Impact of GSE activity on FHA feedback and implications for FHA delinquency rates – evidence from prime and subprime mortgages

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ABSTRACT

The US government has adopted an affordable housing goal and under this goal Government sponsored enterprises have increased their presence in certain targeted areas which are primarily low income groups. This increased activity should increase credit supply and ideally should improve the housing market conditions for these groups. Unfortunately, this has not been the case and this paper aims to resolve this paradox. As GSE activities increase in certain areas by targeting lower income groups, they eat into FHA's market share. With this expansion the GSE targets the higher income group for FHA loans. In response the FHA applies more strict underwriting standards and as a result, in the new market equilibrium, the FHA loan proportion reduces. So overall, the credit supply and homeownership does not change. Additionally, the paper also intends to check if an increased GSE activity has affected the delinquency rates of other government loan programs, namely the FHA.

Keywords

GSE, FHA, FHA delinquency rates, economic crisis, affordable housing goals.

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1.0 INTRODUCTION

This paper examines a seeming paradox in the area of mortgage originations and affordable housing goals, which has not been studied in great detail in academic literature. We extend previous research by investigating the impact of involvement of Government Sponsored Entity (GSE) in achieving affordable housing goals on the Federal Housing Administration (FHA) activity, using this historical data to demonstrate that the involvement of GSE increases FHA foreclosure rate trends in the following years.

In order to facilitate credit access and home-ownership among lower-income and minority households, the Federal Housing Enterprise Financial Safety and Soundness Act of 1992 (GSE Act) empowered the U.S. Department of Housing and Urban Development (HUD) to establish targets for Fannie Mae and Freddie Mac (together called government sponsored entities, GSEs) purchases of mortgages originated to these groups. These affordable housing goals have led the GSEs to increase their activity to the targeted groups (Listokin and Wyly, 2000) however, evidence has not established a direct impact of the goals and GSE purchase activities on credit access and homeownership (Ambrose and Thibodeau, 2004; Bostic and Gabriel, 2004).

This paper attempts to replicate the seeming following paradox from the paper (An and Bostic, 2006): Although GSE activities in targeted groups have increased, but there has been little measurable improvement in credit access and housing affordability goals in these groups. This paper presents the conclusions in 2 unique dimensions:

1.) The more aggressive GSE pursuit of targeted borrowers, induced potential FHA borrowers to use conventional loans instead, in response the FHA loan

volumes reduced. Is there evidence to support that an increased GSE activity reduces FHA feedback?

2.) We have extended our research in point 1 above by investigating whether an increase in the GSE loan activity increases the foreclosure rates for the FHA loans. Such a relationship has not been previously examined in academic literature and we attempt to provide our analysis on this feature.

Using a simple model of credit rationing, we establish that the GSE activities can have a feedback effect on FHA: in response to the more aggressive lending pursuits of GSE, FHA applies more strict underwriting standards under a new market equilibrium which results in reduced loan volumes. The overall effects offset each other and leave the credit supply and home ownership effectively unchanged. We test this model by analysing whether intensified GSE purchases are associated with a reduction in FHA activities in 50 states and D.C. and find that such a relationship exists, in support of the theory.

The research is focussed on allowing for new insights regarding the relationships between different segments of the mortgage market and how these relationships change as institutional settings evolve. The findings from this paper can be used to scrutinize whether the current affordable housing goals are appropriate and whether new incentives should be provided to the GSEs to extend its services to the underserved communities.

The research paper is divided into sections, the next section gives a brief background of GSE and FHA loans and their respective roles in the US housing market crisis. Section 3 briefly reviews the policy context and existing studies related to the current research. Section 4 develops a simple theoretical model based on credit rationing theory. Section 5 and 6 discuss the data report the empirical approach and findings. Conclusions and remarks are in section 7.

1.1 Background

U.S. housing policy has long promoted homeownership for American households. Major federal housing programs with this goal include:

1.) Fannie Mae and Freddie Mac are government sponsored enterprises (GSEs) with a public mission to support the U.S. mortgage market and private incentives to maximize profits and shareholder value. The GSEs had outstanding obligations (debt and mortgage backed security (MBS) guarantees) of over $5.5 trillion at 9/30/2008, just after being placed in a government conservatorship. Their public mission also includes "housing goals" that provide motivation for the GSEs to support the mortgage market for lower income households and regions. The GSEs today are traded on the stock exchange and are entities with an explicit guarantee of payment.

2.) The Federal Housing Administration (FHA), created in 1934, operates as an independent entity within the Housing and Urban Development (HUD) agency to insure home mortgages for lower income households. The FHA is normally self-supporting, setting its insurance fees to cover its expected losses. It has been highly successful over its history and has never required a government subsidy or bailout for its single-family mortgage insurance program. However, it is facing escalating losses in the aftermath of the mortgage crisis.

Role of FHA in the US housing market

The FHA is not a mortgage lender. Instead, its primary role is to insure mortgages FHA-approved lenders provide home buyers. One to four-unit residential properties, manufactured homes and hospitals are all included in the FHA program.

As of 2012, the FHA had insured more than 34 million properties, making it the world's largest mortgage insurer. FHA loans generally serve as an alternative for borrowers unable to meet the 20 percent down payment and other requirements of conventional lenders. FHA loans typically require a 3.5 percent down payment minimum and have looser credit restrictions.

The FHA mortgage process works because it benefits all parties involved. Borrowers have access to financing otherwise not available. FHA-approved lenders can take on more risky borrowers with less down payment because the crux of the program is the FHA mortgage insurance premiums buyers pay. Premiums usually include about 1 percent of the loan value upfront and 1 to 2 percent of the loan balance annually paid through monthly installments. This is what allows the FHA to insure lenders against loss from non-paying borrowers. The housing market and economy benefit as well because of the increased volume of available home buyers.

The Role of GSEs in US housing market

One major responsibility of GSEs is to promote access to mortgage credit throughout the United States. The others include providing stability in the secondary market for residential mortgages, responding to private capital markets, increasing liquidity of the mortgage investments and improving the distribution of capital available for mortgage finance.

The GSEs buy the mortgages that are issued by the banks and securitize them by creating mortgage backed securities. These mortgage backed securities are then sold off to outside investors with a guarantee of full payment of principal and interest. Fannie Mae and Freddie Mac are private institutions owned by stockholders.
Though these are institutions that trade on the stock market, they have in exchange for regulatory oversight accepted an implicit government guarantee of support.

As a result of this guarantee they get access to cheap credit from the market. As these GSEs work closely with lenders, they can free up tied capital thereby providing more loans and increasing the home buying population.

For over three decades, the two GSEs increasingly dominated the U.S. mortgage market, reaching a major penetration by 2003 of over 50 percent of all U.S. single-family mortgages and close to 100 percent of all prime, conforming, mortgages. After the economic crisis of 2008, the Federal Housing Financing Agency placed the GSE's into conservatorship and provided substantial financial support. The FHFA also undertook broad authority over the GSE's but do not manage every aspect of their operations.

Figure 1-1 depicts the growth of Freddie and Fannie. The left-hand side provides the total dollar value of Fannie and Freddie's commitments to the mortgage market through their portfolios and their net MBS issuances, while the right hand side represents their share of the mortgage market.

