal times, optimistic buyers are infra-marginal participants in the housing market. At the prevailing house prices they would like to purchase additional housing but are prevented from doing so because the cash-flow constraint or the downpayment constraint is binding. However, during the early phase of a housing boom, lenders may reduce the required downpayment percentage on new mortgages and begin to relax other underwriting standards due to the strong performance of house prices and low delinquency rates. These actions enable the optimistic buyers to purchase additional housing. The increasing leverage allowed in the market, then, begins to shift the composition of new purchase transactions in the market toward more optimistic buyers who are willing to bid higher prices for houses. This is an additional channel by which higher leverage can amplify the upward pressure on house prices. Geanakoplos describes this dynamic as the upswing phase of a "leverage cycle".

Can increasing leverage help to explain the acceleration in house prices from 2004 to 2006? For leverage to have played an important role we need to establish at least two things. First, we need to show that leverage was increasing over these three years. Second, we need to demonstrate that the composition of purchasing activity was shifting toward more optimistic buyers. Table 2 summarizes changes in leverage from two different sources of information on housing transactions and mortgages. Glaeser *et al* (2010) report data on combined LTV ratios for purchases drawn from 89 metro areas and recorded by DataQuick. An advantage of this data is that they reflect all mortgage products that were used to finance these purchases and reflect up to three liens on the house. The

second is changes in leverage on securitized nonprime purchase mortgages as recorded by LoanPerformance.[15]

There are two observations that can be drawn from Table 2. First, as pointed out in Glaeser *et al* (2010) extreme leverage in the form of zero downpayment mortgages were available and used by at least 10 percent of borrowers.[16] Second, when we look below the 90th percentile, we see that leverage was increasing throughout the distribution of origination LTVs.[17] Glaeser *et at* (2010), however, conclude that the magnitude of the observed LTV changes do not appear to be large enough to be an important determinant of the acceleration in house prices. This conclusion may be model dependent. If Geanakoplos (2009) is correct that increasing leverage also affects prices through shifting the composition of buyers, then this additional amplification mechanism may imply that the observed changes in leverage are capable of explaining more of the acceleration in house prices. Glaeser *et al* (2010) in fact explicitly condition their conclusion (that credit market factors were not the main drivers of the housing boom) on the absence of significant composition changes in the population of buyers. They also raise the distinct possibility that the surge in the number of buyers during the boom may have been accompanied by an overall decline in credit quality of buyers not captured by LTVs, but were not able to find any evidence of large composition changes when measured by demographics.

One such potential shift in the composition of buyers during the housing boom and especially during the 2004-2006 period, concerns the number and activities of real estate investors. There are several reasons to expect credit conditions to have particularly affected investor activity in

[15] Our finding of increases in the median nonprime CLTV at origination is consistent with that of Mayer and Pence (2009). We use our matched sample, which represents a random sample of all LP loans as described below, for this table.

[16] The Glaeser *et al* (2010) data indicate that the 90th percentile was at 100 going back to 1998.

[17] This is consistent with trends reported by Geanakoplos (2009, chart 1) for the average downpayment as a proportion of the purchase price. Among the 50% lowest downpayment ratios for subprime and ALT-A borrowers (based on CoreLogic data), he found a decrease in the average downpayment from 13% in the first quarter of 2000, to a low point of 2.7% in the second quarter of 2006.

the buildup of the housing boom. In discussing these, we will distinguish between three different types of buyers in a housing market: buyers who want to live in the house (owner-occupiers), investors who want to keep the house as vacation or future retirement home or who want to rent the property and then resell at a future date (buy and hold), and investors who want to resell the property without living in or renting the house (buy and flip).

The first reason to expect a role for investors in bidding up prices concerns the impact of the previously discussed increase in average origination LTVs. For a given mortgage interest rate, reducing the required downpayment percentage can allow a borrower to bid more aggressively for a property, but this is especially so for investors. The easiest way to see the impact of variation in the allowed LTV on the maximum bid is to take the case of a "buy and flip" borrower. As an illustration, consider an investor who has $50,000 to invest in real estate. This money must cover the downpayment as well as the mortgage payments, property taxes and home insurance during the expected holding period. For simplicity, we assume that the house is financed with a 30-year fixed-rate mortgage with an interest rate of 5.5 percent. We assume that annual property taxes, insurance payments and any required maintenance expenditures equate to 2 percent of the house value. The investor will not be renting out the property during the time until resale. We consider two cases: in the first the investor plans to be able to finance the purchase for up to three years, and in the second the investor plans to be able to finance the project for up to two years.

The relationship between the allowed level of leverage as indicated by the origination LTV and the maximum bid is shown in Figure 2. For the three year holding horizon, the maximum bid increases from $118 thousand with a twenty percent downpayment requirement to $189 thousand with no downpayment required – a sixty percent increase. The sensitivity of the maximum bid to

changes in the origination LTV is increasing in the degree of leverage.[18] For example, reducing the required downpayment from 20 percent to 19 percent raises the maximum bid by $2,260. Reducing the required downpayment from 5 percent to 4 percent raises the maximum bid by $4,189 – nearly double the earlier increase. For the same degree of leverage, investors with a shorter holding period have a higher maximum bid. We show how the schedule of maximum bids increases as the investor moves from a three to a two-year holding period. Shorter holding periods also increase the sensitivity of the maximum bid to changes in leverage at any given LTV. For example, with a two year holding period moving from a 5 percent to a 4 percent required downpayment raises the maximum bid by $9,335. Investors may have shortened their expected holding periods as the housing market heated up and the pace of house price increases accelerated. For a given maximum leverage, faster turn-around times for the investment properties would allow the investors to bid more aggressively.

A second mechanism through which investor behavior may have amplified the impact of changing credit conditions on house prices is through the loosening of loan documentation requirements. It has been speculated that the loosening of documentation standards may have facilitated the misreporting by borrowers of their true expected home-occupancy status.[19] This in turn may have enabled them to purchase homes under more favorable terms than they would have as investor. We explore the evidence for this possibility below.

A third channel affecting real estate investors concerns the use of second liens on existing mortgages to facilitate the down payment and meeting of loan requirements for purchasing additional investment properties. As documented in earlier work by Chakrabarti *et al* (2011), with house prices appreciating homeowners extracted home equity through higher balances on first

[18] The nonlinearity is due to the fact that the origination LTV is determined by the ratio of the downpayment to the value of the house, which here equals the maximum house bid.
[19] See, for example, http://www.fincen.gov/news_room/rp/reports/html/mortgage_fraud112006.html.

mortgages, cash-out refinances, second mortgages and home equity lines of credit. In fact, on average for each 1% increase in home prices, homeowners increased their mortgage debt by 1%, so that proportionally their equity share in their homes actually remained relatively constant until the end of 2006. Equity extraction may have been especially attractive to optimistic, but cash-constrained investors, by allowing them to use these funds to make downpayments on purchases of additional homes. Accordingly, we expect the combined LTV on existing mortgages to have increased for investors during the period in which they purchased additional properties.

Finally, we refer again to the amplification effects that result from shifts in the market toward more optimistic buyers. In the next section of the paper we explore the Geanakoplos hypothesis. We identify optimistic buyers as investors, and especially the "buy and flip" investors. We document the role of this class of investors over the past credit cycle both nationally as well in four boom states. We explore the extent to which the investor share of purchase transactions changes over the credit cycle. These changes are decomposed into both the extensive margin – more investors enter the market – and the intensive margin – existing investors increase the size of their portfolio of residential real estate exposures. We also examine the default behavior of investors as compared to owner-occupant borrowers. The final section of the paper discusses implications of our findings for current policy work on improving financial stability.

Investors and the Leverage Cycle

If Geanakoplos' description of the dynamics of the leverage cycle is applicable to the housing boom-bust cycle of the 2000s, we would expect to see changes in the characteristics of leveraged buyers of residential real estate over the period. In this section, we provide descriptive evidence of some major changes in the observable characteristics of mortgagors between 2000 and 2010.

While there has been some anecdotal evidence supporting the idea that investors played an important role in the boom, careful analysis of this issue has been impeded by lack of appropriate data.[20] For investors, the benefits of living in a house are immaterial to the decision of whether or not to keep making the mortgage payment, making default a less costly decision for investors than for owner-occupants. Of course, lenders are well aware of this difference, and typically require mortgagors to declare whether they will live in the collateral property, charging higher interest rates and requiring higher downpayments from those who acknowledge that they will not, *ceteris paribus*. But the interest rate penalty and limitations on leverage discourage borrowers from declaring their intention to live elsewhere, and self-reported "occupancy status" is thus considered a particularly unreliable piece of data. Haughwout *et al* (2008), for example, indicate their suspicion that miscoding of occupancy status in loan-level data may help to explain the large increase in early nonprime defaults that are unexplained by observable – i.e., reported - characteristics of loans and borrowers.[21] Fitch (2007) found evidence of occupancy misrepresentation in two-thirds of the small sample of subprime defaults they examined. It is thus desirable to identify a mortgage data source that allows the analysis of borrowers without relying on the information that is self-reported by the borrower on the mortgage application.

We bring two distinct kinds of data to the analysis of this important question. Our primary source is the FRBNY Consumer Credit Panel (CCP) which comprises an anonymous and nationally representative 5% random sample of US individuals with credit files and all of the household members of those 5%. [22] In all, the data set includes files for more than 15% of the population, or

[20] See, for example, http://www.metrotrends.org/commentary/mortgage-lending.cfm
[21] Early defaults are defined to be defaults that occur within the first year.
[22] The FRBNY CCP panel is based on Equifax credit report data. Lee and van der Klaauw (2010) provides further details on the data set. The analyses reported in this paper are solely based on the representative random sample and do not include the additional household members sampled.

approximately 37 million individuals in each quarter from 1999-2011Q1.[23] The FRBNY CCP data allow us to overcome some of the difficulties with self-reported occupancy status. Unlike loan-level data, which focus on individual debt contracts and the information used in underwriting them, credit reports are designed to give lenders (and potential lenders) dynamic credit information on individual *borrowers*, including the types and amounts of debt they have outstanding at any point in time. Our panel allows us to track individual borrowers over time, through refinances and moves, where at each point in time we observe all outstanding mortgage loans and non-mortgage debts.

We can use this information to separate mortgage borrowers based on how many distinct first-lien mortgage accounts appear on their credit reports. Since each property can secure at most a single first-lien mortgage, the number of such mortgages on a borrower's credit report is a reliable, non-self reported, indicator of the minimum number of properties a given individual has borrowed against.[24] This kind of information about individual borrowers is not available in loan-level data sets and thus the FRBNY CCP data provide a unique perspective into important questions about who is originating new mortgages at any point in time, as well as their subsequent behavior.

At this point, it is worth extending our earlier discussion of the relationship between the number of properties against which an individual has levered and what Geanakoplos describes in his leverage cycle theory. First, it is important to note that virtually all homeowners have some investment motivation in making a home purchase. While there is some debate in the academic literature about whether housing is a good investment relative to other assets, many buyers – whether they own only the home in which they live or own several units at a time – consider

[23] In the balance of the paper, we use the term "mortgages" to refer to installment debt secured by residential real estate. Mortgage payments are typically determined so as to pay off the balance, plus interest, over a fixed time period, but some mortgages negatively amortize – the balance can grow over time. HELOCs are lines of credit, again with residential real estate as the collateral. HELOC borrowers may utilize credit up to some fixed limit.

