Fannie Mae and Freddie Mac’s March into Subprime Mortgages

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ABSTRACT

This study investigates the series of events that led to Fannie Mae and Freddie Mac expanding their lines of business into the risky subprime mortgage market. Faced with competition from commercial banks and pushed to expand their purchases of low income and minority mortgages in order to fulfill their affordable housing goals, in 2005 the mortgage giants began making investments in the riskiest portion of the United States housing market. The riskiest assets they guaranteed were refinance mortgages borrowed by low income Hispanics and African Americans in underserved areas. There is also some incidence of the Government Sponsored Enterprises investing in mortgages in which the borrower leveraged his income to unsafe loan levels. Faced with a falling housing market, losses on these guaranteed mortgage assets forced the United States Treasury Department to take the GSEs into conservatorship on September 7, 2008.
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Introduction

The astronomical rise in house prices the first half of this decade was fueled by an environment of low interest rates and excessive risk taking. After the burst of the technology bubble in 2001 and post-9/11, Federal Reserve Board Chairman Alan Greenspan lowered the federal funds rate to the unprecedented level of one percent.

Banks, awash with cash, turned much of their excess reserves into home mortgages. Consumers, eager to profit from the historic rise in home prices, took on large mortgage debt.

Born from this housing bubble were new types of mortgage loans called subprime and Alt-A mortgages. Both were intended to spur home ownership in population segments that had historically been left out of the American Dream, such as low-income households and minorities. Subprime loans were extended to borrowers with low-income and/or poor credit histories. Alt-A loans were given to borrowers whose incomes fell in the prime category but whose mortgage applications lacked extensive borrowing history and information. Lenders were eager to extend these products to potentially problematic consumers because of the “originate to distribute” model, a scheme that allowed them to sell their mortgages to investment banks, who would then package them into Mortgage Backed Securities (MBS) or Collateralized Debt Obligations (CDOs). These were then sold to investors, who coveted the AAA ratings and higher yields when compared to treasuries or corporate debt. Underpinning this entire industry was the assumption that home prices would continue to rise. Increasing home value would allow subprime
borrowers to refinance their mortgages when their adjustable rates reset, typically two years into ownership, shielding investors from substantial default risk on their securities.

Against this backdrop of excess, greed and political expediency, investment banks, mortgage lenders, investors, consumers and regulatory bodies all played a role in the most dramatic decline in home prices and a financial crisis not seen since the Great Depression. No role is more pivotal to this still-unfolding drama than that played by Fannie Mae and Freddie Mac. By examining the existing literature, reports and data from the Office of Housing and Urban Development, this paper examines the events leading to the housing crisis and focuses on Fannie Mae and Freddie Mac and on whether they purchased a disproportionate number of risky mortgages, including loans with favorable terms to minorities and subprime or near subprime mortgages, and what relationship, if any, this had on house prices.

Unraveling Scheme

In 2006 the Office of Federal Housing Enterprise Oversight (OFHEO) home price index ceased its historic rise and began to fall in 2007, setting in motion a two-year decline in home values across the country. Many of the regions that experienced the greatest appreciation, including Southwest California, Nevada, and Florida are now suffering the greatest declines. Lower home values have increased mortgage delinquencies and defaults, causing massive devaluation in the trillions of dollars of mortgage securities. The banks that underwrote and invested in the US housing market have taken writedowns of billions of dollars and have accepted billions of dollars of government bailout money in order to secure their capital base. The investment banks
have been particularly hard hit. Bear Stearns was forced into a shotgun marriage with JPMorgan Chase in March of 2008. In September of 2008 the New York Fed and Treasury Department allowed Lehman Brothers to go bankrupt, precipitating a credit crunch that threatened the entire financial system. Merrill Lynch subsequently sold itself to Bank of America (who had previously purchased mortgage lender Countrywide Financial) and Goldman Sachs and Morgan Stanley turned themselves into Bank Holding Companies. Since the original bailout legislation both Citigroup and Bank of America have sought more taxpayer bailout money from the government.

The recession, spurred by the fall in house prices, began in December of 2007, resulting in massive unemployment, a bear market with highs roughly 50 percent off the Dow Jones Industrial Average high of 14,000 in October of 2007, and battered corporate earnings.

Loosening Regulatory Reins

Criticism against the government generally comes in the form of two arguments. The first blames the prevailing economic theory since 1980 that deregulated markets are more efficient than those with heavy- handed regulation. The government undertook many significant deregulatory policies since that time. Notably, it eliminated the Depression-era Glass/Steegal Act that separated securities firms and traditional investment banking from commercial retail banking. This led to the creation of the financial supermarket symbolized by the behemoth Citigroup built by Sandy Weill, who merged Citibank, Travelers Insurance, and Salomon Smith Barney. A second significant undertaking was the Gramm-Leach-Billey Act of 1999 that limited the regulatory
oversight of financial derivatives, such as credit default swaps that are behind the $100 billion dollars in losses borne by insurance company AIG.