Figure 1-1: Growth of GSEs from 1980 – 2009.
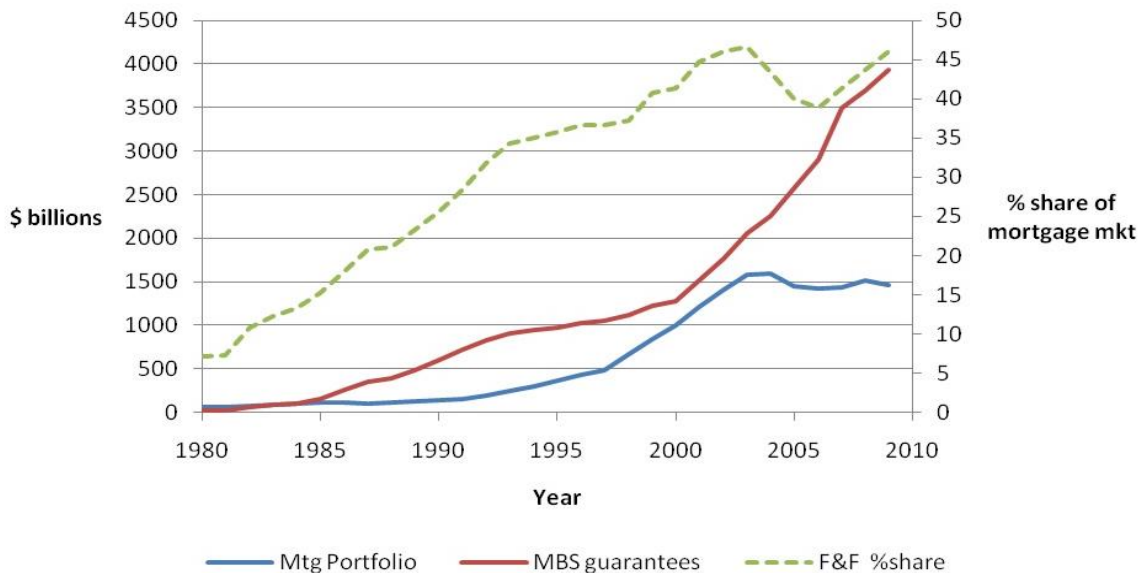
Source: FHFA and Federal Reserve.

2.0 Literature Review

The number of low income families in the United States has steadily been growing over the years. At the same time, the income gap between the low-income working families and the nation's wealthiest have been widening. Homeownership rates among lower-income and minority populations in the United States regularly lags that for the population at large. For example, the overall home-ownership rate in 2003 was 68.3 percent, but only 51.8 percent for lower-income families and about 45 percent for minorities (U. S. Department of Housing and Urban Development, 2005b).

These gaps have drawn the attention of policy makers, and were a major impetus for the passage of the GSE Act and the establishment of the affordable housing goals. Under their respective charters, Fannie Mae and Freddie Mac (GSE's) are vested with unique and government originated competitive advantages worth $8-$10 billion a year. With this money, the GSE's are expected to extend the frontiers of affordable housing and facilitate the flow of capital at the margins including the following public purposes

a) Providing secondary market assistance relating to mortgages to low and middle income families

b) Ensuring stability and liquidity in the secondary mortgage market.

c) Promoting access to mortgage credit throughout the nation especially in underdeveloped areas.

d) Responding appropriately to private capital market.

In order to oversee the goals of the GSE affordable housing performance, Congress has granted supervisory authority to HUD which sets affordable housing goals. HUD is charged with specifying GSE purchase percentage requirements for each category and adjusting the percentage periodically, as market conditions shift. HUD established the first set of affordable housing goals in 1995 and these have evolved over time. Between 2001 and 2003, the HUD established certain goals for the GSE namely:

a) Low and moderate income goal: At least 50% of the dwelling units financed by each of the GSE's mortgage plan should be for families with median incomes not greater than the area median income

b) Underserved areas goal: At least 31% of the dwelling units financed by each GSE's mortgage units should be for units located in the underserved areas.

c) Special Affordable goal: At least 20% of the dwelling units financed by each of GSE's mortgage plan should be for very low income families.

Research has found that both the GSEs have responded positively to the affordable housing goals. For example, Bunce and Scheessele (1996), Bunce (2002) and Manchester (1998) prove that GSE's increased the proportion of their loan purchases to targeted populations. The reached this within a few years after the enactment of the GSE act. Additionally, Listokin and Wyly (2000) and Temkin, et al. (2001) show that the GSEs enhanced their product offerings and facilitated more purchases of loans from targeted communities. These new products allowed for higher risks and departed from the industry norms in terms of their underwriting criteria. Harrison, et al. (2002) shows that GSEs can help lower-income and minority communities by reducing information externalities and increasing transactions in thin markets. However, research has also found that the GSEs have not played a leading role in serving lower-income and minority populations. For example, Bunce and Scheessele (1996) find that the "shares of the GSEs' business reaching lower income borrowers and underserved neighborhoods typically fall short of the corresponding shares of other market participants"(page 3). Other researchers, including Manchester, et al. (1998) and Case, et al. (2002) arrive at similar conclusions. While these studies focused on GSE activities directly, there are another set of studies that focused on market outcomes associated with the increased GSE purchases in response to the affordable housing goals. Freeman and Galster (2004) studied underserved neighborhoods in Cleveland from 1993 to 1999. They examined if GSE activity causes any changes in single family home sales volumes and prices. They find no links between secondary market activities, by the GSEs or others, and sales prices. Additionally, they do find some evidence indicating that secondary market

activities are associated with some increases in sales volumes. However on studying further, they realise that GSE purchase activities do not drive this relationship.

Bostic and Gabriel (2004) empirically evaluates changes in various homeownership features such homeownership rate, vacancy rate, and median house value among GSE-targeted census tracts relative to changes in a control group of similar tracts. They find limited direct effects of affordable housing goal incentives on local housing market outcomes in California during the 1990s. Ambrose and Thibodeau (2004) analyze another dimension of market outcomes – the credit supply. They built a credit supply-demand system and estimated their model based on historical data on mortgage lending and other economic and demographic variables. Based on this system they concluded that the affordable housing goals had a limited effect on the overall supply of mortgage credit to targeted groups in the largest 308 metropolitan statistical areas during 1995 and 1999. Therefore the existing studies suggest a paradox. On one hand, GSEs increased their purchase activities to targeted groups under the affordable housing goals, which should result in increased access to credit and improved housing market outcomes. On the other hand, the evidence suggests that these positive market outcomes did not occur. This research argues that market dynamics between GSE activities and those of the FHA might help to explain the seemingly paradoxical findings. Created under the National Housing Act of 1934, FHA provides mortgage insurance mainly to those borrowers who do not have sufficient down payment or have higher debt-to-income ratios as represented by their credit scores. Essentially, the federal government insures loans for FHA approved lenders in order to reduce their risk of loss if a borrower defaults on their mortgage payments. Typically an FHA loan is one of the easiest loans to qualify for because it requires a very low down payment and one can have less than perfect credit. A FHA down payments of just 3.5% is required as opposed to a traditional loan that requires a down payment of roughly 20%. FHA loans are therefore generally more costly than conventional loans (Gabriel and Rosenthal, 1991; Hendershott, Lafayette and Haurin, 1997; Ambrose, Pennington-Cross and Yezer,