[24] Because some properties may have no first-lien mortgages but do secure a HELOC, our count of properties is a minimum rather than an exact figure. In addition, some properties support no debt at all.

expected capital gains a part of their motivation for buying rather than renting (Case and Shiller 1988). However, some homebuyers differ from others in that some or all of their residential property portfolio does not also directly provide them with shelter: that is, they own multiple properties and do not live in all of them. While we recognize the investment motive of all homeowners, we will refer to these multiple property owners as "investors". Regardless of what these borrowers are called, the data make clear that they act differently from other housing market participants, as we shall see below.

As we suggested above, some further differentiation among investors is in order. On the one hand, there exists a class of borrowers who buy properties in order to rent the housing units they contain. For these investors, the flow of rental income generated by real property is an important motivation for their investment, and the crucial consideration, as described above, is whether this income exceeds the cost of carrying the property (roughly speaking, principal, interest, taxes, insurance, maintenance net of any tax considerations) over a long period of time. Other investors may buy properties to use as a vacation or future retirement home. These "buy and hold" investors will thus be sensitive to changes in interest rates: a significant decline in rates can often offset the fixed cost of refinancing since they expect to hold the property for some time.

By comparison, the kind of investors portrayed in the popular television show "Flip This House" differs from those who hold assets for their income-generating potential. Indeed, in that program, a team of investors typically purchases a house, does some renovations and then re-sells the property to a new owner without ever receiving any rental income whatsoever. For these "buy and flip" investors, the primary motivation for the investment is capital gains, suggesting, for the reasons described above, that they will be both highly leveraged and will be considerably less sensitive to interest rate movements. In what follows, we will explore several dimensions of the behavior of investors in general, using the data on multiple first-lien mortgages as a way of

distinguishing investors from owner-occupants. In our analysis we will distinguish between different categories of investors; by whether they are holding 2, 3 or 4 or more first mortgages. It is more difficult in our data to differentiate investor type – flippers vs. holders – within each category, although changes in many of the investor series as the boom unfolds are strongly suggestive of a change in composition of the investor group, as we shall see.[25]

While the CCP data provides unique insights into the role of investors in the entire mortgage marketplace, it has some limitations. A specific drawback is the absence of information about the collateral property – its location and value – in the credit report data. To allow additional analyses, we have matched individual mortgage loans from the CCP data to loan-level data from CoreLogic's LoanPerformance ABS database. LoanPerformance ABS data provides detailed loan-level information on over 15 million securitized nonprime loans, including loans which were packaged into subprime and "Alt-a" private label securities, but excluding jumbo loans with balances that exceed the GSEs' conforming limits. The LoanPerformance (LP) data include detailed information on both the origination characteristics of the loans – such as level of documentation, interest rates, balance, and the value and location of the collateral property.[26] Interestingly, the data also include the borrower's self-reported occupancy intentions: indicating whether the property's purpose will be for owner-occupancy, for use as a second home, or for an investment property, which we can compare with our own definition of investors: CCP information on the number of first-liens

[25] Ex post we can differentiate by the average holding periods by different investors. However, the preferred classification would be based on the ex ante expected holding periods which we do not observe. Bayer et al (2011) use the former approach, defining flippers by the number of times they bought and sold a home in less than two years during the 1992-2005 period in Los Angeles. They then refer to individuals with two or three flips during the period as speculators, and those with over 10 flips as middlemen.

[26] Our merge was provided by Equifax Corporation using servicers' loan numbering system. Given that the CCP constitutes a representative random sample of individuals, the matched sample represents a representative random sample of LP loans.

reported contemporaneously on the borrower's credit report.[27] We will contrast the data on these "investor" definitions below; for now it is worth pointing out that the mortgage application refers to the reported use of a particular *property*, while the credit report refers to the extent of residential investment by an *individual*.

Our matched data are, of course, reflective of a subset of the entire market, albeit the part that changed most rapidly and noticeably during the boom. Even with the matched data, we are limited to analysis of individuals' credit reports: to the extent that residential real estate investment is conducted through incorporated businesses or partnerships, we will not capture that form of investor activity here. Notwithstanding these limitations, the FRBNY CCP and our matched dataset provides many unique benefits that will allow a much clearer picture of the kinds of borrowers holding, originating and defaulting on mortgages during the 2000s housing cycle. Moreover, the matched data overcome many of the limitations of the datasets used in isolation, and allow us to examine both the characteristics of the loans and details of the borrower's credit report simultaneously.[28]

Results

We begin by using the CCP data to provide a description of the part played by various types of buyers in the stock of outstanding mortgages. A fundamental stylized fact from the Geanakoplos model is that investors in their role as optimistic buyers ought to be playing an increasingly

[27] An alternative definition would define investors in a more static way, by identifying individuals who at *any point* in our sample period had more than one first-lien mortgage on their credit reports. Using that definition, our primary results remain similar to those reported here, although we discuss this distinction further below.
[28] We observe borrowers' credit reports on the final day of each quarter. Because there can be delays in credit reporting such that a mortgage that has been paid off may stay on the credit report for a period of time, we use the data's panel structure to correct for these delays. Throughout this section of our analysis investor status is determined based on the maximum number of first mortgages that appear in both of the two most recent quarters. Thus we can be more confident that each first-lien we consider is in fact associated with a unique property.

important role in borrowing during the upswing in the leverage cycle. Figure 3(a) shows the proportion of all new purchase mortgage balances originated by borrowers with 2, 3 and 4 or more first-lien mortgages on their credit reports in each quarter between 1999Q1 and 2010Q4. As can be seen in the figure, this investor proportion increased from around 20 percent in 2000 to a peak of nearly 35 percent in 2006. The purchase share for borrowers with 4+ first-lien mortgages increased by more than 5 percentage points over this period. Meanwhile, investors make up a much smaller share of refinance originations (see Figure 3(b)), a result consistent with the view that investors hold properties for shorter periods.[29] For borrowers with short time horizons, the fixed costs of refinancing can make the option to refinance uneconomic.

Previous research has indicated that there was significant variation in the timing and, most importantly, the amplitude of the housing cycle over space (see, for example, Himmelberg *et al* 2005). If investors were playing an important role in fueling the growth of house prices in those states which experienced the greatest increases, we would expect to see differences over space in investors' share of the mortgage market. Our data confirm this conjecture. Figure 3(c) displays the same information focusing on the four states that experienced an especially pronounced housing cycle: Arizona, California, Florida and Nevada. Multiple lien holders of all types (2, 3, and 4+) were more prevalent in these "bubble" states than they are for the nation as a whole. The investor share of purchase mortgages also increased faster in these states as the housing boom peaked, rising from almost 25 percent in 2000 to 45 percent in 2006. The purchase share for borrowers with 4+ first-lien mortgages increased by more than 7 percentage points (or 350%) over this period.

[29] Unlike loan-level data, borrower-level credit report data indicates the closing and opening of mortgage loans over time but do not include an indicator for whether a new mortgage loan represents a new purchase origination or a refinance. We identify refinances as a closing and opening of a new mortgage loan within a 6 month period during which the loan holder did not change address. Our refinance measure therefore may include some purchase loans associated with cases where an investor sold and bought a new property within a relatively short period of time. Nonetheless as shown later the patterns displayed in Figure 3 are mirrored in our matched sample, where loan purpose (purchase vs refinance) is explicitly measured. See Figure 7.

Given this evolution of the flow of mortgage borrowing, it is unsurprising that we find investors increasing their share in the *stock* of mortgage debts. Figure 4(a), shows the share of outstanding mortgage *balances owed* by the number of first-liens reported on the borrowers' credit report.[30] Beginning in 2004, we see a pick-up in the share of all mortgage debt owed by borrowers with multiple first-liens, and this figure reached 24.7% by early 2008. Figure 4(b) displays the same information for the four "bubble" states. At the peak nearly one-third of all first-lien balances in these four states were owed by borrowers with at least two first-liens. By the peak in early 2008, first-lien mortgage debts owed by bubble state borrowers with four or more first-liens had risen to nearly $170 billion, over three and a half times their levels of early 2004. Figure 5 shows the investor share over time by selected states. For all states listed, their share of mortgage balances increases over the boom but with less amplitude than in the bubble states.

In the upswing phase of a leverage cycle that is unfolding as described by Geanakoplos, we would expect to see increases in both the extensive margin (reflected here as increases in the share of buyers who have multiple first-liens) and in the intensive margin (increases in the number of first-liens held, conditional on having more than one and increases in the average balances for each mortgage). The data demonstrate both increasing prevalence of investors in the housing marketplace and an increase in their share of outstanding and newly originated debt. An increased share of borrowers with multiple first-liens is evidence of an increase in the *extensive* margin: investor status became more widespread during the boom, especially in those markets where prices rose the most sharply. The fact that the share of new and existing purchase mortgages were owed by investors

[30] Between 2004Q1 and 2008Q1 the share of borrowers who had multiple first-liens increased from 7.3% to nearly 10%. During this four year period, the share of all mortgage borrowers with four or more first-lien mortgages on their credit reports increased by more than 50% (from 0.43% to 0.70%). In bubble states the investor share increased from 10% to 14% during this period, while the share of borrowers with four or more first-liens increased from 0.65% to 1.22%

reflects this fact, but also may reflect the *intensive* margin, as investor-types increased their exposure to the housing market by borrowing more against residential property.

In order to discriminate between the two, we examine the intensive margin more carefully. In Table 3, we show the average balances on mortgages owed by the number of first-liens reported on the borrower's credit report for the US and the bubble states. We observe a change in the relative size of first-liens owed by highly leveraged borrowers. Because property values were rising sharply between 2000 and 2006, it is no surprise that the average balance on outstanding first-lien mortgages rose as well. But balances owed by investors rose even more sharply than those owed by owner-occupants. In 1999 for the US as a whole (panel (a) of Table 3), the average balance on first-liens owed by borrowers with debt secured by more than three properties was 13% higher than that of owner-occupants.[31] By 2006, the average investor balance (in the 4+ line) was nearly 50% larger than the corresponding owner-occupant figure. Interestingly, a more muted version of the same pattern obtains in the bubble states, shown in panel (b).

Further evidence of this increase in the intensive margin is found in Figure 6. Here we track the transitions into and out of the various first-lien mortgage count categories. In both panels (a) and (b) we find what we will refer to as "up-leveraging" transitions: the proportion of investors in year *t*-1 who have additional mortgages in *t*.[32] For example, Figure 6(a) shows that approximately 6% of all investors with two first-lien mortgages in 2005 had added a third by 2006. As can easily be seen in the figure, the proportion of all mortgage borrowers who added additional properties to their portfolios grew between 2000 and 2006, with the sharpest increases found among those who already had the highest residential real estate holdings. Around 12% of US borrowers with exactly three

[31] A similar relative increase is observed for average origination balances.

[32] The transition rates are based on the maximum number of first mortgages held during the two most recent quarters at time t, and the maximum number of first mortgages held during the two most recent quarters at time t-1.

first-liens in 2005 added additional properties to their portfolios during 2006; in the bubble states this figure exceeded 16%.

We conclude from our analysis that mortgage borrowing by investors – defined as those with multiple properties in their portfolios – increased substantially during the boom, especially in those markets where house price increases were particularly pronounced. We find evidence of increases in both the extensive margin – new investors entering the marketplace – and the intensive margin – increased exposure to residential real estate among previous investors.