**GSEs in the Picture**

The other line of criticism involves the Government Sponsored Enterprises (GSEs) Federal National Mortgage Association or Fannie Mae and the Federal Home Loan Mortgage Corporation or Freddie Mac. Prior to the financial crisis these GSEs operated as both government-sponsored enterprises and private companies. They were founded for the purpose of purchasing and securitizing mortgages to ensure that there are always consistent funds available to commercial mortgage lenders. The GSEs, upon purchase of a mortgage, either hold the loan to maturity or package pools of loans into securities for sale to investors as mortgage-backed securities. If either Fannie Mae or Freddie Mac holds the mortgage, it gives the loan its full guarantee and, in the event of default and foreclosure, the GSE takes over the property and attempts to resell it to recoup some of the value.

As of 2008 the GSEs owned or guaranteed roughly half of the country’s 12 trillion dollar mortgage market. After an accounting scandal that resulted in restated earnings, the companies sought higher earnings and began to purchase subprime and Alt-A mortgages. This increased the companies’ holdings of risky assets via mortgages to borrowers who were more likely to default on their mortgage payments.

The housing market turmoil that began in 2007 and the nationwide wave of delinquencies, defaults, and foreclosures took a toll on the GSEs portfolios. By the summer of the 2008 the companies were reporting losses and asset write-downs that
totaled in the billions of dollars. The companies’ stock prices were falling rapidly and questions swirled as to whether they would be able to survive as public companies. Many argued that they were still able to operate because of the implicit government backing. But by July, as market conditions made it look increasingly difficult for the companies to be able to raise capital in the private markets, then-Treasury Secretary Hank Paulson outlined plans to take the companies under control of the government if the need arose. After months of speculation, in September 2008 the government took the GSEs into conservatorship. The companies now operate with full government backing.

Many economists suggest that the nation’s economic woes won’t cease until the housing market recovers. With banks unable or unwilling to lend and millions of Americans either falling behind on their mortgage payments or with their home values underwater, the government plans to support home ownership. Propping up the housing market will involve Fannie and Freddie taking an even larger role and pumping money into the system by buying more mortgages. This is a safer proposition now when there is no possibility of a disruptive bankruptcy, but it means that the troubled agencies will play a major role in the housing market and run on government money for the foreseeable future.

It is an important policy debate to decide what role, if any, GSEs should play in the private housing market. A bankruptcy over the summer of the largest player in the market would have had drastic consequences for home values nationwide and exacerbated their already steep slide. In search of profits, the companies grew, took on excessive risk, poorly managed risk and now are in need of taxpayer money to stay
viable. It is important to look at how they got here to begin to develop a framework of what these companies will look like in a post-recession economy.

**History of Fannie Mae and Freddie Mac**

The GSEs are a major source of funding for the United States housing market. Borrowers who seek a mortgage to buy a house apply for one through private mortgage lenders. These range from independent mortgage brokers, such as Countrywide Financial (before its buyout by Bank of America), to lending branches of large banks, such as JP Morgan Chase. Large banks can fund the mortgage purchases using their deposits but smaller brokers rely on borrowed funds. If these firms were to hold on to the originated mortgages they would be exposed to both the interest rate risk and the default risk over the maturity of the loan, and would have balance sheets saddled with debt needed to provide the consumers with the upfront borrowings. Eventually the pool for available mortgages would decline or costs for mortgages would drive down demand for home purchases. To solve this, mortgage lenders have the option to sell their loans to either large banks, investment banks such as Goldman Sachs, or one of the GSEs, Fannie Mae or Freddie Mac. Exchanging cash for the loans frees the lenders to originate new mortgages. This system provides a constant flow of mortgage funds for home purchases, refinancing, and home equity loans and lines of credit. The institutions now in possession of the loans package pools of them into bonds derived from the stream of monthly payments or MBSs for sale to investors ranging from individuals, to pension funds, mutual funds, and hedge funds.
By far the largest players in this secondary market are the GSEs. The larger of the two, Fannie Mae, was created in 1938 during the Great Depression to ensure that there was a supply of mortgage funds within the country’s crippled financial system. In 1968 President Lyndon Johnson re-chartered the company as a publicly traded corporation. Thus Fannie became a for-profit company operating in the private sector yet doing so with a Congressional charter to support the country’s housing market and to stimulate affordable home ownership opportunities for traditionally underserved low-income persons. The Congressional charter gives the company broad responsibilities including:

“(1) [Providing] stability in the secondary market for residential mortgages;
(2) [Responding] appropriately to the private capital market;
(3) [Providing] ongoing assistance to the secondary market for residential mortgages (including activities relating to mortgages on housing for low- and moderate-income families involving a reasonable economic return that may be less than the return earned on other activities) by increasing the liquidity of mortgage investments and improving the distribution of investment capital available for residential mortgage financing;
(4) [Promoting] access to mortgage credit throughout the Nation (including central cities, rural areas, and underserved areas) by increasing the liquidity of mortgage investments and improving the distribution of investment capital available for residential mortgage financing; and
(5) [Managing] and liquidate federally owned mortgage portfolios in an orderly manner, with a minimum of adverse effect upon the residential mortgage market and minimum loss to the Federal Government.1

Therein lays the dichotomy inherent in the company’s mission: to earn profits for shareholders and to serve the public good. The relationship between the two competing forces becomes especially problematic at the beginning of this decade.