2002). Nonetheless, research indicates that conventional and FHA loan products compete for many borrowers, particularly those with marginal credit quality (Ambrose, et al., 2002; Bradford, 2002; Nothaft and Trentcheva, 2003; Abt, 2004). Given that GSEs generally do not purchase FHA loans, our intuition is that intensified GSE purchases targeting underserved populations under the affordable housing goals have a feedback effect on FHA. Given this aggressive GSE pursuit primarily with the intent to increase profits induces potential FHA borrowers with the best credit quality to use the conventional market and obtain conforming conventional loans instead. The FHA in order to retain its risk levels, undertakes higher underwriting standards and consequently ends up reducing its loan volume. This feedback effect offsets the increase in credit supply associated with the GSE purchases and limits changes in housing market outcomes. There are a few empirical studies which analyze the dynamic relationship between FHA and conventional lending (or private mortgage insurance, PMI). For example, Ambrose,Pennington-Cross and Yezer (2002) find that, as economic uncertainty increases, FHA market share increases and conventional market share decreases. Nothaft and Trentcheva (2003) find that the FHA loan limit increase both expands the lending market and "crowds" out some conventional activity. There has also been no studies that capture the effect of this aggressive GSE increase on the FHA delinquency rates. The paper below tries to formally model the relationship between increase GSE activity and FHA feedback and its delinquency rates.

3.0 Data

This research uses two main data sources to build the relationship between GSE activities, FHA feedback and FHA foreclosures; the data segment will be broken into two sections: the Home Mortgage Disclosure Act (HMDA) as the primary data source and Mortgage Bankers Association (MBA). This section aims to explain the sample data in detail and explain the analysis process.

3.1 HMDA

The Home Mortgage Disclosure Act (HMDA) was enacted in 1975 and implemented through Regulation C, on July 21, 2011. The HMDA provides the most comprehensive mortgage- related dataset in terms of coverage. It contains loan level mortgage application and origination information, including borrowers' demographic traits, like age, race and income, loan type, loan amount, location of property, origination status and certain institutional variables all over the nation. The HMDA has two main purposes within the mortgage industry. The first purpose of HMDA is to provide public information on housing data, financial institutions, and lending patterns within geographic regions. This data is collected by the government to ensure that financial institutions are meeting the needs of all US citizens (regardless of where they preside) in order to reduce discriminatory lending (Gupta et al. 2010). The second purpose of the HMDA, is to aid the government in targeting private and public investment to areas of the country requiring government support; this increases the efficiency of the federal governments tax spending. The HMDA resources are collected and maintained on an annual basis by the Federal Financial Institutions Examination Council (FFIEC) and this information is released electronically and can be viewed publically ("HMDA Data" 2014).

Our analysis is restricted to the loan originations across 50 states and D.C characterized by loan type (GSE/Conventional and FHA). By limiting the search parameters on the HMDA database to cover loans granted for the purpose of home

purchase, refinance and home improvement, the research looks at the percentages of conventional loans and FHA loans to total loan originations. We wrote a code in Python to access and mine relevant data from HMDA.. For both years 2005 and 2006, we searched for the aggregate report for each state. These states are broken down by Metropolitan State Area (MSA). For each of these MSA's for each state, table A1 (Loan Sale by Loan type 1 to 4 families) gives us information on the loan application (it could be for home purchase, refinance or home improvement) and the number of loans against each loan type(Conventional, FHA,VA,FSA/RHS). By adding up all the information for each of these MSA's, we calculated the number of the conventional and FHA loans for each state. The python code we have automates the entire process to capture the details. Using the above data for the years 2005 and 2006, FHA and GSE loans as a percentage of the total loans were calculated for both years. The percentage change in these FHA and GSE loan originations (as a percentage of total loans) for these two years were then determined.

Confining our dataset to loans originated within 2005-06 we will be able to build a clear relationship excluding the biases due to the economic or environmental factors surrounding the US housing market crisis in 2007. We examine the loan originations for each type of loan which were broken down into state-level detail to illustrate the trends in GSE activity and its impact on FHA feedback in diverse geographic regions across the country. Analysing the percentage change in loan originations from 2005 to 2006 for both the GSE (conventional) and FHA loans, uncovered interesting insights about the GSE activities prior to the period of crisis. The dollar amounts of loans were not used because of their relative complexity and inability to add clarity to this research.

3.2 Mortgage Bankers Association (MBA)

The Mortgage Bankers Association (MBA) is the national association representing the entire real estate finance industry.

The National Delinquency Survey (NDS) is one of the most recognized sources for residential mortgage delinquency and foreclosure rates. Based on a sample of approximately 41.6 million mortgage loans serviced by mortgage companies, commercial banks, thrifts, credit unions and others, NDS provides quarterly delinquency and foreclosure statistics at the national, regional and state levels. Delinquency and foreclosure measures are broken out into loan type (prime, subprime, VA and FHA) and fixed and adjustable rate products. At each geographic classification, there are 7 measures: total delinquencies, delinquency by past due category (20 – 59 days, 60 -89 days and 90 days and over), new foreclosures, foreclosure inventory and seriously delinquent. The total number of loans serviced each quarter, as compiled through the survey, is also included in the data. We used the NDS quarterly reports to get information on the FHA delinquent loans. The seriously delinquent loans were the number of FHA delinquent loans whose installments were past due 90 days or more plus the number of loans that were in foreclosure at the end of the quarter. We analysed data for the years 2008 and 2009 as we intend to study the relationship between the changes in the GSE loan originations before the crisis on the FHA loan delinquency rates after the crisis. Also, we kept such a gap between the origination activity and the delinquency rates as we believe that the most mortgages take at least a year before default.

4.0 Methodology

GSE's exist to serve the American Housing market and both Fannie Mae and Freddie Mac are national mortgage finance companies but they do not offer home loans. They stand behind mortgage lenders, which include national banks, thrifts, credit unions and other financial institutions in all the states in the USA. The GSE's purchase the mortgage loans that these financial institutions originate thereby replenishing the funds for these institutions. These mortgage lenders can then use these extra funds to again lend out to other homeowners and apartment owners. By 2003, the GSE's achieved a target share of over 50% of single family mortgages and close to 100% of prime mortgages.

FHA's on the other hand do not purchase mortgages nor act a mortgage lenders but insure loans given out by FHA approved lenders to certain target groups. These groups have primarily been the lower income, minority population and individuals with low credit scores.

Both the GSE's and the FHA's have one goal that is to increase homeownership rates in the USA although they have different means to achieve this(As described above) and even different target populations. Ideally we should not expect any relationship to exist between these entities, however if there is one, it will be a surprise.

With the GSE expansion, banks have more funds and now can extend loans to even individuals with lower credit scores. This eats into the FHA market share and hence we believe that an expansion of GSE activity pushes the FHA into marginal borrowers. We think that this might cause the FHA delinquency rates to increase and hence test for a relationship between an increased GSE activity and FHA delinquency rates.

For an analysis on the relationship between the impacts described above, we use the below two methods:

4.1 OLS Regression Analysis

We test for the relationship between an increased GSE activity on FHA feedback in two ways.