These results contrast with previous discussions of the role of investors in the mortgage marketplace, and underscore the benefits of the FRBNY CCP for analyzing these questions. Mayer, Pence and Sherlund (2008), for example, conclude "because our data show that [self-identified] investors were a small or declining share of overall originations [of non-prime mortgages], it seems unlikely that they accounted for much of the rise in the overall delinquency rate *unless they increasingly misrepresented themselves as owner-occupiers* or their unobserved characteristics deteriorated over time." (2009, pg. 44, emphasis added). Our data allow us to "see through" the self-reported information captured on the mortgage application, and show precisely this – an increasingly large discrepancy between mortgage application occupancy self-reports and the number of first-liens on the credit report during the crucial 2004-2006 period. These results thus leave open the question of the role of these investors in the subsequent increase in defaults and delinquencies.

Figure 7 contains three panels which explore the relationship between occupancy self-reporting on mortgage applications and borrowers' first-lien counts for our matched CCP-LP sample. In panel (a), we plot the proportion of new nonprime purchase originations by self-reported occupancy status (from LP) and number of first-liens (from CCP). The dashed line plots the proportion of balances taken out by borrowers who checked either "2nd home" or "investor property" on the mortgage application, while the solid line shows the proportion of balances

originated by these same borrowers who, after closing this mortgage, simultaneously have two or more first-liens.[33]

Comparing the two series provides some insight into the value of self-reported occupancy status. First, at the beginning of the period the two series are reasonably close together, but even in 2000 there is a significant discrepancy between what borrowers report on the mortgage application and the number of properties they own. Over time, the proportion of new originations by borrowers who acknowledge that they will not use the home as their primary residence (the dashed line) increases slowly, and is fairly flat at 13-15% for the crucial 2004-2006 vintages. While we are including second homes, balance weighting and using only purchase mortgages, this pattern is similar to the results found by Mayer, Pence and Sherlund (2008). Meanwhile, however, the proportion of borrowers who have 2 or more first-lien mortgages rises much more quickly, and approaches 41% by 2006. The bubble states, shown in Figure 7(b), exhibit the same pattern, although in somewhat more extreme, where in 2006 the gap between self-reported occupancy status and the number of first-liens reached 30 percentage points. In other words, many of the borrowers who claimed on the mortgage application that they planned to live in the property they were purchasing had multiple first-lien mortgages when the transaction was complete. Mayer, Pence and Sherlund (2008) accurately report that borrowers' self-reported occupancy status was not changing dramatically during this period, but they are unable to observe the change in the characteristics of borrowers who report themselves as owner-occupants. In fact, the importance of investors as defined in the CCP – borrowers who have 2 or more first-liens on their credit reports – expanded sharply during this period, especially in the bubble states. Also note that this increase in the share of investors in non-prime purchase originations is very similar to that shown earlier for all purchase originations in Figure 5 (based on the entire CCP), which is reassuring.

[33] Recall we count only those first-liens that remain on the credit report for at least two calendar quarters.

While it is possible that all of these borrowers intended to live in the purchased property, it seems unlikely. In addition, the matched data allow us to track whether the individual changed addresses after closing the mortgage, and whether they moved to the same zip code recorded for the property. Figure 7(c) shows, by borrowers' self-reported occupancy status and the number of first-liens on their credit reports, the percentage who changed addresses to the zip code containing the property within two years of originating a nonprime purchase mortgage. Unconditional on self-reported occupancy status we find respectively 70% and 25% of single and four first-lien holders to have moved to the property zip code within two years of the new purchase. The data indicate further that 73% of those who claim owner occupancy while holding a single mortgage changed addresses and their new zip code matches that of the property. By contrast, only 43% of those who claimed owner occupancy on the mortgage application while carrying four or more first-liens prior to closing moved to the property zip code within two years. Unsurprisingly, relatively low shares (under 30%) of those who reported the property as a second home or investor property moved to the property zip code within two years. While the evidence cannot be definitive, we take this as suggestive of significant occupancy misrepresentation in nonprime mortgages during the boom.

Mortgage Products and Leverage

Since the Geanakoplos theory focuses on highly-leveraged positions taken by optimistic buyers here identified as investors, a natural next step in our discussion is to explore the leverage obtained by investors relative to owner-occupants. Our discussion proceeds on two fronts. We are able to provide some insight into this issue by using the CCP-LP matched sample to examine the mortgage products used by investors. Leverage theory suggests that "buy and flip" investors will want to use as much leverage as lenders will allow. We would expect to observe investors using non-prime mortgages – which allow for higher leverage than conforming mortgages - relatively more

than non-investors as the boom progressed. As noted above, investors are less sensitive to the higher interest rates charged on non-prime loans than owner-occupants due to the shorter expected holding period. Buy and flip investors are more willing to pay higher rates in order to increase leverage.

Figure 8 provides some insight into the mortgage products chosen by investors and non-investors. In panel (a) we plot the national proportion of first mortgage balances that were securitized by private ABS issuers, by the number of first-liens on the borrower's credit report.[34] These are essentially market shares for the nonprime mortgage lenders for each group of first mortgage holders, respectively. The temporal patterns are interesting: while the total nonprime share rose sharply in 2004 and 2005, borrowers with multiple first-liens were even more likely than other borrowers to obtain credit from the nonprime part of the market. By 2006, 26.0% and 24.4% of first mortgage balances associated with borrowers with three first-liens and four first-liens on their credit reports respectively, was nonprime, compared with 15% for those with a single first-lien. Panel (b) reports the same information for the bubble states, and demonstrates a more significant increase for all borrowers, as well as providing a similar picture of investors' preferences for nonprime credit.

The second piece of evidence we can bring to bear on the leverage issue is also from the matched sample. For securitized subprime and alt-a mortgages we observe lender-reported combined LTVs at the origination of each first-lien. Table 4 extends Table 2 by reporting the median combined LTV and the share exceeding 90 for our matched sample, focusing on 2002, 2004 and 2006 purchase originations only, drawing on the loan-level LP data. The table shows some striking features of the data. First, note that reporting an intention to live in the purchased property is consistent with higher leverage: in all years, self-declared owner occupants have higher median

[34] We calculated these figures by comparing the total originations in our matched sample with all purchase originations in our CCP data.

LTVs, and are much more likely to have LTVs above 90. Second, conditional on their self-reported status, borrowers' property ownership, reflected by the number of first-liens on the credit report, does not have a consistent relationship with LTV.

We conclude that, given down payment requirements in the prime market, investors were able to increase their leverage by disproportionately using nonprime securitized mortgages, and were a major driver of growth in that important market segment. By declaring an intention to live in the properties collateralizing these loans, investors were able to reduce both the interest rates and the minimum downpayments, with the latter being the most valuable for our buy and flip investors.

An additional development of interest in the type of mortgage loans chosen by investors and non-investors is shown in Figure 9(a) for the nation and 9(b) for the bubble states. Here we consider whether the account was an individual or joint account. This distinction is interesting for two reasons. First, we do not observe debt-to-income ratios in our data, but it is a reasonable presumption that individual accounts carry higher ratios since they depend on the income of a single borrower; of course the narrower support makes these mortgages riskier as well.[35] Second, if the borrower is making a speculative leveraged investment, it is presumably a dominant strategy to expose only one credit account to the risk of a foreclosure. . The figure documents a general increase in the use of individual as opposed to joint mortgage accounts that began after 2000 and finally began to taper off at the end of 2007. However, the shift from joint to individual mortgage accounts since 2001 was much greater for investors, especially for investors with 4 or more first mortgage accounts. By 2007 over 60% of the total outstanding first mortgage balance in the US was associated with individual accounts. Interestingly, unlike for single mortgage-holders, for investors the balance share associated with individual accounts began to drop after 2007. As shown in Panel

[35] Indeed, in the hazard analysis described below, we find that individual accounts are more likely to transition into 90+ day delinquency, cet. par.

9(b), the same trends apply to the bubble states, except that the increase in the balance-weighted share of debt in individual accounts was more pronounced.

The Geanakoplos leverage cycle theory predicts that as an asset price boom unfolds, buy and flip investors will become a more important share of the investment property marketplace. As hypothesized earlier, as the housing boom intensifies investors are likely to reduce their expected and actual holding periods. We can provide insight into whether this hypothesis is consistent with housing market developments during the 2000s boom by examining the holding periods for mortgages originated during the boom. Figure 10 provides some of this evidence. Here we plot the share of all purchase mortgages securing property sold in year *t* that had been held for less than three years. As an example, during 2006 60% of mortgages paid off (excluding re-finances) by borrowers with at least four first-liens had been originated less than 36 months earlier.

In the figure, we see evidence of several interesting phenomena.[36] First, fairly large shares of first-liens are held for a short period of time. Even in the early part of our sample, between 30 and 40 percent of pay-offs are for mortgages on properties held for less than three years, regardless of the investor status of the seller. Second, as a group, borrowers with multiple first-liens initially look quite similar to owner-occupants in their mortgage durations. As the boom unfolds, however, we see increasing shares of properties held by investors (see especially the 3 and 4+ lines) being sold quickly. By the peak of the market, a large share of sales by investors complete relatively short holding periods. Our interpretation of this phenomenon is that the composition of those in the multiple first-lien categories is shifting from "holders" to "flippers".

Delinquencies and de-leveraging during the bust

[36] A chart showing the share of mortgage closings that were originated within the past two years showed very similar trends, but with levels peaking during the 2004-2007 period at around 35 percent for 4+ investors while the rate during the period fell from about 20 to 15 percent for single homeowners during that period.

We have shown that short time-horizon multiple first-lien holders became an increasingly important part of the mortgage marketplace during the boom between 1999 and 2006, thus confirming that several elements of the Geanakoplos leverage cycle model are applicable to the US housing market. The second stage of the cycle is the bursting of the bubble, reflected in this case by the collapse in housing prices and sharp increases in delinquencies and defaults after 2006. Here again the model contains several implicit predictions that we can examine with our data.

One such prediction is that investors will stop increasing their exposure to real estate and will rapidly begin to divest themselves of their positions. We saw clear evidence of this in Figure 6, particularly in the bubble states (panel (b)), where 17% of three property owners had increased their exposure to housing during 2006; by 2009 that figure was just over 1%. This sharp reduction in additions to the intensive margin is consistent with a rapid retrenchment among investors. Figures 3 and 4 and Table 3 all contain evidence consistent with the conclusion that investors reduced their role in the market after prices peaked in 2006-2007, including reductions in both the extent and intensity of investor activity.

A second prediction, not only from Geanakoplos but also from the previous literature on mortgage defaults, is that investors will be quite influenced by house price changes in their repayment behavior.[37] Figure 11 provides some evidence for this hypothesis. In panel (a), which depicts the severe delinquencies contributed by multiple first-lien holders in the nation as a whole, we see an extraordinarily rapid increase in the investor share. Early in the period, as house prices were rising, severe delinquencies by investors, especially those with three or more first-liens, were quite rare, and considerably below their proportionate share of outstanding first-lien balances. Beginning in early 2006, however, as the housing market peaked, serious mortgage delinquencies by

[37] This is consistent with the findings in Mayer et al (2009) which found the decline in house prices to be a key factor in explaining the big increase in mortgage delinquencies.

investors rose sharply, and by 2007 investors' delinquency share exceeded their share of outstanding mortgage debt. This period was marked by especially large, disproportionate delinquencies by borrowers with three or more first-liens. A similar, even more dramatic, version of this dynamic is present in the bubble states, depicted in Figure 11(b). Here, the data indicate a virtual explosion in delinquencies among multiple first-lien borrowers, especially those with more than two properties.