Two years later, in 1970, the government also chartered Freddie Mac to compete with Fannie and eliminate its monopoly in the secondary mortgage market for guaranteeing conforming2 loans. The companies earned profits in two ways3. The first is through a fee they collect upon guaranteeing the mortgages that they purchase and then sell to investors in the form of MBSs. The other involves holding the purchased loans in their own portfolios and making money on the spread between the portfolio yield and their low cost of capital.4

Built-in Advantages, Risky Bets

The GSEs benefited from their unique standing as private corporations with a government charter. They possess advantages, including exemptions from state and local income taxes, less stringent capital requirements, and by having access to a government “line of credit,” since the Treasury has the ability to buy GSE debt up to 2.25 billion

1 Fannie Mae National Charter Act
2 A conforming loan is a mortgage in which the borrowed principal is less than a limit set by the agencies’ regulator; it also must pass acceptable underwriting standards, standards that became looser as the decade wore on
3 The company also speculated in derivatives to hedge its portfolio of mortgages. It had to report big losses on its positions through 2008. It can also generate profits on correct bets but derivative trading is not meant to be a driver of profits
dollars. In the private markets, investors regarded Fannie and Freddie debt as safe as United States Treasuries, assuming an implicit government backing of the companies if they ever fell into trouble. While this was never explicitly stated the GSEs would nonetheless stoke investors’ beliefs that the government would never let them default and used it markedly to their advantage. Their AAA-rated debt historically yielded just a few basis points more than Treasury bonds. The cumulative effect allowed the GSEs to fund their operations cheaply and devote more of their capital to building their portfolio. Up through 2005 Fannie Mae experienced double-digit profit growth for 17 consecutive years. During this time the holding of residential mortgages substantially increased.

Over the years Fannie and Freddie’s power and influence grew. The companies provided top-paying executive positions to influential politicos, who lobbied hard on the firm’s behalf. Politicians who touted growing home ownership in the country credited the GSEs for making mortgages more affordable and available. Even Wall Street, while a competitor on some levels (large banks would have loved to get a part of the residential mortgage market that Fannie and Freddie dominated), supported the institutions for the fees they generated for the broker-dealer businesses that serviced the agency-backed MBSs. But this drew the ire of critics uncomfortable with both the special privileges given to the companies and the lax regulatory oversight by the OFHEO. This agency within the Department of Housing and Urban Development has no experience regulating financial markets. Even when OFHEO tried to take a tougher stance against Fannie Mae and Freddie Mac, their massive lobbying efforts were able to beat back any governmental overtures.

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But in 2003 with White House backing, OFHEO hired Deloitte & Touche to investigate the accounting practices at the GSEs. The investigation concluded with both Fannie and Freddie issuing earnings restatements and the ouster of top management at both companies. Under the cloud of having to restate earnings, and facing diminished spreads from competition from hedge funds performing carry trades, in 2005 Fannie and Freddie both decided to expand into purchasing riskier mortgages. This practice was thought to carry two advantages for the GSEs. Because riskier mortgages such as subprime and Alt-A were targeted mostly towards low income people and minorities they would be achieving their targeted goals for expanding credit into underserved areas. Secondly, these riskier mortgages have higher yields, and thus stronger earnings potential in the face of stiffer competition. But what resulted in the ensuing housing meltdown proved disastrous for both Fannie Mae and Freddie Mac.

Housing Market Dynamics

From November 2001 through November of 2004 Federal Reserve Board Chairman Alan Greenspan held the federal funds rate at unprecedented low levels. With the overnight lending rate at less than two percent, financial markets were awash with liquidity, subsequently leading to credit expansion. Millions of Americans applied for first mortgages or sought to take advantage of low interest rates by refinancing their existing mortgages. The housing market boomed and home values across the country proved disastrous for both Fannie Mae and Freddie Mac.

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soared. Between 2000 and 2007 the OFHEO home price index jumped 68 percent.\textsuperscript{8} During this time the use of newer financial instruments, such as subprime and Alt-A mortgages grew rapidly. A working paper published by the National Bureau of Economic Research by Atif Mian and Amir Sufi entitled \textit{The Consequences Of Mortgage Credit Expansion: Evidence From The 2007 Mortgage Default Crisis} concluded that the credit supply expansion during this decade was targeted to subprime borrowers.

Subprime mortgages were an innovation intended to extend home ownership opportunities to lower income citizens. There is no formal financial definition for these loans. The term subprime is used to describe many different characteristics of risky loans. Typically, a subprime borrower is one who would not be eligible for a conventional prime mortgage because of either insufficient funds for down payment, credit issues, inability to document income, or lack of key documentation and demographic information (loans with lack of information generally fall into the Alt-A category and they differ from subprime in that the borrowers have good credit scores).

The originators of these mortgages were not simply altruistic but profited from the higher costs associated with these mortgages. Originators stand to generate more fees from the different underwriting standards and structures of subprime mortgages. The typical subprime mortgage is a hybrid 30-year mortgage with 2/28 structure. The mortgage requires a small or nonexistent down payment and a low interest rate for the

\textsuperscript{8}“The HPI is a broad measure of the movement of single-family house prices. The HPI is a weighted, repeat-sales index, meaning that it measures average price changes in repeat sales or refinancings on the same properties. This information is obtained by reviewing repeat mortgage transactions on single-family properties whose mortgages have been purchased or securitized by Fannie Mae or Freddie Mac since January 1975.” Office of Federal Housing Enterprise Oversight. \textit{About the HPI Index.} Available from http://www.ofheo.gov/hpi.aspx?Nav=269.
first two years. After the initial 24 months, the interest rate resets to a higher rate
determined by market forces. To escape these higher payments, the subprime borrowers
were encouraged to refinance to another subprime mortgage after these two years to
avoid the higher monthly payments. The underlying assumption, of course, was that
refinancing to a lower rate would always be possible as house prices continued their
ascent.