First we compare the state level trends in GSE and FHA market shares between 2005 and 2006 (pre-crisis period). Second to more accurately characterize the relationship between GSE and FHA activities, we use OLS regression. Regression analysis predicted a relationship between a selected variable (% change in FHA activity) and an observed outcome (% change in GSE share); it is essentially a line of best fit between two variables (Hoy, Livernois, McKenna, Rees, and Stengos 2001). Using linear regression in the ordinary least squares (OLS) model, we can create a robust formula that can fit our real-word data.

$$(1)\, \Delta Fi = \alpha + \eta \Delta Gi$$

Here ΔFi is the change of market share of FHA between period t1 and t2, ΔGi is the change of GSE market share during the same period. If we expect a relationship to exist, it would be interesting to test if the increased GSE activity results in a higher liquidity in the residential markets or does it only take away from the FHA market share. We estimate α and η by performing the OLS regression. We estimate this regression to test if

The linear regression function we have used in an inbuilt MATLAB function 'Regstats'. Alternatively, we have also used the regression analysis tool from the Data analysis toolbox in Excel. Another important aspect of the linear regression formula is its ability to provide a precise best-fit line with very few data inputs; however, the more data points utilized, the more convincing the research becomes because its degrees of freedom increases.

On an average, in a given year about 96% of the loans were sold to GSEs and only 4 % of the loans were involving the FHA. In moving from 2005 – 2006 for all the

states that increased the GSE activity had their FHA share contracted. These findings are consistent with our theoretical model.

Next we test the relationship between the GSE activity and FHA delinquency rates in the following year. We estimate the same OLS regression except that our dependent variable now is the FHA delinquency rates for 2009.

4.2 Statistic test

The two-sample t-test with unequal sample size and variance was used, with a 95% confidence level rather of a one-tail test because we wanted to capture the variance on both sides of the coefficient error term (standard deviation) to get a complete picture of the relationships statistical significance. The t-statistic was utilized over the P-value approach because we can analyse one value instead of providing a range of values.

$$t = \frac{\overline{X}_1 - \overline{X}_2}{s_{\overline{X}_1 - \overline{X}_2}} \qquad (2)$$

Where

$s_{\overline{X}_1 - \overline{X}_2} = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}.$ Here, s^2 is the unbiased estimator of the variance of the two samples. The paper utilizes a two-tail t-test on each coefficients standard error term in order to determine which terms are significant for our research. The t-stat calculated above is compared to the critical two- tail t-value of 2.009575 (using 49 degrees of freedom) to determine the level of significance of the error term with 95% confidence. One drawback of statistical tests like the t-test, is that it relies heavily on unrealistic assumptions and other unknown characteristics of your data set; the test choice is susceptible to human error (Vogelvang 2005).

The inbuilt MATLAB function ttest2(x,y) returns a test decision for the null hypothesis that the data in vectors x and y comes from independent random samples from normal distributions with equal means and equal but unknown variances, using the two-sample t-test. The alternative hypothesis is that the data in x and y comes from populations with unequal means. The result h is 1 if the test rejects the null hypothesis at the 5% significance level, and 0 otherwise.

We divided the percentage change in GSE loan originations for 2005 and 2006 into two buckets. One bucket consisted of states that increased its GSE activity and the other bucket consisted of states that decreased its GSE activity from 2005 to 2006. For each of these buckets we use the corresponding FHA delinquency rates and run a t-test to compare the means of the FHA delinquency rates for the states that saw an increase in GSE activity vs those that saw a decrease in GSE activity. The null hypothesis is our initial assumption which is "An increase in GSE activity increases the FHA delinquency rates by pushing the FHA into more marginal borrowers".

5.0 LIMITATIONS OF RESEARCH

This paper has used linear regression relationship, however, two limitations occurred during the data collection phase. Limitations on delinquency data caused the research to be less rigorous than originally intended. The lack of a thorough study creates scope further research in the field.

The first limitation was related to the delinquency rates for FHA loans which were broken down only on the state level. HMDA provides the loan information at the MSA/county level which is a preferred geographic line as opposed to states. To have data consistency, we were limited to using the loan originations at the state level. The second limitation also lies within the Mortgage Bankers Association's National Delinquency Survey. We reached out to the MBAA based out of Washington DC to obtain 2008- 09 delinquency reports which provide the delinquency rates broken down at the state level which was based on a fee. We were able to research and find National Delinquency Survey reports for 5 quarters, Q2 2008, Q4 2008, Q1 2009, Q3 2009 and Q4 2009, these were publically available on the internet. We believe the gap due to a missing quarter in 2009 could be a drawback in this research. Other researchers with access to appropriate data could overcome this approximation bias and the errors it might have embedded in it.

6.0 Empirical Results

Empirical evidence from implementation of the affordable housing goals which were designed to increase GSE presence in transactions involving lower-income and minority populations in order to improve access to credit and homeownership suggests a puzzle. On one hand, substantial evidence shows that the GSEs have responded positively to the affordable housing goals by allocating more of their purchases to the targeted groups defined by the goals. On the other hand, recent research finds limited improvement for these neighborhoods in terms of credit supply, home sale volumes and prices, homeownership, and other housing market outcomes. Also the increase in GSE activity in pursuit of high creditworthy borrowers which in turn pushed the FHA into more marginal borrowers does not seem to a factor influencing the FHA delinquency rates in the following year.

6.1 Relationship between GSE activity and FHA feedback.

Using our model of credit rationing as described in the theoretical model section our null hypothesis is, "The GSE market share in targeted areas should increase after the implementation of the goals and this increase should cause the market share of FHA to shrink" We tested for this relationship using a regression analysis with the percentage change in GSE loans from 2005 to 2006 as the independent variable and the percentage change in FHA loans from 2005 to 2006 as the dependent variable. Refer to appendix 8.1.1 for results.

The regression equation that we have obtained is

$$(3)\ Y = -13.85X + 0.0105$$

$$t\text{-stat}\quad (-5.7638)\quad (0.3925)$$

Which indicates a negative relation between the change in GSE loans and FHA feedback. Given that our p value here is .6964 which is >0.05 we fail to reject the null hypothesis that "The GSE market share in targeted areas should increase

after the implementation of the goals and this increase should cause the market share of FHA to shrink" . The tstat for the intercept term is 0.3925 while the tstat for the slope is -5.7638 which confirms the strong negative relationship between these variables. As the tstat value is lesser than the t critical value, we fail to reject the null hypothesis. Further the R square value is 0.404 which implies that our regression explains 40% of the variation between GSE and FHA activities which is very strong.

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6.2 GSE activity prior to crisis and FHA delinquency post crisis.

We attempt to provide innovative extension to the results of An Bostic's papers to check whether an increase in GSE activity prior to the crisis affects the FHA delinquency rates post the crisis. This question stems from the fact that the GSEs took away the high creditworthy borrowers from the FHA which then started lending to marginal borrowers as a result of stricter underwriting standards. Our null hypothesis in this case is our initial assumption which is "As GSE activity increases, FHA delinquency rates increase" Refer to appendix 8.1.2 for results.

The regression equation we have obtained is

$$(4)\, Y = -0.0562X + 0.0794$$
$$\text{t-stat} \quad (-0.1504) \quad (19.1126)$$

The p value that we have obtained for this regression is 2.33E-24 which is much smaller than 0.05 and hence statistically significant. Given this, we reject our null hypothesis. Also, the absolute value for tstat for the intercept term is 19.1126 which is greater than 0.05 and confirms with our results obtained with the significant p value. We reject the null hypothesis. The coefficient show a small negative slope of -0.0562 which is also in- conclusive of any relationship between these two variables. The R square value is 4.61E-04 which means that our

regression only explains 0.000461% of the variation between these two variables which is statistically insignificant.