We can also investigate the relationship between investor status and delinquencies in the securitized non-prime sector using our matched sample. Moreover, we are able to do so for both the multiple first-lien and declared owner-occupancy measures of investor status. In Figure 12, panel (a) shows the contributions, in billions of dollars, to serious delinquencies for the nation for borrowers with single and multiple first liens. Panels (b) and (c) instead show the balance-weighted shares in serious delinquent debt for the nation and the bubble states for borrowers who had multiple first-liens and those who reported that they would not be using the home as their primary residence. What is evident from these figures is, as noted previously, a huge increase in serious delinquencies in the non-prime sector after the house price peak in 2006, with a large share coming from the bubble states. Perhaps more important for our purposes is that reliance on the self-reported occupancy status to understand the increase would lead researchers to conclude that investors had relatively little to do with the rise in delinquencies, whereas in fact the contribution from borrowers with multiple first-liens (the CCP measure) is very large, reaching almost $250 billion by 2009 in the securitized non-prime sector alone.

Among the underlying forces behind the increase in delinquencies among investors are (a) a sharp increase in the rate of initial delinquency among investors, (b) a large increase in the rate at which initial delinquencies transition into a severe delinquency and (c) a large decrease in the rate at which initial delinquencies cure. Investors not living in houses they own will make their default decisions purely based on investment motives, as opposed to consumption motives. This suggests

more ruthless or strategic behavior on the part of investors where conditional on an initial delinquency, loans would transition more quickly into defaults. As shown in Figure 13(a), while transition rates into early delinquency were lower among investors before 2007, they were much higher in the subsequent period, especially for those with 4 or more first mortgages. Figure 13(b) shows that such early delinquencies after 2006 also transitioned into defaults at a much higher rate for investors, with fewer early delinquent loans curing as seen in Figure 13(c).[38]

To obtain some further insight into the sharp increase in delinquencies among investors, we next investigate the role of various investor characteristics. First, as documented earlier, the investor share of mortgage holders was much greater in the bubble states, states which subsequently experienced the sharpest house price declines. Second, reflecting their growing share in real estate transactions, mortgages held by investors were more likely to have been originated in more recent years. Unlike homes purchased in earlier years, homes bought after 2005 experienced little or no price appreciation and their buyers therefore saw no gains in home equity. The subsequent drop in house prices was therefore more likely to cause these mortgages to go underwater, a necessary condition for default. Third, as shown earlier, investors are more likely to use non-conforming loans, which generally carry higher interest rates, and to use individual rather than joint mortgage loans. Moreover, average origination balances generally were higher among investors. All these factors could put mortgages held by investors at greater risk of default.

To analyze the respective importance of these factors, we estimated a set of loan-level delinquency hazard models, relating the quarterly rate of entry into 90+ day delinquency to loan and borrower characteristics. Linear probability model estimates of the year-specific impacts of investor status on the delinquency rate are presented in Table 5. The models underlying the estimates in the

[38] In additional analyses, not reported here, we found very similar trends in transition rates for the subset of conforming loans.

first panel of the table impose a linear effect of number of first-mortgages held, while the second panel estimates separate effects for investors holding 2 and 3+ first mortgages. For each, we estimated four different models. The first includes only includes year fixed effects as controls. The second specification adds state fixed effects, while the third specification in addition includes loan vintage-year dummies. Finally, the fourth also includes controls for loan characteristics including loan origination amount, loan type (whether guaranteed by Government Sponsored Enterprises Fannie Mae and Freddie Mac, FHA/VA, other) and whether the mortgage account was individual or joint.[39]

The estimates for specification (1) mirror those in Figure 7, showing lower average delinquency rates for investors up to 2006, and higher rates since then, especially among those with 4 or more first mortgages. Adding controls for state fixed effects in specification (2), vintage effects in specification (3), and loan characteristics, in specification (4), leads to subsequent declines in the estimated remaining investor effect, indicating that each set of controls can explain a piece of the higher overall delinquency rates of investors. A graphical depiction of the year-specific investor effects are shown in Figure 14. The estimates imply that slightly more than half of the change in the relatively delinquency rates of investors versus non-investors can be accounted for by differences in the timing and location of home purchases and differences in the types of mortgages used to finance these purchases. However, substantial investor effects remain, suggesting that there were additional unmeasured differences between investors and non-investors that put mortgage loans of the former at higher risk of default.

The second panel in Table 5 repeats the same analysis but using a specification that allows for year-specific effects of investors with 2 or 3+ first mortgages. The estimates indicate that the

[39] For a subset of GSE mortgage loans in our database, the GSE identifier was missing. Therefore the included measure is only a rough proxy of true loan type.

difference between delinquency rates for investors with 3+ mortgages and single home-owners was much larger than for investors with 2 mortgages – they were much safer before 2006 and much riskier after 2006, when prices had begun to decline.

Finally, we repeated the loan-level delinquency hazard models using a different definition of investor. Instead of a cross-sectional definition, where investor status can change over the life of a loan as loans are added or closed, we adopt a panel definition, where investors are defined by the maximum number of first mortgage loans held during the lifetime of the loan. Such a definition allows us to identify loans as associated with individuals who previously were investors but closed some of their other mortgages. This may occur, for example, where other properties in an investor portfolio are sold or foreclosed on. As shown in Table 6, investor effect estimates both before and after 2006 are generally somewhat larger in absolute magnitude. The biggest difference in estimates when compared to Table 5 are for 2010 representing the extent of deleveraging by investors. Figure 14(a) and 14(b) summarize the investor effects for each analysis.

All of these results underline the reasons for our focus on these borrowers, whether one chooses to refer to them as investors or not: as a group the behavior of owners of multiple properties was significantly more pro-cyclical than that of other borrowers throughout the 2000s.

Conclusion

The effects of boom-bust cycles in asset prices are nowhere more potentially dangerous than in housing, which makes up about 80% of the debts owed by households. While changes in underwriting standards have been the focus of many studies trying to understand housing cycles, less attention has been paid to how these standards interact with the distribution of borrowers in the marketplace. Our exploration of the 2000s housing cycle suggests that this interaction was an important, but poorly understood, dynamic. Our analysis reveals patterns consistent with

Geanakopolos's theory of the leverage cycle. Possibly house price-driven relaxation of down payment and documentation standards induced or facilitated a change in the composition of mortgage borrowers toward more optimistic buyers, here identified as short time horizon investors. Giver their willingness to bid more aggressively, the large influx of investors is likely to have amplified the upward pressure on house prices during the boom. As they represented almost half of all buyers in the bubble states during the boom, we can expect an impact on the appraisals and purchase prices of homes bought by non-investors. Our analysis also indicates that these marginal borrowers appear to have contributed substantially to both the increasing amount of real estate-related debt during the boom, and to the rapid deleveraging and delinquency that accompanied the bust. Whatever term one chooses to use in referring to borrowers with multiple first-liens, their behavior is worthy of study, as it is quite different from that of single-property owners.

The findings in our paper so far have important implications for the design of future policies to reduce the likelihood and deleterious consequences of future house price bubbles. While investors in the role of 'middlemen' can provide important liquidity to the housing market (Bayer et al, 2011), investors as speculators can generate amplifications of house price movements. There is thus scope for policy instruments that target the activities of speculative investors. To dampen speculation and to cool down the nation's housing market, the Chinese government during the past few years has implemented a number of successive tightening measures that include higher down-payments and mortgage rates on second and additional investment homes.[40] Some cities in China have also introduced a new real estate tax on such properties as well as limits and freezes on the purchasing of second and additional investment homes. Such explicit management of the use of leverage by

[40] Down payment requirements for the purchase of second homes and additional investment properties were increased to 30% of the property price in January 2010, to 50% in April 2010 and 60% in February 2011.

optimistic buyers may serve to dampen upswings in asset markets, thereby ameliorating the effects of the decline if and when it occurs.

Our findings regarding the role of investors in the housing boom and bust and the high rate at which they defaulted after 2007 also has important implications for the design of effective, equitable and targeted assistance programs. While the majority of home-owner assistance programs developed over the past several years have been targeted to owner-occupants, many have experienced relatively low take-up rates. If, as indicated here, a large share of defaulters are not living in the collateral home, then programs such as HAMP may not be effective in stemming foreclosures. On the other hand, less sensitive policies, like blanket modifications offered regardless of occupancy status might be more efficient, but would provide assistance to a large class of multiple property owners – no one's first priority for receiving taxpayer dollars.

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Table 1. Distribution of Mortgage Loan Documentation Level, by Year

Year	Full	Low	None
Subprime[1]			
2001	77.84	21.76	0.40
2002	71.13	28.30	0.57
2003	67.02	32.52	0.46
2004	65.37	34.34	0.29
2005	62.28	37.47	0.24
2006	61.71	38.00	0.29
2007	64.20	35.48	0.32
Alt-a			
2001	36.77	55.56	7.68
2002	40.64	51.96	7.40
2003	35.50	57.26	7.23
2004	37.75	55.72	6.53
2005	31.11	64.44	4.46
2006	18.92	76.56	4.53
2007	16.84	77.49	5.68

Notes: Authors calculations.
[1] Source: LoanPerformance data

Table 2. Mortgage Leverage During the Housing Boom

	All Housing Purchases[1]				Nonprime Purchase Mortgages[2]			
Year	25th	50th	75th	90th	25th	50th	75th	90th
2004	56	80	95	100	80	95	100	100
2005	64	86	99	100	80	95	100	100
2006	70	90	100	100	90	99	100	100

Notes: Percentiles of the distribution in each year of combined origination loan-to-value ratios
[1] Source: Glaeser *et al* (2010). DataQuick data from 89 metro areas
[2] Source: LoanPerformance data on securitized non-prime mortgages.