Shane Sherlund’s study The Past, Present, and Future of Subprime Mortgages
noted that by 2005 and 2006 these loans became even riskier as loose lending and
underwriting standards were relaxed further in order to maintain the volume of loans and
generation of fees. By this time the average subprime mortgages had loan-to-value ratios
greater than 85 percent. The share of fully documented subprime mortgages fell from 75
percent in 2000 to 60 percent during this time period. Sherlund notes that one in six
subprime mortgages has little or no documentation combined with LTV ratios greater
than 95 percent.

Conflicted Priorities

A working paper by Christopher Mayer and Karen Pence entitled Subprime
Mortgages: What, Where, And To Whom? analyzed Loan Performance and Home
Mortgage Disclosure Act data and observed that subprime lending was much more
prevalent in areas of the country with a greater percentage of minority residents. They
reinforced the link by showing that when controlling for credit scores and other
geographic characteristics, race is strongly related to issuing of subprime purchase and

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9 Sherlund, Shane M. The Past, Present, and Future of Subprime Mortgages. Finance and Economics
Discussion Series Divisions of Research & Statistics and Monetary Affairs Federal Reserve Board. 2008.
refinancing loans. They were also able to establish a link between this risky lending and the housing boom. Price appreciation was higher in the areas of the country, such as Los Angeles, Riverside, Las Vegas, and Phoenix, that also had some of the highest concentrations of subprime lending. Their study found that “a one standard deviation increase in house price appreciation in the previous year is associated with a 39 percent increase in subprime loans.”\(^{10}\) While subprime originations were heavily concentrated in fast-growing regions that experienced price appreciation greater than the national average, Mayer and Pence note that there were other parts of the country that realized substantial price gains but did not have a greater percentage of subprime borrowers. This study also shows that refinancing loans are a greater percentage of total subprime mortgages. The high proportion of refinancings underscores borrowers’ crucial need for continued access to the mortgage market to avoid the costly step up to higher monthly payments.

Borrowers attracted to the low initial monthly payments and lured by ever increasing home prices kept up demand for these mortgages through 2006 and into early 2007. Their enthusiasm was only exceeded by the originators’ eagerness to generate fees by pooling these mortgages into securities and by investors’ desire for yields higher than treasuries, along with AAA-rated safety. Mortgage-backed securities and collateralized debt obligations backed by these mortgages were scooped up by investors across the globe. The demand for these securities even outpaced the supply of mortgages. Soon, synthetic mortgage-backed CDOs were introduced. These consisted of credit default

swaps written on the bonds securitized from subprime mortgages. This was an important
development as it led to the first market pricing of these securities.

In 2006 the ABX index was introduced. The index consisted of a basket of credit
default swaps written on these securities backed by subprime mortgages. The indexes
covered the performance of different tranches of bonds. Upon introduction in 2006 and
coinciding with the first declines in house prices in some metropolitan areas, the index
allowed investors to speculate on the performance of these popular bonds. From its
inception, the index fell, revealing that many market players believed the bonds were not
as safe as originally thought.

Falling home prices imposed a heavy burden on subprime borrowers. Sharply
decreased home equity values forced borrowers to carry home mortgages that, in many
cases, exceeded the value of their home, dampening the incentive to stay current on their
mortgages. Further, it made refinancing or selling much more difficult. By the middle of
2008, according the Sherlund, the delinquency rate on subprime mortgages grew to an
alarming 30 percent.

The GSEs and Risky Mortgages

After the accounting scandals at the GSEs, the focus of the business had to shift to
dealing with management changes and the restatement of earnings, which led to some
loss of market share to private competitors. Prior to 2005 the agencies only had nominal
presence in the subprime and Alt-A markets. Post 2000 those segments of the market

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grew at the expense of the GSEs. The companies were on the outside of the fastest growing piece of the mortgage market.

When HUD became the agencies’ regulator in 1992, each year they required the GSEs to buy a portion of affordable mortgages to underserved borrowers. In 2004, in the midst of OFHEO’s investigation of the GSEs’ accounting practices, President George Bush’s HUD required the agencies to increase their promotion of affordable housing for low-income people by increasing the agency’s affordable housing goal from 50 to 56 percent. According to the assistant secretary of HUD, the GSEs were lagging in their lending to low-income borrowers and “must do more”.  

But at the same time regulators did not enforce their own standards for evaluating which mortgages complied with those goals. Regulations state that HUD “would not credit them for loans they purchased that had abusively high costs or that were granted without regard to the borrower’s ability to repay.” Yet HUD allowed the $169 billion in subprime securities Fannie and Freddie bought in 2005 to count towards the affordable housing goal, despite the fact that multiple academic, governmental, and consumer advocates were warning that subprime originators were enticing borrowers into loans they could never repay and were ignoring borrowers’ qualifications.