In order to further confirm any relationship we ran a t-test on data. The null hypothesis for the ttest on the bucketed data for FHA delinquency rates is "The FHA delinquency rates are the same for states that saw an increase in GSE activity and states that saw a decrease in GSE activity." As seen in appendix 8.1.2 we notice that the means for the two buckets (FHA delinquency rates for states that increased GSE and states that decreased GSE) are the same. This is proved by the P value for the two tail test which equals 0.12784 which is greater than 0.05 and hence statistically insignificant. Also, the t-stat value of 1.5500 is lesser than the t critical two tail value of 2.011 and greater than the critical value of -2.011.

The ttest fails to reject the null hypothesis which means that an increase in GSE activity prior to the crisis does not appear to increase the delinquency rates for the FHA loans after the crisis. We also report the mean values for positive and negative buckets of data. The means of FHA delinquency rates for positive GSE activity and negative GSE activity show a very small change (-0.0122) and is not statistically significant.

6.3 Does winsorizing the data help reduce the impact of outliers?

Data Mining – We suspect the inadequacy of GSE activity in explaining the FHA delinquency rates might be due to the influence of possibly spurious outliers. We considered data mining techniques such as trimming or truncation but winsorizing seemed an attractive method to reduce the impact of the outliers. While data trimming reduces the impact of outliers by excluding them, winsorizing is reduces the impact of outliers in a statistically more robust way (Leon, Mesa, Wasley 2013)Post Winsorizing – We simulate a few different combinations of winsorizing the data for 50 states and D.C. for % change in proportion of GSE loans vs the FHA delinquency rates. From the scatter plot of the winsorized data, we notice

that the major outliers have reduced. Following the similar statistical analysis, we run the same regression test again to test whether the statistical variables show any improvement. We notice that the t stat value for the intercept term has increased to 21.9913 which is greater than the t critical value of 2.009 and the p values for both slope and intercept are smaller than 0.05 and hence statistically significant. Given this, even after winsorizing our data, we have to again reject the null which is "As GSE activity increases, FHA delinquency rates increase" This regression has an R square value of 1.69E-04 which means only a very small portion of the relation between these variables is explained by the regression. We also ran the t-test on the two buckets as described in the sections above to check for the any difference in the means. The p value obtained in such a test is 0.1125 which is statistically insignificant. Also, the t-stat value of 1.6166 is lesser than the t-critical value of 2.010 and greater than -2.010, which theoretically proves that there is no difference between the means.

From both pre-winsorising and post – winsorizing the tstat value is However, since our sample size is pretty small, obtaining a value of tstat greater than 1 might mean there is a relationship between the two variables which might be a good surprise for the Refer to appendix 8.1.3 for results

6.4 Effect of additional explanatory variables

Given our small sample size, we need to incorporate additional explanatory variables to build a more robust model for testing a relationship between the GSE activity and the FHA delinquency rates. We added four variables to the regression Unemployment rate in 2009, change in Unemployment rate (2008 to 2009), change in GDP (2008 to 2009) and Change in House Price Index (2008 to 2009). A brief description of these variables are provided below-

Unemployment rate in 2009: The unemployment rate is a measure of the prevalence of unemployment and it is calculated as a percentage by dividing the number of unemployed individuals by all the individuals currently in the labor force. When a consumer borrows money to make a large purchase, his ability to repay his loan and or the interests in dependent on his ability to remain employed.

Change in Unemployment rate: A decrease in unemployment indicates a prospering economy and subsequently indicates the ability to repay loan premiums and interests.

Change in GDP: GDP or Gross Domestic Profit is an aggregate measure of production equal to the sum of all gross values added of all resident institutional units engaged in production. An increase in GDP indicates a prospering economy

Change in House Price Index: House Price Index is a broad measure of the movement of single family house prices in the U.S. This index serves as an indicator for house price trends and it also works as a tool to estimate changes in mortgage rate defaults, prepayments and housing affordability.

The regression equation we have obtained from the multiple regression analysis is as below

(5) $Y = 0.0062615 - 0.26398 * \%\text{change in GSE} + 0.508 * \text{Unemployment rate in } 2009 + 1.007 * \text{Change in Unemployment} - 0.3013 * \text{Change in GDP} + 0.0918 * \text{HPI change}$

As from the equation 5 above, the percentage change in GSE has a negative relationship with the FHA delinquency rates. Unemployment rates in 2009 have a positive relationship with the FHA delinquency rates, change in unemployment rates have a positive relationship, Change in GDP has a negative relationship and the change in House Price Index has a positive relationship with FHA delinquency rates in 2009. All this is indicated by the sign of the coefficients in the regression equation above. Please refer to Appendix 8.1.4 for all details

The adjusted R square value is 46.74% and this means that all the above explanatory variables explain about 47% of the variation in the FHA delinquency rates and is a pretty high value.

The regression model is statistically significant for both 95 and 99% confidence intervals as given by the significance F value of 2.25413E-06.

The p value for percentage change in GSE is 0.34606 which is greater than 0.05 and hence statistically insignificant. This indicates that we cannot prove a negative relationship between the percentage change in GSE loans before the crisis and the FHA delinquency rates after the crisis.

The p value for the unemployment rate in 2009 is 0.1023 which is greater than 0.05 and hence statistically insignificant. This indicates that we cannot prove a positive relationship between the unemployment rate in 2009 and the FHA delinquency rates in 2009.

The p value for the change in unemployment rate from 2008 to 2009 is 0.1130 which is greater than 0.05 and hence statistically insignificant. This indicates that we cannot confirm a positive relationship between the change in unemployment rate from 2008 to 2009 and the FHA delinquency rates in 2009(as indicated by the coefficient)

The p value for the change in GDP from 2008 to 2009 is 0.0070 which is lesser than 0.05 and hence statistically significant. This test indicates that we can confirm a negative relationship between the change in GDP from 2008 to 2009 and the FHA delinquency rates in 2009(as indicated by the coefficient). However, more tests would need to be done to confirm this relationship.

The p value for the change in House Price Index from 2008 to 2009 is 0.2164 which is greater than 0.05 and hence statistically insignificant. This indicates that we cannot confirm a positive relationship between the change in HPI from 2008 to 2009 and the FHA delinquency rates in 2009(as indicated by the coefficient)

7.0 Conclusions

In this research paper, we tried to study and examine any relationship between GSE activity, FHA feedback and FHA delinquency rates. Primarily, we sought to answer the following questions:

1) Is there a relationship between GSE activity and FHA feedback?
2) Did the GSE activity prior to the crisis have any impact on the FHA delinquency rates for the period after the crisis?

Through our research and study we concluded the following about the relation between the two government sponsored housing loan programs:

1) There is a negative relation between GSE activity and FHA feedback. As GSE loans increase in proportion to the total loans, FHA loan originations decrease.
2) None of our statistical tests could indicate that an increase in GSE activity prior to the economic crisis resulted in an increase in FHA loan delinquency rates.