Table 3. Average balance per mortgage, by investor status[1]

a. US

Year	Number of First Mortgages Held			
	1	**2**	**3**	**4+**
1999	95,160	102,636	105,917	100,489
2000	98,317	105,618	109,636	102,624
2001	102,664	113,750	120,447	110,290
2002	110,227	122,222	130,521	117,925
2003	123,335	139,651	146,173	128,873
2004	131,992	153,712	164,099	142,328
2005	141,977	171,042	187,087	158,730
2006	150,840	186,609	207,801	185,337
2007	157,965	197,464	218,394	201,147
2008	160,818	198,283	217,812	197,969
2009	161,194	197,127	212,477	193,175
2010	160,331	193,429	203,860	183,640

b. Bubble States

Year	Number of First Mortgages Held			
	1	**2**	**3**	**4+**
1999	116,037	120,670	125,548	120,033
2000	120,534	124,715	132,297	122,919
2001	125,809	133,262	141,287	127,844
2002	136,490	145,598	152,644	139,575
2003	155,907	167,779	171,582	162,933
2004	172,227	190,560	201,527	185,925
2005	193,432	220,128	232,655	211,273
2006	212,578	242,978	262,601	243,702
2007	225,048	258,618	278,413	262,718
2008	226,177	256,374	272,984	258,179
2009	223,594	252,630	266,031	254,578
2010	219,407	245,778	255,779	238,709

[1] *Notes*: Q4 values of average mortgage balance
Source: FRBNY Consumer Credit Panel

Table 4: Combined Loan to Value ratios at Origination, Securitized Non-prime Mortgages

	2002		2004		2006	
	Median	% > 90	Median	% > 90	Median	% > 90
Self-report owner-occupied . . .						
. . .with 1 first-lien	85	31.6%	95	58.8%	100	70.3%
. . .with 2 first-liens	90	31.6%	95	57.4%	100	67.6%
. . .with 3 first-liens	80	25.0%	95	51.1%	100	65.1%
. . .with 4+ first-liens	85	15.8%	90	44.5%	100	70.5%
Self-report second home . . .						
. . .with 1 first-lien	80	11.1%	80	10.0%	90	37.8%
. . .with 2 first-liens	83	0.0%	90	19.0%	90	40.9%
. . .with 3 first-liens	80	0.0%	90	13.3%	90	29.8%
. . .with 4+ first-liens	73	0.0%	80	6.3%	90	35.4%
Self-report investment home . . .						
. . .with 1 first-lien	85	12.8%	90	27.4%	90	38.3%
. . .with 2 first-liens	85	5.8%	90	18.8%	90	31.2%
. . .with 3 first-liens	85	5.0%	90	16.2%	90	36.3%
. . .with 4+ first-liens	80	0.0%	90	16.7%	90	31.1%

Source: FRBNY Consumer Credit Panel

Table 5. Annual Investor Effects on 90DPD Delinquency Rate[1]

Linear Investor Effect

	Specification			
Year	(1)	(2)	(3)	(4)
1999	-0.08%	-0.08%	-0.08%	-0.07%
2000	-0.07%	-0.07%	-0.07%	-0.05%
2001	-0.11%	-0.09%	-0.10%	-0.07%
2002	-0.13%	-0.12%	-0.12%	-0.11%
2003	-0.11%	-0.09%	-0.09%	-0.06%
2004	-0.09%	-0.08%	-0.07%	-0.04%
2005	-0.06%	-0.05%	-0.06%	-0.04%
2006	-0.03%	-0.02%	-0.05%	-0.05%
2007	0.14%	0.11%	0.01%	-0.02%
2008	0.41%	0.28%	0.12%	0.07%
2009	0.40%	0.26%	0.11%	0.08%
2010	0.10%	-0.01%	-0.12%	-0.12%

Separate Investor Effects

	Specification							
	(1)		(2)		(3)		(4)	
	Investor Type		Investor Type		Investor Type		Investor Type	
Year	2	3+	2	3+	2	3+	2	3+
1999	-0.06%	-0.20%	-0.06%	-0.21%	-0.06%	-0.21%	-0.04%	-0.20%
2000	-0.15%	-0.13%	-0.14%	-0.13%	-0.14%	-0.13%	-0.10%	-0.11%
2001	-0.08%	-0.30%	-0.06%	-0.27%	-0.07%	-0.27%	-0.02%	-0.23%
2002	-0.15%	-0.30%	-0.14%	-0.28%	-0.14%	-0.29%	-0.11%	-0.25%
2003	-0.14%	-0.23%	-0.12%	-0.20%	-0.12%	-0.19%	-0.08%	-0.13%
2004	-0.15%	-0.15%	-0.12%	-0.12%	-0.12%	-0.11%	-0.07%	-0.05%
2005	-0.18%	-0.06%	-0.16%	-0.04%	-0.17%	-0.06%	-0.13%	-0.03%
2006	-0.04%	-0.06%	-0.02%	-0.03%	-0.06%	-0.10%	-0.03%	-0.10%
2007	0.28%	0.33%	0.24%	0.26%	0.09%	0.02%	0.11%	-0.05%
2008	0.41%	1.03%	0.27%	0.71%	0.03%	0.34%	0.04%	0.20%
2009	0.34%	1.15%	0.18%	0.81%	-0.02%	0.45%	0.02%	0.35%
2010	0.19%	0.23%	0.08%	-0.04%	-0.03%	-0.30%	0.03%	-0.34%

[1] *Source*: FRBNY Consumer Credit Panel. Linear probability model estimates of year-specific impacts of the current number of first mortgages held on the quarterly entry rate into 90+ delinquency. The first panel imposes a linear effect, while the second panel estimates separate effects for investors holding 2 and 3+ first mortgages. Specification (1) controls for year fixed effects. Specification (2) adds state fixed effects, and specification (3) in addition includes loan vintage-year dummies. Specification (4) adds controls for loan characteristics such as the loan origination amount, whether loan was guaranteed by a GSE, and whether mortgage account was individual or joint.

Table 6. Annual Investor Effects on 90DPD Delinquency Rate – Panel Definition of Investor[1]

Linear Investor Effect

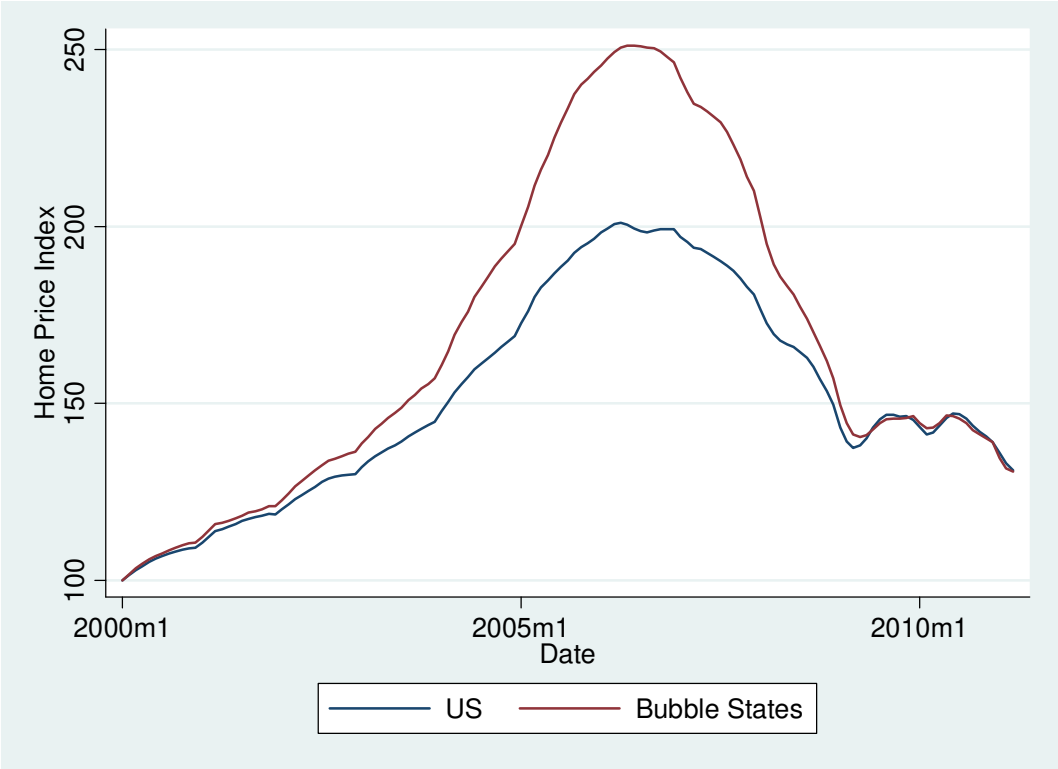
	Specification			
Year	(1)	(2)	(3)	(4)
1999	-0.10%	-0.10%	-0.10%	-0.09%
2000	-0.10%	-0.10%	-0.10%	-0.08%
2001	-0.16%	-0.15%	-0.15%	-0.13%
2002	-0.18%	-0.17%	-0.17%	-0.16%
2003	-0.14%	-0.13%	-0.13%	-0.10%
2004	-0.13%	-0.12%	-0.12%	-0.09%
2005	-0.09%	-0.08%	-0.09%	-0.06%
2006	-0.05%	-0.03%	-0.05%	-0.04%
2007	0.06%	0.03%	-0.03%	-0.04%
2008	0.35%	0.23%	0.12%	0.08%
2009	0.34%	0.20%	0.09%	0.07%
2010	0.17%	0.07%	-0.03%	-0.03%

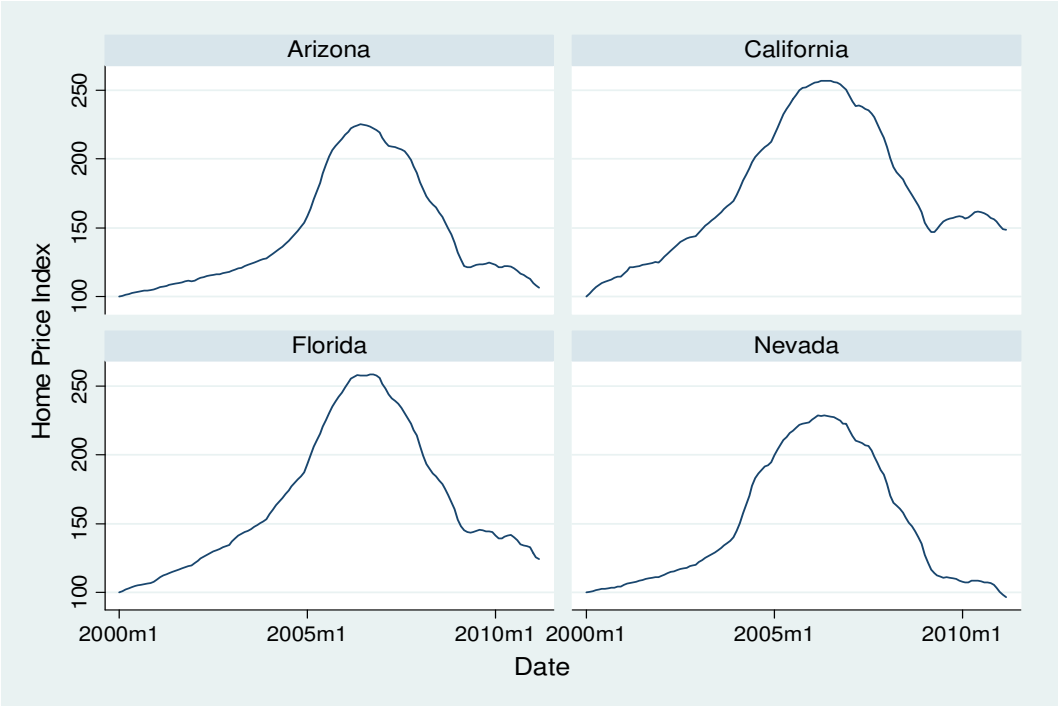
Separate Investor Effects

	Specification							
	(1)		(2)		(3)		(4)	
	Investor Type		Investor Type		Investor Type		Investor Type	
Year	2	3+	2	3+	2	3+	2	3+
1999	-0.13%	-0.22%	-0.13%	-0.23%	-0.13%	-0.22%	-0.12%	-0.21%
2000	-0.17%	-0.20%	-0.17%	-0.20%	-0.17%	-0.20%	-0.14%	-0.17%
2001	-0.20%	-0.36%	-0.19%	-0.34%	-0.20%	-0.35%	-0.16%	-0.29%
2002	-0.27%	-0.37%	-0.27%	-0.36%	-0.27%	-0.37%	-0.24%	-0.33%
2003	-0.20%	-0.30%	-0.19%	-0.28%	-0.19%	-0.28%	-0.14%	-0.21%
2004	-0.22%	-0.26%	-0.20%	-0.23%	-0.20%	-0.22%	-0.14%	-0.15%
2005	-0.21%	-0.17%	-0.20%	-0.14%	-0.20%	-0.16%	-0.16%	-0.11%
2006	-0.19%	-0.06%	-0.17%	-0.02%	-0.18%	-0.07%	-0.15%	-0.06%
2007	0.01%	0.18%	-0.03%	0.11%	-0.08%	-0.05%	-0.05%	-0.10%
2008	0.14%	1.01%	0.00%	0.71%	-0.09%	0.43%	-0.07%	0.33%
2009	0.10%	0.97%	-0.07%	0.65%	-0.16%	0.36%	-0.10%	0.29%
2010	0.13%	0.51%	0.01%	0.26%	-0.07%	0.03%	-0.01%	0.01%

[1] *Source*: FRBNY Consumer Credit Panel. Linear probability model estimates of year-specific impacts of the maximum number of first mortgages held during the lifetime of the loan on the quarterly entry rate into 90+ delinquency. The first panel imposes a linear effect, while the second panel estimates separate effects for investors holding 2 and 3+ first mortgages. Specification (1) controls for year fixed effects. Specification (2) adds state fixed effects, and specification (3) in addition includes loan vintage-year dummies. Specification (4) adds controls for loan characteristics such as the loan origination amount, whether loan was guaranteed by a GSE, and whether mortgage account was individual or joint.