The GSEs were all too happy to acquiesce to placate their regulators and to become bigger players in the profitable subprime market. A letter written by then-Fannie Mae CEO Daniel Mudd to his board of directors at the beginning of 2007, just as the housing market was on the brink of its rapid descent, stated that one of Fannie’s

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achievements over the past years was expanding its involvement in the market for subprime and other nontraditional mortgages.\(^{15}\) Even with house prices in many major metropolitan areas declining, foreclosures on subprime mortgages rising, and the ABX index--tracking the performance of many of the $434 billion dollars in subprime securities Fannie had purchases from 2004 through 2006--plummeting, Mudd wrote that his company planned to further its involvement with subprime and Alt-A mortgages to continue to gain market share and achieve the government quotas. These actions only served to lubricate the already unregulated subprime market and provided fresh cash to subprime originators, who continued to relax what were already loose lending standards.

But these plans were never realized, as falling house prices eroded the value of their assets while the debt they took on to purchase those assets remained on their balance sheets. The GSEs funded their long-term obligations (the guaranteeing of principal and interest payments) with short-term borrowing. Short-term borrowing is already a cheaper form of financing used by commercial banks, broker dealers, and hedge funds, but the GSEs used their unique position and implicit government backing to their advantage and were able to borrow at even lower rates than other financial institutions.

Buoyed by low interest rates, the GSEs borrowed heavily as they ramped up their purchases of subprime securities. Goldman Sachs’ chief US economist Jan Hatzius determined that the GSEs were levered up 24 times equity, nearly three times that of commercial banks and only barely exceeded by broker dealers and hedge funds\(^{16}\). This amount of debt is particularly harmful when the firms are experiencing massive losses.

and losing capital. Investors, nervous over the viability of the GSEs as they continued posting losses, bid down the share price of the GSEs into the summer of 2008. Over the week of July 7th alone the Fannie and Freddie’s stock prices plummeted over 50 percent, as speculation persisted that the government would have to take over the companies or allow them to go bankrupt. In the face of mounting losses the companies were under pressure to raise capital. Selling off assets was unrealistic. If Fannie and Freddie were to dump their housing assets on the market, it would only add tremendous downward pressure on prices in the market, assuming that any investors were willing to take on the risks of holding housing assets during the worst house price downturn since the Great Depression. Further, raising equity through stock offerings would be difficult, given their low share price and the amount of short sellers who continued to drive it down.

Since the agencies used short-term borrowing to finance their business activities, they faced substantial interest rate risk, which they hedged through entering into derivative contracts with counterparties. But with the prices of their mortgage assets falling and potential inability to raise capital threatening their net worth and solvency, the debt markets became problematic for the institutions. Other financial institutions could retreat from entering to swap contracts to limit their counterparty risk exposure to the GSEs and with their financial viability in question their low borrowing costs began to increase. A long-term increase in borrowing costs would throw a wedge in the companies’ operations and make future profitability impossible by eliminating the spread between what the company was able to earn on their mortgage portfolio and what they paid for the mortgages.
On July 14th the Treasury Department announced a plan to back the GSEs should their financial state worsen. They were also given a new chief regulator, the Federal Housing Finance Agency (FHFA). Even with this explicit government backing, the agencies’ precarious financial standing deteriorated over the course of the summer and the Treasury put Fannie and Freddie into conservatorship on September 7th. The decision stated, “as conservator, the FHFA [took] over the assets and assumed all the powers of the shareholders, directors and officers. It may take any necessary action to restore the firms to a sound and solvent condition…”

To restore financing to the companies, the government purchased preferred stock, agreed to buy Fannie and Freddie securitized MBSs to support the flow of credit in the market, and gave the GSEs access to short-term loans from the Treasury.

Over the 2008 fiscal year Fannie Mae lost 58 billion dollars and the smaller Freddie Mac lost 50.1 billion dollars. Combined, they have already received over 60 billion dollars in federal aid and the government has committed to covering up to 200 billion dollars in potential losses with taxpayer money. Much of the attention in these articles is on the subprime MBSs purchased by the GSEs. But the agency role in these transactions is simply as an investor of a security issued by a commercial bank or other financial institution. These MBS purchases are an important, yet more indirect method of extending credit to underserved borrowers while also profiting from the higher yielding debt. Critics of the GSEs claim, however, that Fannie and Freddie stimulated the subprime market by directly purchasing and guaranteeing risky mortgages by holding them in their portfolio of loans. The economic policy analysis blog Econbrowser run by

17 Jickling, Mark. “Fannie Mae and Freddie Mac in Conservatorship.” CRS Report for Congress. 15 September 2008
James Hamilton of the University of California- San Diego and Menzie Chinn of the University of Wisconsin- Madison write that:

“Fannie and Freddie .... didn't like losing their market share, and they pushed the envelope on credit quality as far as they could inside the constraints of their charter: they got into "near prime" programs (Fannie's "Expanded Approval," Freddie's "A Minus") that, at the bottom tier, were hard to distinguish from regular old ‘subprime’”

Again, many believe this is attributed to Fannie and Freddie coming out of the accounting scandal and wishing to assert themselves in this area of the market to regain market share.