7.1 Is there a relationship between GSE activity and FHA feedback?
Yes.

Our empirical analysis of changes of market shares of FHA and GSE supports the theoretical hypothesis of a feedback loop between GSE purchases and FHA activities. There is a significant negative relationship between the change in GSE and FHA market shares, which is consistent with the view that more aggressive GSE purchases in "underserved neighborhoods" result in a significant feedback on FHA activities. *We conclude that the GSE gain could have come at the expense of other market participants.*

Our regression results as shown above replicate the basic result of Rafael and An Bostic's paper that as the GSE loan originations increase, the FHA loan originations decrease. As with the intuition stated in the paper, we believe that as GSE starts expanding into more market segments in order to increase profits, they target what would have been the higher quality loans for FHA segments. Now the FHA in order to maintain its lending standards and an appropriate risk appetite adopt stricter underwriting standards and hence do not offer loans to individuals who do not meet this criteria. As a result of this increased GSE loan activity, FHA loan originations reduce.

7.2 Did the GSE activity prior to the crisis have any impact on the FHA delinquency rates for the period after the crisis?

No.

As discussed in the 1st conclusion above, as the proportion of GSE loans to total loans increase, FHA loan activity decreases. We further investigate the data to check whether an increase in GSE loan activity has an effect on the FHA loan delinquency rates in the following year. We ran a regression test with the change in the proportion of GSE loans to the total loans (from 2005 to 2006) as the independent variable and the FHA delinquency rates as the dependent variable. Since the regression provided no significant results between the two variables (please refer to section 6.2 above), we changed our statistical approach and used the t-test methodology to verify any other possibility. We checked for a difference in the means between the FHA delinquency rates for states that increased GSE and for states that decreased its GSE activity. Our result as described in section 6.2 proved that there is no difference in the means thereby confirming that an increased GSE Activity has no effect on FHA delinquency rates.

We believe that the increase in GSE activity in pursuit of high creditworthy borrowers pushed the FHA into more marginal borrowers. Given that GSEs generally do not purchase FHA loans, our intuition (also proved above) is that intensified GSE purchases created a feedback effect on FHA. Given this

aggressive GSE pursuit, primarily with the intent to increase profits, induces potential FHA borrowers with the best credit quality to use the conventional market and obtain conforming conventional loans instead. The FHA in turn, in order to retain its risk levels, undertakes stricter underwriting standards and consequently ends up reducing its loan volume. *These two response factors namely, reduced FHA loans and stricter underwriting ensures that FHA retains its loan quality and thereby ensues no increased delinquency rates*. However, these reactions offset the increase in credit supply associated with the GSE purchases and limits changes in housing market outcomes.

In conclusion, regardless of the outcome of the various debates about the affordable housing goals policy, one thing is clear. Homeownership is important. Given this fact, policy-makers should continue searching for new instruments to help lower-income and minority households gain access to credit and homeownership.

8.0 Appendix

8.1 Empirical results

8.1.1. % change in proportion of GSE loan originations Vs % change in change in proportion of FHA loan

Change in GSE vs. Change in FHA (2005 to 2006)

y = -13.85x + 0.0105

Y-axis: Change in FHA loans as a percentage of total loans

X-axis: Change in GSE loans as percentage of total loans
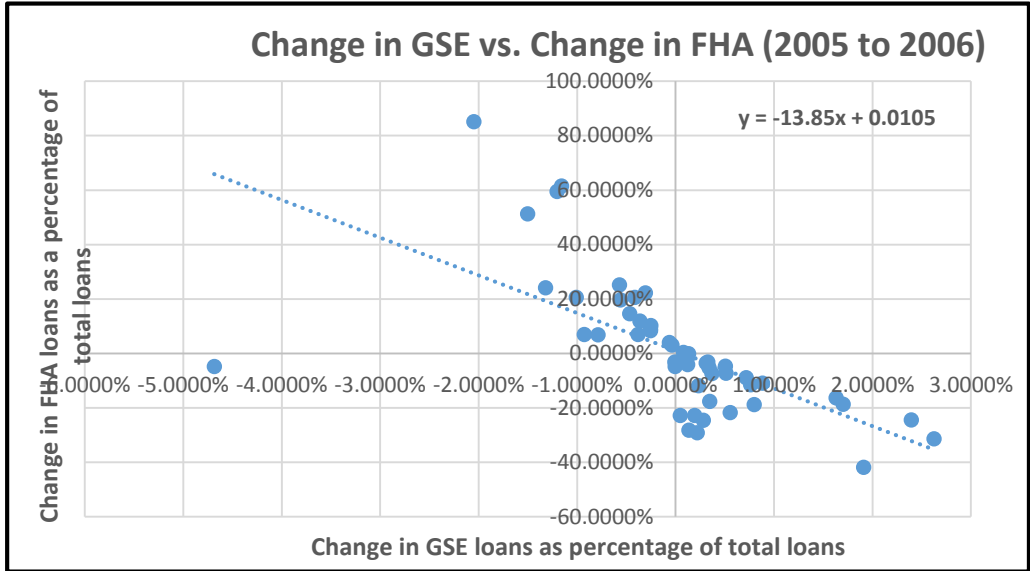
Regression Statistics	
Multiple R	0.64
R Square	0.40
Adj. R Square	0.39
Standard Error	0.04
Observations	51

Statistical Significance Statstics				
	Coefficients	Standard Error	t stat	p value
Intercept	1.05E-02	2.67E-02	0.39	0.70
GSE	-13.85	2.40	-5.76	5.40E-07
t critical (two tail)			2.00975	

Description: Relationship between % change in GSE loan originations Vs % change in FHA loan originations (dependant variable) on a state level. We found that as the GSE activity increases the FHA loan originations reduce, concluding a strong inverse relation between the two variables. The tstat indicates that both standard error coefficients terms are significant at 95% confidence; concluding that this relationship is significant. Each point represents one of the 50 states and D.C. in the US.

8.1.2 Percentage change in proportion of GSE loan originations Vs FHA delinquency rates.

FHA delinquency rates (2008-09) Vs % change in GSE loan originations (2005 to 2006)

y = -0.0562x + 0.0794

(Y-axis) FHA delinquency rates — 20.0000%, 18.0000%, 16.0000%, 14.0000%, 12.0000%, 10.0000%, 8.0000%, 6.0000%, 4.0000%, 2.0000%, 0.0000%

(X-axis) % Change in GSE loans as a percentage of total loans — -4.5000%, -3.5000%, -2.5000%, -1.5000%, -0.5000%, 0.5000%, 1.5000%, 2.5000%, 3.5000%
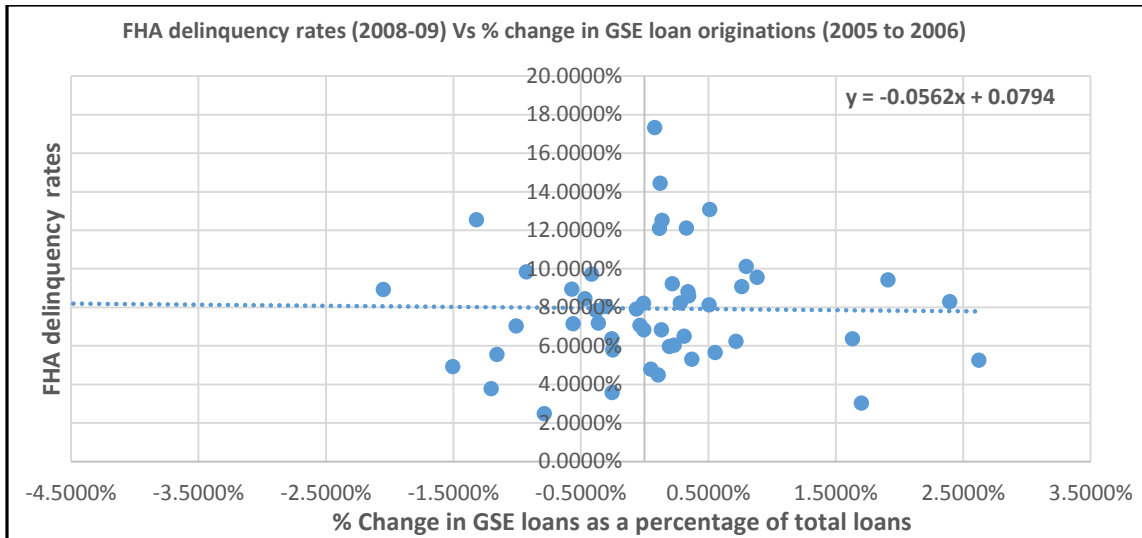
Regression Statistics	
Multiple R	0.02
R Square	0.00
Adj. R Square	-0.02
Standard Error	0.00
Observations	51