Figure 1. House Price Dynamics – US and AZ, CA, FL and NV





Notes: CoreLogic overall repeat-sale price indices. January 2000 = 100.

Figure 2. Maximum House Bids and LTV

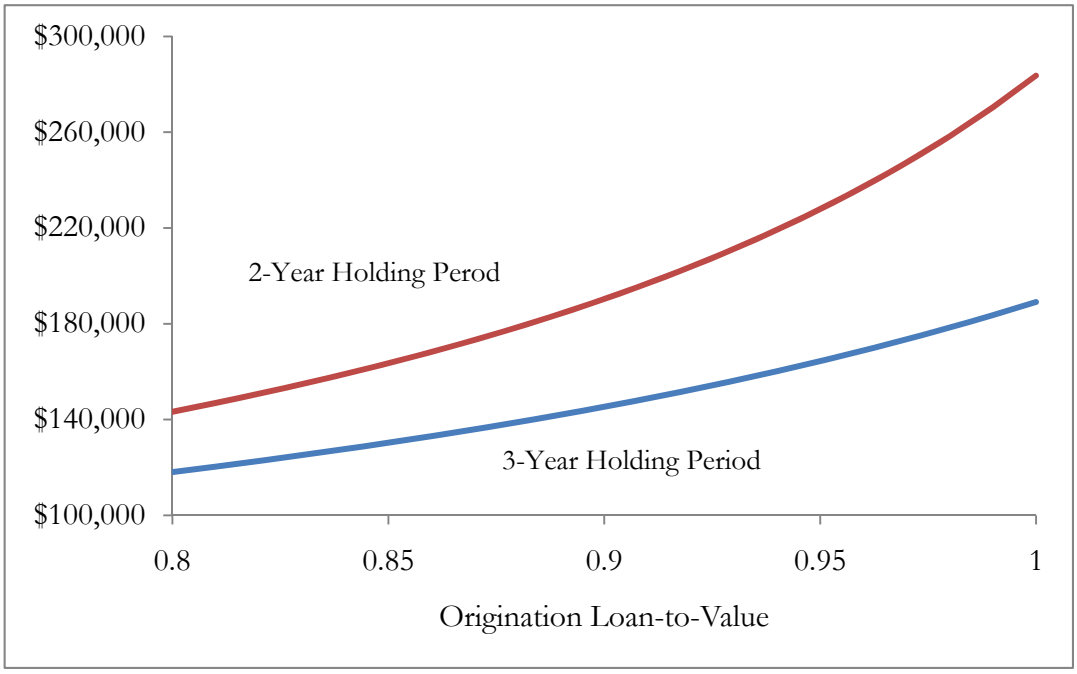
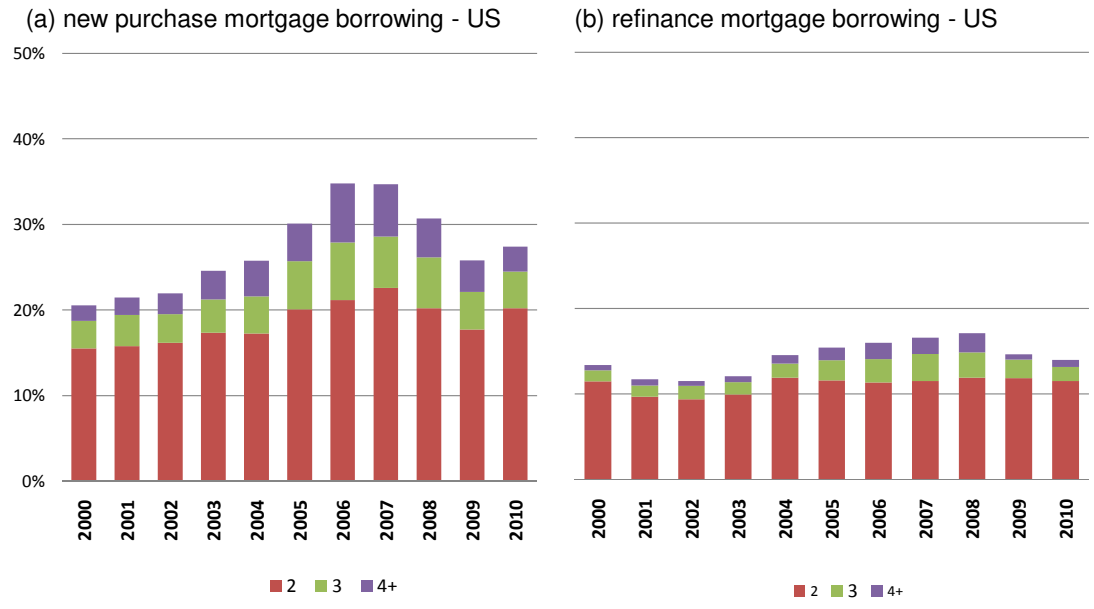


Figure 3. Investor shares in new mortgage borrowing
(by number of first mortgages)



Source: FRBNY Consumer Credit Panel, 1% sample

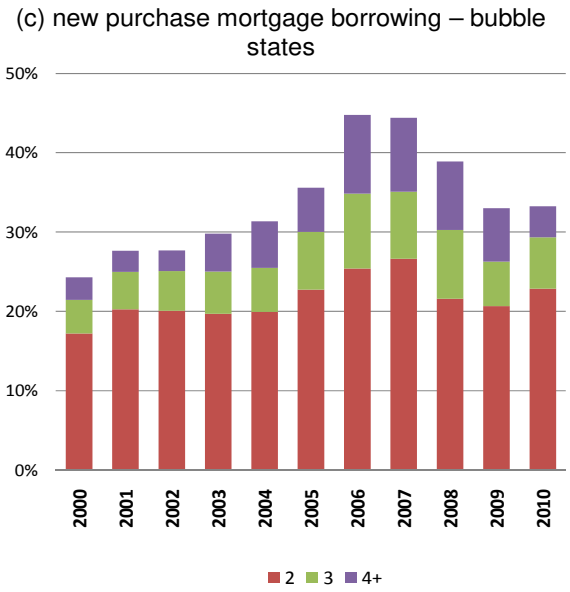
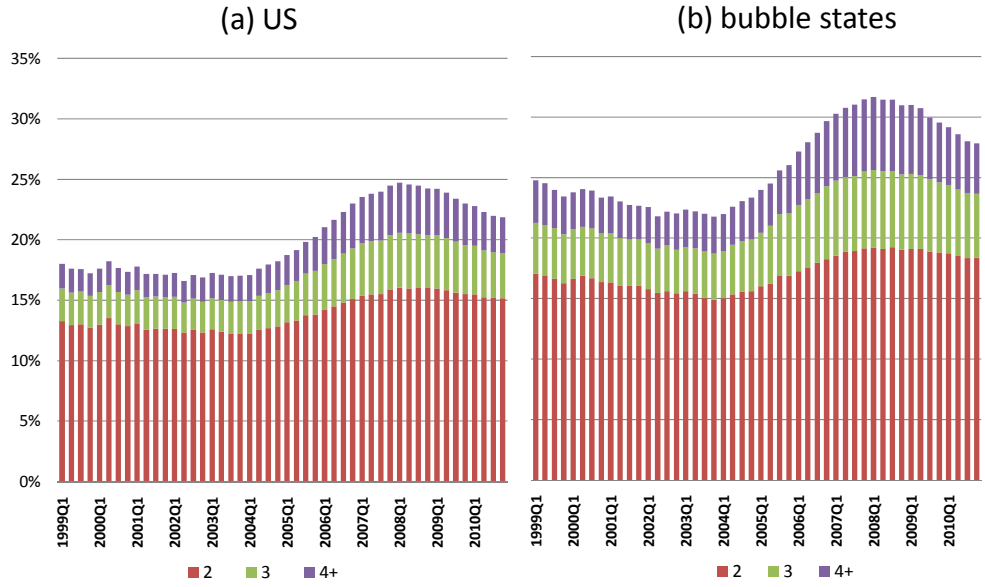


Figure 4. Investor share in aggregate first mortgage balance (by number of first mortgages)



Source: FRBNY Consumer Credit Panel, 1% sample

Figure 5. Balance share of 2+ first mortgage holders by state

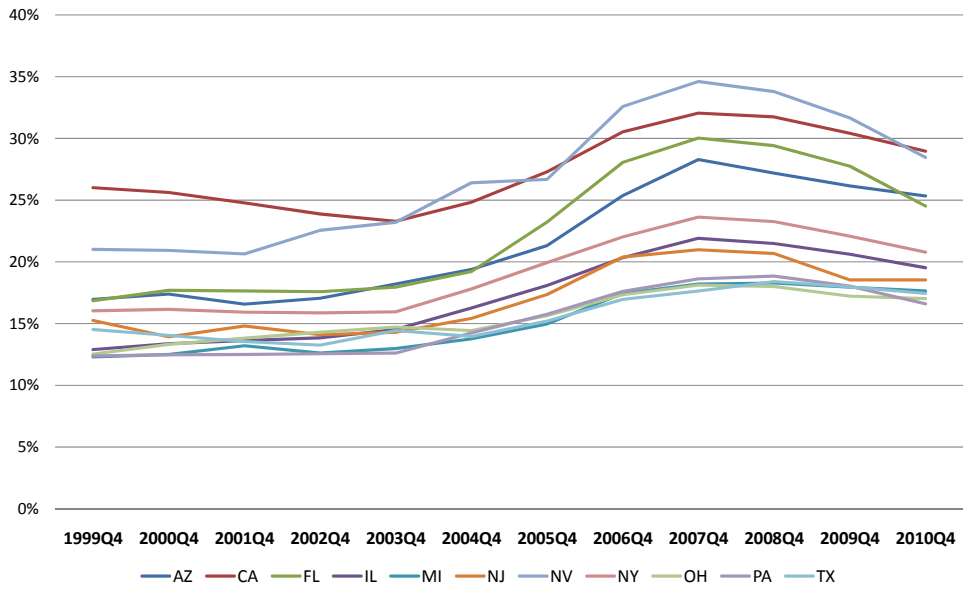
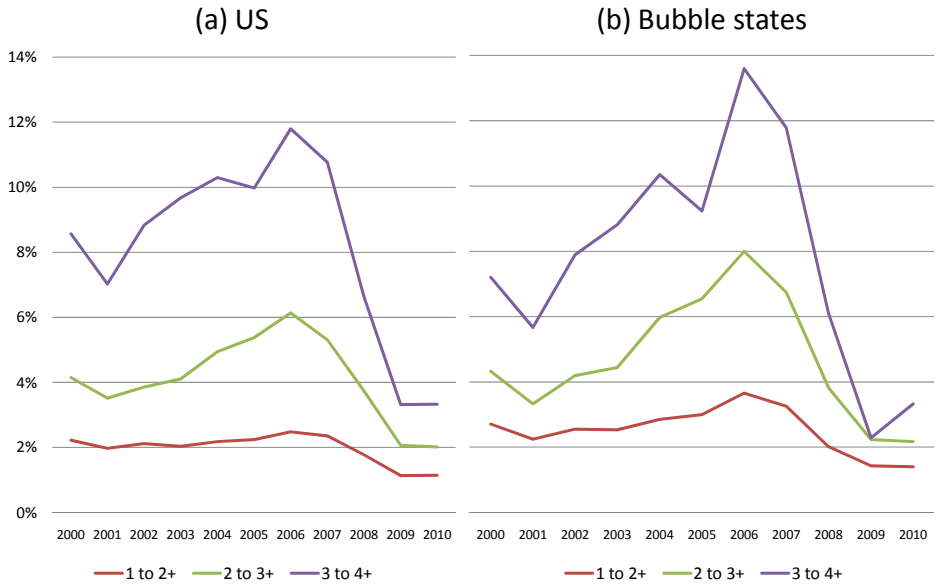