There is evidence that the incidence of non-prime mortgages increased in 2005. These would not typically be classified as subprime, but fall short of the historical standards for conforming, prime loans. American Enterprise Institute scholars Peter Wallison and Charles Calomiris believe that this jump is due to Fannie and Freddie expanding their portfolio to include far riskier mortgages:

“Beginning in 2004, after the GSEs' accounting scandals, the junk loan share of all mortgages in the United States began to rise, going from 8 percent in 2003 to about 18 percent in 2004 and peaking at about 22 percent in the third quarter of 2006. It is likely that this huge increase in commitments to junk lending was largely the result of signals from Fannie and Freddie that they were ready to buy these loans in bulk. For example, in speeches to the Mortgage Bankers Association in 2004, both Raines and Richard Syron--the chairmen, respectively, of Fannie and Freddie—‘made no bones about their interest in buying loans made

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to borrowers formerly considered the province of nonprime and other niche lenders.’ Raines is quoted as saying, ‘We have to push products and opportunities to people who have lesser credit quality’… But the percentage of mortgages with subprime characteristics purchased during this period consistently exceeded 49.8 percent, demonstrating that Fannie was substantially increasing its reliance on junk loans between 2005 and 2007.’

This suggests that they purposely entered the risky mortgage market with its high probability of default. This strategy has severe consequences on the performance of all of the GSEs’ assets, not just the ones containing the junk mortgages. Defaults and subsequent foreclosures ripple through the market by depressing home values throughout affected communities across the country.

The analysis in the following section strives to determine the prevalence of these risky mortgages and their correlation with the collapse of housing prices.

**HUD Data**

The data used in this analysis is from the HUD Office of Policy Development and Research database on GSE mortgage purchases. It contains a record of every mortgage purchased by Fannie Mae and Freddie Mac in 2005. The data is organized at the state level and cumulatively contains over 5 million data points. For each mortgage there are three types of data: geographic, borrower characteristic, and mortgage structure. The

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geographic information gives the postal code, metropolitan statistical area, county, percent of the area that has a minority population, the area median income, and whether the loan was originated in an area of the country that is defined as underserved. The borrower information contains the borrower’s annual income, the ratio of the borrower’s income to the median income of the community in which he or she lives, if the borrower is a first-time home buyer, and the race, gender, and age of the borrower. The mortgage structure defines which agency purchased the mortgage, how many borrowers were on the mortgage application, whether the mortgage was used for a purchase or refinancing, whether the mortgage is for an owner occupied property or an investment property, and whether the mortgage is backed by a federal guarantee.

The data was then culled to build a subset of only those mortgages that were purchased in the country’s 53 largest metropolitan areas. A second subset containing the quarterly OFHEO home price index number for the aforementioned cities from January 2000 through January 2009 was aggregated. These two data sets were then merged to generate a set that includes all the purchased mortgages by city with their individual geographic, structural, and demographic characteristics and the home price index for those cities over the past decade.

Variables were then identified or created that highlight specific characteristics of potentially risky mortgages. Sherlund [2008] determines that borrower leverage is one of the most important factors explaining default. Someone whose loan-to-income ratio is higher will have trouble making interest and principal payments when mortgages reset, especially if refinancing is unavailable. Secondly, an overleveraged borrower is also more likely to default upon a job loss or other extenuating circumstance, such as sickness
or injury. A loan to income variable was created by dividing the unpaid balance variable (upb) by annual income (anninc). A second determinant of mortgages with higher default rates identified in the study was non-owner occupied properties. During this time period many people were buying houses as investments, hoping to sell them in a short time frame for a quick profit. Conceivably, these speculators could take out a subprime mortgage to buy the house with no down payment, pay the low, teaser interest rate, and flip the house before the rate reset. Without regard to likelihood of default, Sherlund found that the lowest quality loans were the previously mentioned ones in which the borrower was not the occupier, had missing documentation, and high unpaid balance. The latter is not applicable to this study. When Sherlund refers to a high unpaid balance he is talking about jumbo loans. The GSEs’ charter sets a maximum loan limit for their purchases, which was $359,000 in 2005. In this study, the best indicator of a homeowner who has borrowed a risky amount of money is the leverage ratio. But, the literature does tell us that Fannie and Freddie loosened its purchase standards to incorporate these Alt-A mortgages with missing documentation, and that fact is found in the data.

Dummy variables were created for these loans with missing information. The first is a dummy for borrowers whose incomes were unknown. Neither the GSE nor the originator can determine the likelihood of mortgage payback if they do not know the income of the borrower. This is a major red flag for a risky, junk mortgage. A second variable was created for mortgages with individuals whose status as first-time borrowers is unknown. This lack of information could signal that the company that originated the mortgage did not adequately check borrowers’ credit history. Any previous mortgages
would certainly be found on any basic credit check. A mortgage that was originated to a borrower with an incomplete credit history is another sign that it is potentially toxic. The final dummy variable for missing documentation is one for mortgages in which the borrower did not report his or her race. Mayer and Pence [2008] find that subprime mortgages were targeted towards minorities, particularly African Americans and Hispanics and if the GSEs were purchasing mortgages without knowing the race of the borrower, they missed an important factor in judging the level of risk they were undertaking. These variables capturing missing documentation need to be looked at cumulatively as well. If mortgages were originated missing key information, then one is left to question the totality of the underwriting process, particularly since there were well-known instances of mortgage fraud committed during this era of relaxed mortgage standards.