Statistical Significance Statstics				
	Coefficients	Standard Error	t stat	p value
Intercept	7.94E-02	4.20E-03	1.91E+01	2.33E-24
GSE	-5.62E-02	3.73E-01	-1.50E-01	8.81E-01
t critical (two tail)			2.00975	

t-Test: Two-Sample Assuming Unequal Variances		
	FHA delinquencies for positive change in GSE loans (2005-2006)	FHA delinquencies for negative change in GSE loans (2005-2006)
Mean	0.08	0.07
Variance	0.00	0.00
Observations	28.00	23.00
Hypothesized Mean Difference	0.00	
df	47.00	
t Stat	1.55	
P(T<=t) one-tail	0.06	
t Critical one-tail	1.68	
P(T<=t) two-tail	0.13	
t Critical two-tail	2.01	

Description: Relationship between % change in GSE loan originations Vs % FHA loan delinquency rates (dependant variable) on a state level. We found that as the GSE activity increases the FHA delinquency rates do not change, concluding no relation between the two variables. The tstat for regression indicates that both standard error coefficients terms are insignificant at 95% confidence; the tstat in the t-test is lesser than the t critical value and hence cannot reject the null hypothesis that the means of the two variables are the same; concluding that there is no impact of increased GSE activity on FHA delinquency rates in the following year. Each point represents one of the 50 states and D.C. in the US.

8.1.3 Effect of 95% winsorization

FHA delinquency rates (2008-09) Vs % change in GSE loan originations (2005 to 2006)

y = -0.0217x + 0.0789

% change in GSE loans from 2005- 06

% FHA delinquency rates 2008-09

Regression Statistics	
Multiple R	0.01
R Square	5.49E-05
Adj. R Square	-0.02
Standard Error	7.74E-04
Observations	51

Statistical Significance Statstics				
	Coefficients	Standard Error	t stat	p value
Intercept	7.84E-02	3.60E-03	21.99	4.87E-27
GSE	0.04	0.45	0.09	9.28E-01
t critical (two tail)			2.00975	

t-Test: Two-Sample Assuming Unequal Variances Winsorized data		
	FHA delinquencies for positive change in GSE loans(2005-2006)	FHA delinquencies for negative change in GSE loans(2005-2006)
Mean	0.08	0.07
Variance	0.00	0.00
Observations	28	23
Hypothesized Mean Difference	0	
df	48	
t Stat	1.62	
P(T<=t) two-tail	0.11	
t Critical two-tail	2.01	

Description: Winsorizing at 95% the % change in GSE loan originations and % FHA loan delinquency rates (dependant variable) on a state level. We found that even after attempting to reduce the influence of the outliers, as the GSE activity increases the FHA delinquency rates do not change, concluding no relation between the two variables. The tstat indicates that both standard error coefficients terms are insignificant at 95% confidence; the tstat in the t-test is lesser than the t critical value and hence we cannot reject the null hypothesis that the means of the two variables are the same concluding that there is no impact of increased GSE activity on FHA delinquency rates in the following year. Each point represents one of the 50 states and D.C. in the US.

8.1.4 Effect of change in GSE, unemployment rate in 2009, change in unemployment rates, change in GDP and HPI change on FHA delinquency rates (2009)

Statistical Significance Statistics

	Coefficients	Standard Error	t Stat	P-value
Intercept	0.01	0.01	0.44	0.66
%change in GSE	-0.26	0.28	-0.95	0.35
Unemp -2009	0.51	0.31	1.67	0.10
Change in unemp.	1.01	0.62	1.62	0.11
Change in GDP	-0.30	0.11	-2.83	0.01
HPI change	0.09	0.07	1.25	0.22
t-critical (two tail)				2.00975

Regression Statistics

Multiple R	0.72
R Square	0.52
Adjusted R Square	0.47
Standard Error	0.02
Observations	51

ANOVA

	df	SS	MS	F	Significance F
Regression	5	0.02	0.00	9.78	0.00
Residual	45	0.02	0.00		
Total	50	0.04			

Description: Relationship between % change in GSE, unemployment rate in 2009, Change in Unemployment from 2008 to 2009., Change in GDP from 2008 to 2009 and change in HPI from 2008 to 2009 on FHA delinquency rates (dependant variable) for 2008,2009. The signs of the coefficients provide for the direction of the relationship. However, we find that the only statistically significant relationship is for the change in GDP which has a p value of 0.007017(lesser than 0.05). All other p values are greater than 0.05 and hence statistically insignificant. Each point represents one of the 50 states and D.C. in the US