Figure 6. Average quarterly transition rates (t-1 to t) in # of first mortgages, by year



Source: FRBNY Consumer Credit Panel, 1% sample

Figure 7. Investor share of purchase origination balances, LP and CCP definitions

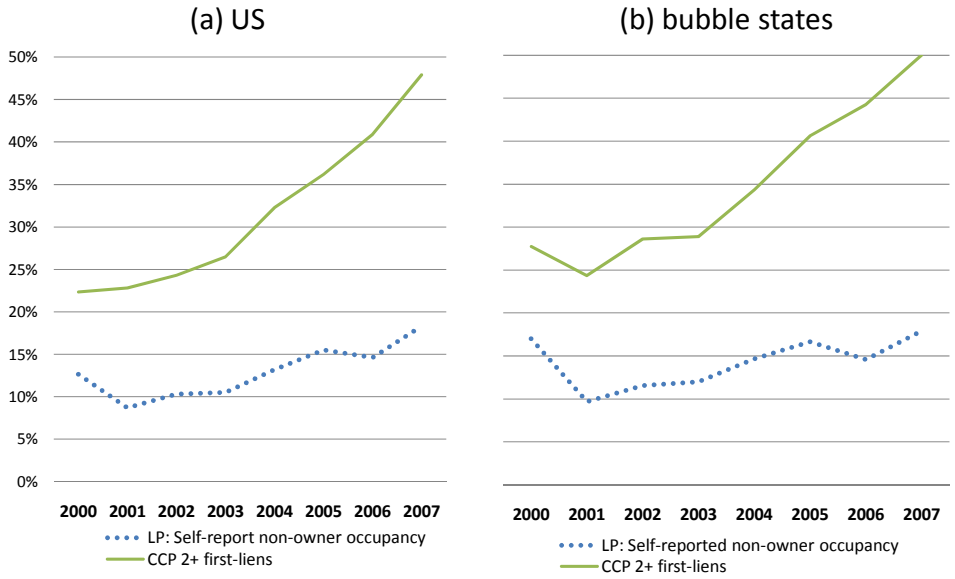
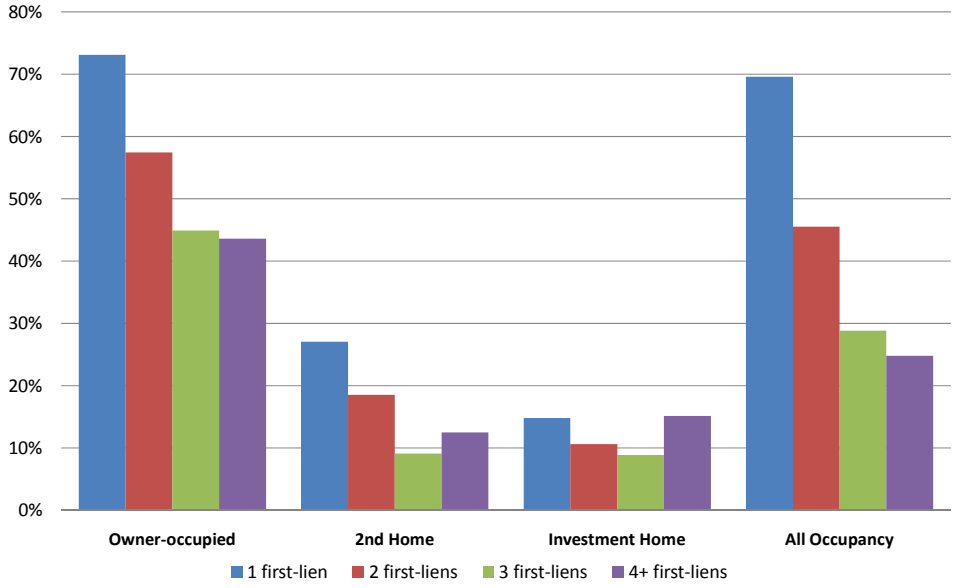


Figure 7(c). Share of new purchasers moving to property Zip code, LP and CCP investor definitions



Source: FRBNY Consumer Credit Panel, 1% sample

Figure 8. Share securitized non-prime in aggregate mortgage balance, by investor type

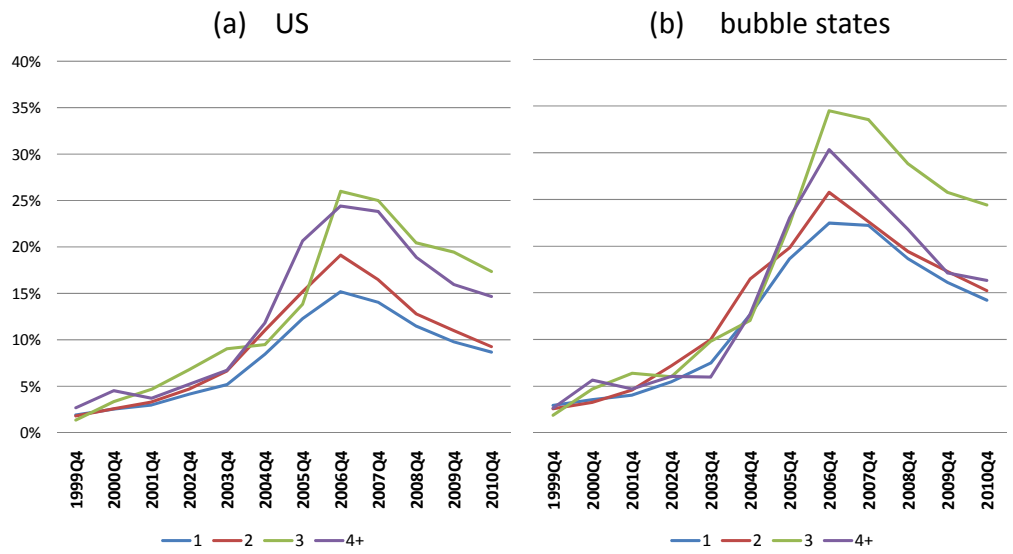
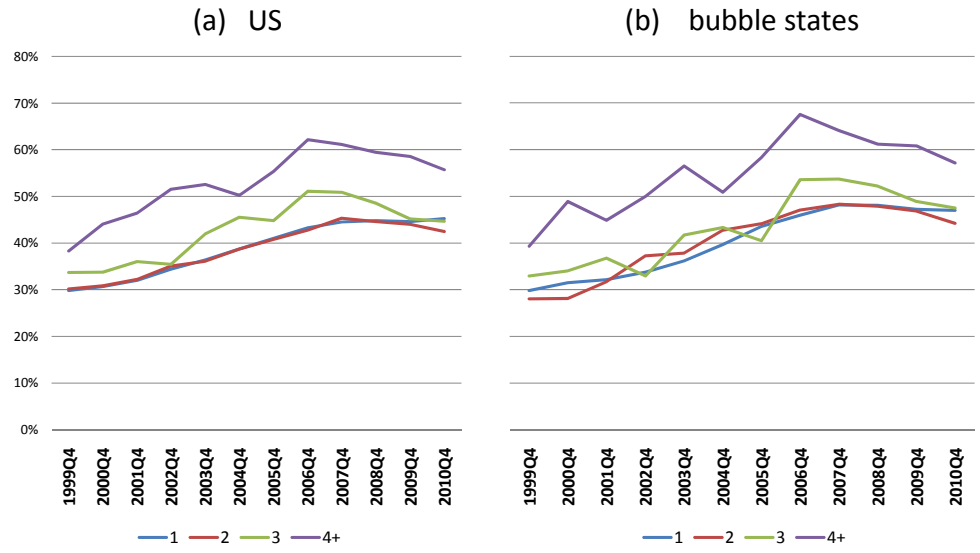


Figure 9. Share of aggregate mortgage balance in individual accounts, by investor type



Source: FRBNY Consumer Credit Panel, 1% sample

Figure 10. Proportion of mortgage payoffs that were originated within the past three years, by investor type

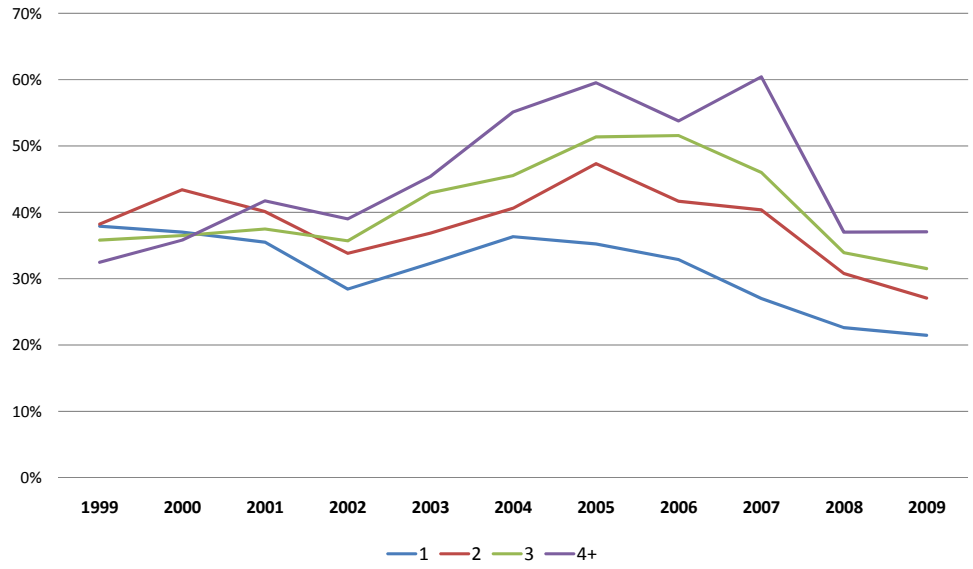
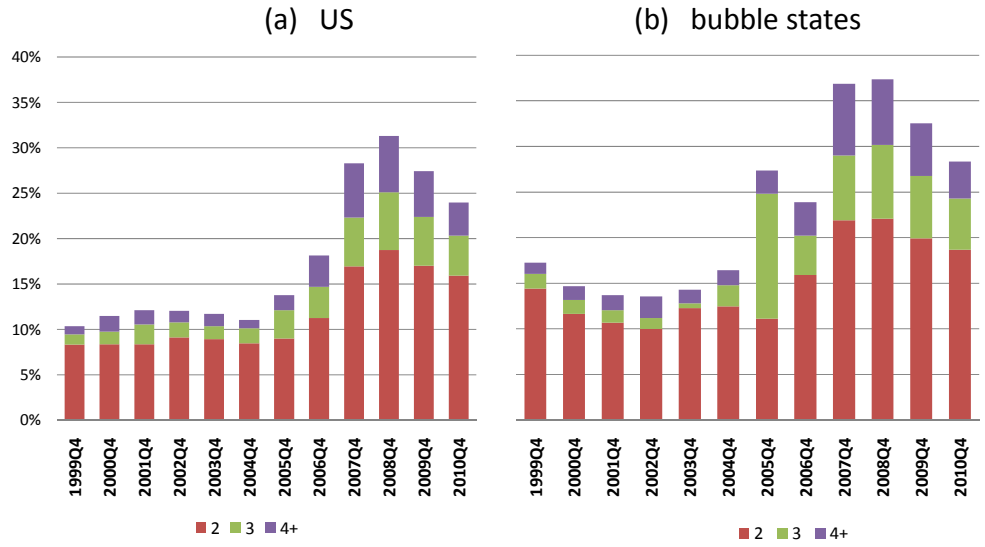