Another significant characteristic of risk is the nature of the loan and whether it was refinanced. Mayer and Pence [2008] showed that refinances represented a majority of subprime loans, and risky borrowers received “subprime-like” mortgages with low initial interest rates, expecting to refinance before the higher rates took effect. Many of the refinances could be subprime refinances or, a refinance for risky borrowers who are moving to a new, less risky mortgage after their initial foray with subprime. Gender is a potential risk factor, especially for single moms with economically sensitive occupations and significant child care costs. A New York Times article published in January 2008 investigated the problems women in Baltimore who received subprime mortgages were having keeping up with their payments. Finally, a mortgage purchased in an underserved area increases the likelihood of risk. The literature showed that Fannie and Freddie had
their affordable housing goals increased during this time-period. So, in an effort to reach the quota, they may have taken on increased risk.

**Empirical Evidence**

The analysis intends to show, using regression analysis, if the GSEs did substantially increase their holdings of risky mortgages as their critics claim. It also intends to demonstrate how they allocated these riskier purchases. The dependent variables in the first series of regressions are the leverage of the borrower (e.g., loan to income variable) and if the mortgage is a refinancing. These are the leading risk factors correlated with mortgage defaults as determined from the literature. The data set does not contain the loan-to-value (ratio of amount borrowed to value of the property) or credit scores. This is proprietary information not available to the public on the individual data point level. But without this information I am still able to construct a profile depicting the characteristics of a risky mortgage.

The first set of regressions uses the borrower’s leverage as the dependent variable. The independent variables chosen include: the purpose of the loan and whether it was for a refinancing or an investment property; the gender of the borrower; area of mortgage origination and whether it was an underserved area; whether the mortgage was for the borrower’s first home, and whether the borrower was a Hispanic or African American. Any positive significant coefficient would indicate increased borrower leverage and substantial increase in risk for future default. The results of the regression show significant positive coefficients on the refinancing and Hispanic variables; a positive but

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21 Aggregate data on these variables can be found in GSE financial statements.
insignificant coefficient on the first home variable; a negative and significant coefficient for investment property, and negative but insignificant coefficients for gender, underserved area, and African Americans. This first regression reveals that the GSEs took on riskier mortgages from Hispanics, but not African Americans. Prior research reveals that areas of the country with significant African American populations were heavily concentrated with subprime loans, but this regression tells us that mortgages from African American borrowers had lower loan-to-income ratios. The GSEs also accepted more levered refinances, but purchased mortgages with less home to income when the borrower would not be occupying the property. The negative underserved area coefficient also seems to disprove the GSEs critics who claim that in order to fulfill government goals the agencies were forced to extend themselves into taking on greater risk.

The next regression looked at the same variables but was run with fixed effects. When looking at within city changes, the Hispanic coefficient turned negative and became insignificant. So it would appear that there were perhaps certain metropolitan areas with large Hispanic populations that were skewing the initial regression. The refinancing variable also turned insignificant while staying positive. When adjusting for within city changes in the data, it appears the GSEs did not encourage risky lending by purchasing leveraged loans given to minorities, persons in underserved areas, and refinances—all of which the literature showed had large incidence of risky lending.

To continue to explore the variances between GSE purchases in cities, I ran this regression two more times over two different groups of cities. Mayer and Pence [2008] construct a map showing where incidence of subprime lending is highest. They are
typically cities that grew over the early part of the decade and are in the Southwest and South. The first group of cities is: Denver, Las Vegas, Los Angeles, Miami, San Diego, Washington DC, Phoenix, Riverside, Orlando, San Jose, Jacksonville, Salt Lake City, Fort Myers, Chicago, Providence, Minneapolis, Sacramento, Atlanta, Houston, Dallas, Memphis, Detroit, Cleveland, and Tampa Bay. The second group of cities was not associated with large amounts of supprime lending, they are: Boston, New York, Charlotte, Portland, Seattle, Philadelphia, St. Louis, Baltimore, Pittsburgh, Cincinnati, Indianapolis, Kansas City, Columbus, Virginia Beach, Milwaukee, Nashville, Louisville, Raleigh, Rochester, New Orleans, and Tulsa. It would be expected that Fannie and Freddie’s risky mortgage purchases would most likely come from the cities that had more “nonprime” lending. The group not associated with subprime only had one significant coefficient and that showed that investment properties were associated with lower loans to income as seen in previous regressions. The group of subprime cities showed insignificant variables for both minorities and underserved areas, but a positive significant coefficient for refinances. Mayer and Pence [2008] as noted previously determined that refinances make up more than half of subprime mortgages. So it should be noted that in the subprime cities refinances with riskier loan terms were purchased but not in the “safer” cities. The makeup of refinances will be fleshed out in later analysis. But there is strong evidence showing that Fannie and Freddie did not purchase mortgages from minorities with heavily leveraged borrowing.

The second series of regressions also looks at borrower leverage but with respect to poor underwriting standards. These regressions investigate if Fannie and Freddie bought mortgages with missing documentation that had higher loan to income ratios. The
first set in the series uses the same equation as in the previous series but replaces the first home, Hispanic, and African American variables with dummy variables for missing first home information and missing race. The missing first home variable is insignificant, but there is a strong negative and significant coefficient for missing race. Thus, mortgages that contained missing demographic information had lower loan to income ratios. The next set examined how total unpaid balance was related to missing income. Leverage could not be looked at it in this regression as you cannot correlate loan to income when the borrower’s income is not reported. With significant results, loans purchased with income missing had 11,490 dollars less of unpaid balance. Fixed effect regressions showing within city changes show very similar results. When comparing between the risky and non-risky cities the same results hold. Missing documentation only has negative effects on borrower leverage and gross loan total.