8.2 Data

8.2.1 FHA Delinquency data broken down at the state level.

State, area and census region	Number of loans serviced	Total past due	30 days	60 days	90 days or more	Inventory at end of quarter	Started during quarter	Seriously Delinquent (90+ FC Inv)
Alabama	66,545	14.90%	7.99%	2.93%	3.98%	1.74%	0.81%	5.72%
Alaska	12,291	6.38%	3.77%	1.37%	1.24%	0.64%	0.37%	1.88%
Arizona	67,635	8.57%	4.89%	1.75%	1.94%	1.18%	0.67%	3.12%
Arkansas	51,371	9.99%	5.83%	1.85%	2.31%	1.33%	0.59%	3.64%
California	102,458	7.17%	4.26%	1.41%	1.50%	1.07%	0.62%	2.57%
Colorado	98,237	9.76%	4.83%	1.92%	3.01%	3.22%	1.24%	6.23%
Connecticut	31,034	10.91%	6.23%	2.20%	2.48%	1.74%	0.73%	4.22%
Delaware	12,009	12.50%	7.18%	2.26%	3.06%	1.72%	0.72%	4.78%
District of Columbia	4,298	10.73%	6.68%	1.91%	2.14%	1.07%	0.63%	3.21%
Florida	177,117	12.42%	6.66%	2.47%	3.29%	3.39%	1.35%	6.68%
Georgia	208,499	17.04%	8.96%	3.28%	4.79%	2.43%	1.21%	7.22%
Hawaii	4,862	5.80%	3.15%	0.93%	1.73%	1.34%	0.29%	3.07%
Idaho	24,908	7.49%	4.49%	1.49%	1.51%	0.97%	0.58%	2.48%
Illinois	129,659	13.83%	7.45%	2.76%	3.62%	3.00%	1.21%	6.62%
Indiana	127,012	13.68%	7.25%	2.62%	3.81%	3.81%	1.46%	7.62%
Iowa	26,838	10.22%	5.73%	2.04%	2.45%	2.54%	0.80%	4.99%
Kansas	37,650	9.95%	5.61%	1.92%	2.42%	1.91%	0.78%	4.33%
Kentucky	55,967	11.64%	6.37%	2.11%	3.16%	2.31%	0.93%	5.47%
Louisiana	55,031	14.00%	7.67%	2.46%	3.87%	2.18%	0.73%	6.05%
Maine	6,933	10.57%	5.47%	2.31%	2.80%	2.26%	0.62%	5.06%
Maryland	75,587	11.50%	6.49%	2.20%	2.81%	1.14%	0.49%	3.95%
Massachusetts	20,361	12.20%	6.41%	2.26%	3.53%	1.95%	0.54%	5.48%
Michigan	121,909	18.16%	9.05%	3.64%	5.47%	5.27%	2.20%	10.74%
Minnesota	51,641	8.05%	4.33%	1.52%	2.20%	2.37%	0.88%	4.57%
Mississippi	36,611	15.70%	8.48%	2.87%	4.34%	1.68%	0.69%	6.02%
Missouri	85,726	11.54%	6.44%	2.31%	2.79%	1.39%	0.72%	4.18%
Montana	13,748	5.85%	3.63%	1.14%	1.08%	0.81%	0.36%	1.89%
Nebraska	25,366	7.71%	4.20%	1.52%	1.99%	1.83%	0.69%	3.82%
Nevada	28,886	7.66%	4.31%	1.43%	1.92%	1.29%	0.74%	3.21%
New Hampshire	5,672	9.59%	5.57%	1.83%	2.19%	1.43%	0.76%	3.62%
New Jersey	74,895	13.60%	7.48%	2.60%	3.51%	3.09%	1.24%	6.60%
New Mexico	25,007	8.89%	5.12%	1.60%	2.18%	1.36%	0.66%	3.54%
New York	131,808	10.75%	6.27%	2.04%	2.45%	2.38%	0.96%	4.83%
North Carolina	126,798	14.59%	7.68%	2.76%	4.16%	2.00%	0.94%	6.16%
North Dakota	9,186	4.57%	2.91%	0.86%	0.81%	0.73%	0.22%	1.54%
Ohio	176,203	13.15%	6.96%	2.50%	3.69%	4.37%	1.56%	8.06%
Oklahoma	68,942	9.68%	5.63%	1.79%	2.26%	2.08%	0.83%	4.34%
Oregon	26,510	6.76%	3.95%	1.26%	1.54%	0.97%	0.50%	2.51%
Pennsylvania	131,454	11.84%	6.95%	2.22%	2.68%	2.24%	0.73%	4.92%
Rhode Island	5,127	10.08%	5.70%	2.05%	2.34%	2.01%	0.92%	4.35%
South Carolina	43,343	14.70%	7.90%	2.69%	4.11%	2.51%	1.05%	6.62%
South Dakota	5,875	6.03%	3.40%	1.14%	1.48%	1.43%	0.43%	2.91%
Tennessee	120,398	12.60%	6.84%	2.35%	3.40%	1.49%	0.70%	4.89%
Texas	511,162	13.00%	7.16%	2.46%	3.37%	1.46%	0.72%	4.83%
Utah	54,175	6.94%	4.15%	1.26%	1.53%	0.72%	0.41%	2.25%
Vermont	1,509	10.87%	6.36%	2.25%	2.25%	2.78%	0.53%	5.03%
Virginia	96,234	9.69%	5.68%	1.86%	2.16%	0.84%	0.49%	3.00%
Washington	57,457	7.77%	4.41%	1.51%	1.85%	1.04%	0.60%	2.89%
West Virginia	8,395	12.67%	7.47%	2.51%	2.69%	1.61%	0.70%	4.30%
Wisconsin	30,349	11.57%	5.98%	2.30%	3.29%	2.91%	1.11%	6.20%
Wyoming	5,155	5.88%	4.05%	0.97%	0.85%	0.50%	0.23%	1.35%

8.2.2 HMDA data

Loan Originations in 2005					
State	Conventional	FHA	Total	% GSE	% FHA
Alabama	122470	7068	133345	0.918445	0.053005
Alaska	18200	1788	21979	0.828063	0.08135
Arizona	525157	6274	535123	0.981376	0.011724
Arkansas	116418	7916	127522	0.912925	0.062076
California	2313883	5051	2320447	0.997171	0.002177
Colarado	275004	13763	294303	0.934425	0.046765
Connecticut	162294	4907	167605	0.968312	0.029277
Delaware	48640	1157	50554	0.962139	0.022886
DistrictOfColumbia	375113	4109	380866	0.984895	0.010789
Florida	1235808	15084	1260459	0.980443	0.011967
Georgia	414058	22379	444701	0.931093	0.050324
Hawaii	39165	323	40017	0.978709	0.008072
Idaho	68963	3051	72910	0.945865	0.041846
Illinois	739623	21605	765915	0.965672	0.028208
Indiana	337495	21520	363121	0.929428	0.059264
Iowa	117609	3998	123455	0.952647	0.032384
Kansas	124864	5770	132279	0.943944	0.04362
Kentucky	229175	11474	246722	0.928879	0.046506
Louisiana	106937	4681	114066	0.937501	0.041038
Maine	42360	694	43506	0.973659	0.015952
Maryland	707613	10892	722154	0.979864	0.015083
Massachusetts	400201	3323	404110	0.990327	0.008223
Michigan	416695	14791	433649	0.960904	0.034108
Minnesota	239568	5493	246409	0.972237	0.022292
Mississippi	83291	5757	90973	0.915557	0.063283
Missouri	322518	13914	341069	0.945609	0.040795
Montana	12773	936	14194	0.899887	0.065943
Nebraska	53821	2697	57913	0.929342	0.04657
Nevada	235357	1835	238075	0.988583	0.007708
NewHampshire	48962	485	49648	0.986183	0.009769
NewJersey	732807	13110	747556	0.98027	0.017537
NewMexico	59622	3187	64492	0.924487	0.049417
NewYork	567841	12384	581902	0.975836	0.021282
NorthCarolina	386182	16275	416476	0.927261	0.039078
NorthDakota	14925	1136	16393	0.91045	0.069298
Ohio	418325	20305	442994	0.944313	0.045836
Oklahoma	90334	6650	100366	0.900046	0.066257
Oregon	204807	2775	209243	0.9788	0.013262
Pennsylvania	582365	14072	599413	0.971559	0.023476
PuertoRico	91712	4655	97123	0.944287	0.047929
RhodeIsland	95145	1278	96573	0.985213	0.013234
SouthCarolina	229739	9038	243865	0.942075	0.037061
SouthDakota	19236	909	20832	0.923387	0.043635
Tennessee	206938	12606	225385	0.918153	0.055931
Texas	693392	55604	768460	0.902314	0.072358
Utah	131024	9645	142313	0.920675	0.067773
Vermont	9629	89	9760	0.986578	0.009119
Virginia	613027	11911	633671	0.967422	0.018797
Washington	460479	7231	473436	0.972632	0.015273
WestVirginia	436485	5650	444706	0.981514	0.012705
Wisconsin	445913	9004	457427	0.974829	0.019684
Wyoming	8519	222	9148	0.931242	0.024268

9.0 References

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