Figure 11. Investor share of 90+ DPD first-mortgage balances, by investor type



Source: FRBNY Consumer Credit Panel, 1% sample

Figure 12(a). Aggregate 90+ DPD securitized non-prime mortgage balances ($B), by investor type

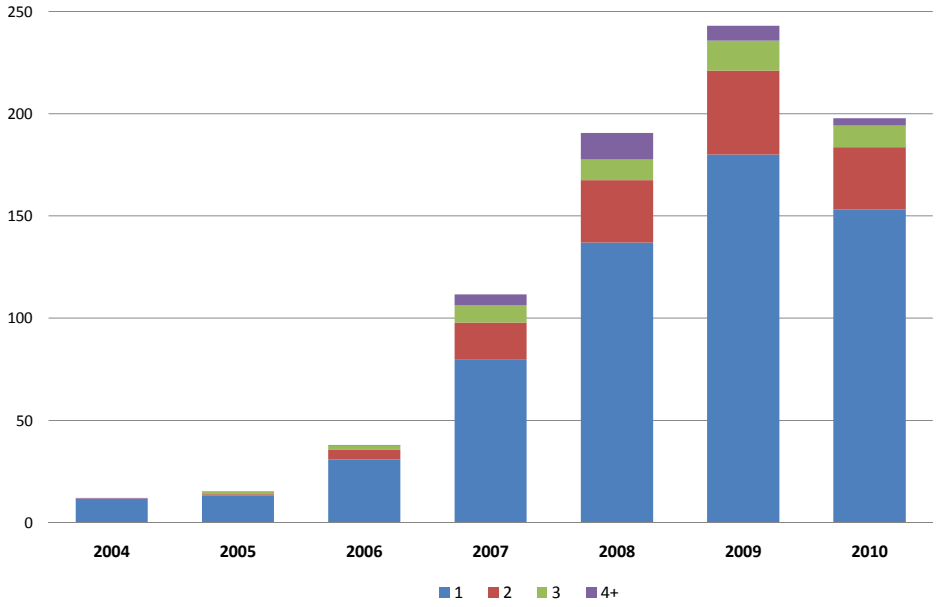
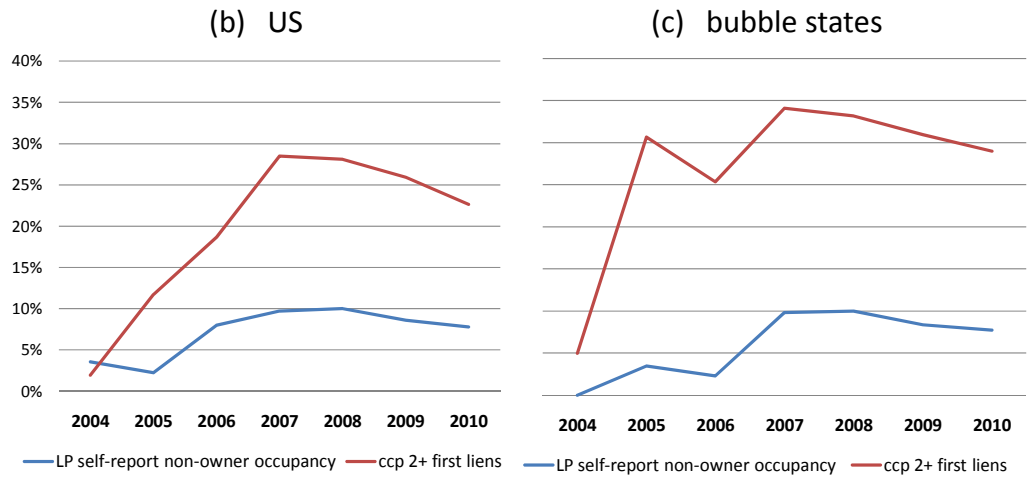


Figure 12. Investor share 90+ DPD securitized non-prime balances, LP and CCP definitions



Source: FRBNY Consumer Credit Panel, 1% sample

Figure 13. Average quarterly transition rates by investor type

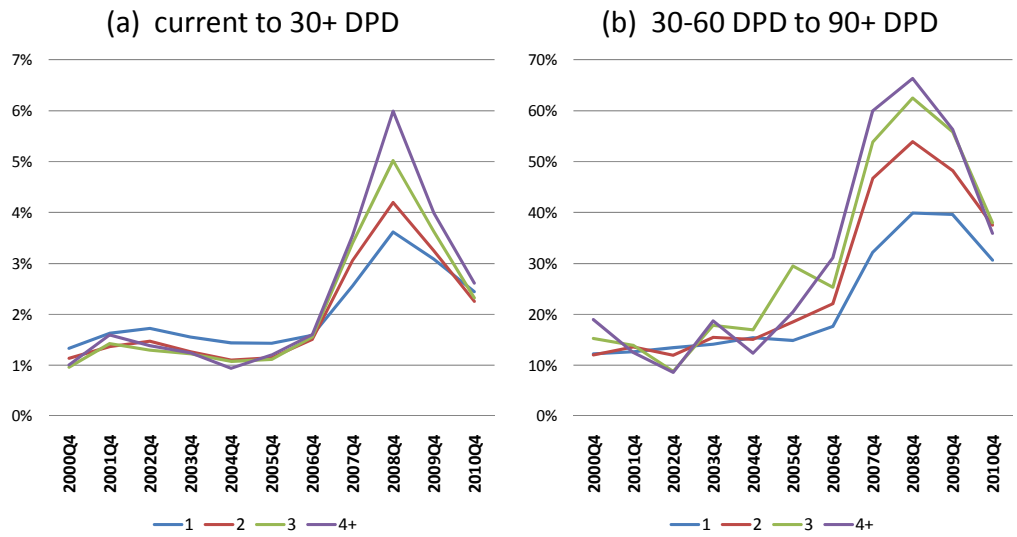
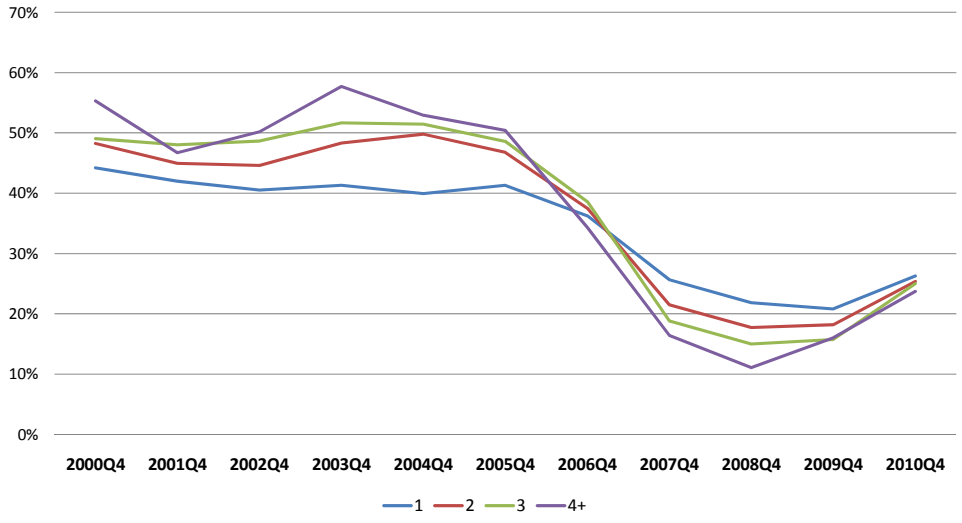


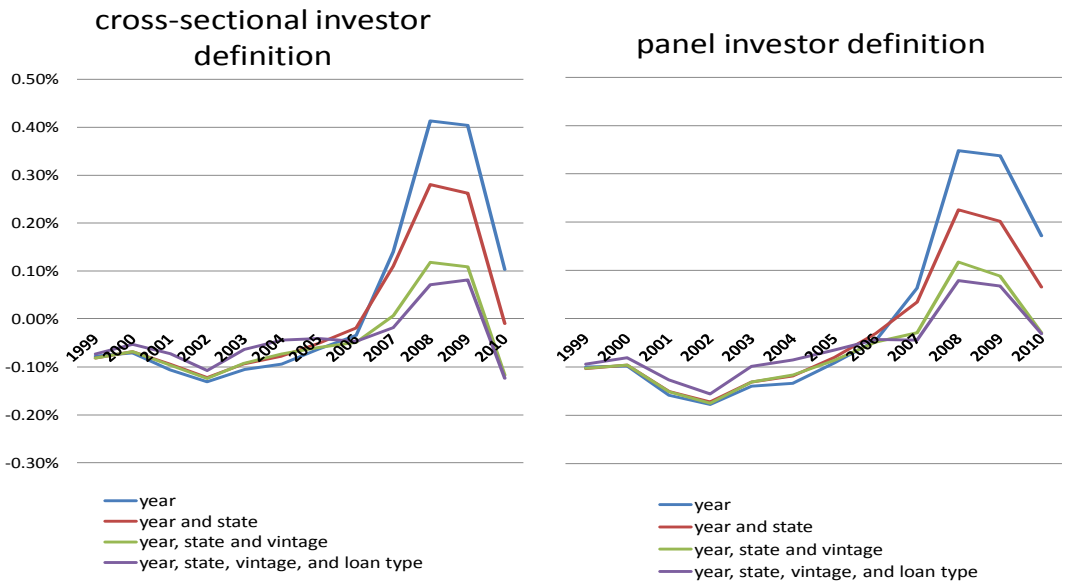
Figure 13. Average quarterly transition rate by investor type

(c) 30-60 DPD to current



Source: FRBNY Consumer Credit Panel, 1% sample

Figure 14. Investor effect on quarterly flow into 90+ delinquency



Source: FRBNY Consumer Credit Panel, 1% sample