In the first group of regressions refinances were shown to be significantly correlated with risky borrowing amounts relative to income. In this second group refinances are tested as the dependent variable. Some of the independent variables in the group are different. The first independent variable looks at the quarterly change in the home price index from January of 2000 through December of 2004, which is right up until the year in which these mortgages were purchased. Where house prices are increasing, people are more likely to refinance their mortgage to better terms in order to take advantage of the increased equity. They may also cash-out refinance to take cash out against the appreciated value in the home. These regressions also take into account the area median income. Subprime refinances would be more likely to occur in areas with lower median incomes. Unpaid balance to income is used as an independent
variable in these regressions, although we already know the positive correlation between these two variables. The underserved areas, gender, and investment property variables are also used again. Here we also look at race but look at it in terms of income. We include low income Hispanics and low income African Americans into the equation as defined by borrowers with incomes less than the sample median. This regression finds that areas that home prices appreciation is significantly correlated with refinance mortgages. As area median income increases the probability of refinance also increases. Leveraged home borrowers are also more likely to refinance as are borrowers in underserved areas, low-income Hispanics and low income African Americans. Only women and borrowers who are investing are less likely to refinance. Of particular note is that low income Hispanics and African Americans are 2 percent and 6 percent more likely refinance respectively. This supports the claim that these minority groups are attaining risky mortgages although not necessarily in terms of leverage. When looking at this regression but replacing the race variables with missing race documentation and missing income we find that mortgages with the race of the borrower missing is 3 percent more likely to be a refinance while missing income is 6 percent more likely. When the sets are broken into the two city groups the differences are stark. By every coefficient measure, the risky cities are more likely to refinance. Of note is that in the cities where subprime lending is less prevalent mortgages in underserved areas are 1 percent less likely to be refinances while borrowers who are low income Hispanics are 6 percent less likely to have a refinanced mortgage. In the areas of the country where there are more subprime loans the GSEs have purchased many more potentially risky mortgages when measured as refinances.
At this juncture it is important to present a caveat. I already addressed how the data set lacks two important variables: loan to value and FICO (or credit) score. Depending on what these values are for each individual borrower can drastically change the overall risk level of the mortgage. These results suggest that Fannie and Freddie did not purchase highly leveraged mortgages from risky populations such as minorities, women, and underserved areas. But if within these populations are borrowers who took out greater than 80 percent of the value of the home purchase on their loan or have poor credit histories then the risk level of the GSE portfolio drastically increased. Conversely, these results also suggest that many leveraged mortgages were for refinance loans taken out by low income African Americans and Hispanics in underserved areas. This appears to be a significant risk undertaking given that refinances make up the majority of the country’s subprime mortgage lending. But the borrowers may have been low income persons with strong credit and low loan to value ratios. There is no available information as to how Fannie and Freddie managed and balanced the risks within their portfolio (i.e. how they weighed purchasing a loan from a borrower who significantly leveraged his income but has a strong credit history).

The one method I have determined that can help to understand just how much risk is inherent in the mortgages identified in the first section is to look at what happened to home prices after these mortgages were purchased. After the mortgages were purchased in 2005 home prices continued to rise until 2006 when they began their precipitous drop that has not yet ceased. Mortgage default and foreclosure rates have spiked for the duration of this crisis and have been a leading cause of the price decline. If the mortgages that Fannie and Freddie purchased were risky, there is a strong chance they
have defaulted and contributed to the price drop within their communities. Therefore, looking at the correlation between the variables that characterize risk and the home price drop between the peak and January 2009 should give some indication as to the overall risk profile of the mortgages. In this regression equation the price change from the third quarter of 2006 until January 2009 is the dependent variable. The independent explanatory variables are the two preceding time periods (purchase point to peak and January 2000 to purchase), borrower leverage, purpose of mortgage (purchase or refinance), gender of the borrower, the underserved area indicator, code for investment property, race variables, whether the purchase is a first home, area median income, whether the mortgage is federally guaranteed, and the low-income Hispanic and African American variables. The result gives credence to the hypothesis outlined above. Despite the record home price drop, loans that are refinances are associated with a positive price gain—their performance has held up despite the turmoil. Likewise, the coefficient on low income Hispanics is positive and significant. Low-income African Americans have a negative and significant coefficient as does the unpaid balance to income ratio variable although it is insignificant. The race variables provide a mixed bag. Both are correlated with receiving refinance mortgages but Hispanic mortgages are correlated with increasing house prices while African Americans are correlated with decreasing. The borrower leverage ratio, while initially appearing to have been correlated with less risky loans, is actually deteriorating along with the housing market. What we initially identified as risky loans are correlating positively with the housing downturn and in turn the loans identified as less risky are feeling the effects of the downturn.
Conclusion

The regression results suggest that the GSEs did purchase mortgages that fit the profile of potential junk assets given the housing downturn. These assets particularly take the form of refinance mortgages to low income Hispanics and African Americans and refines in underserved areas of cities with greater prevalence of subprime mortgage lending. There is also significant correlation between refines and missing documentation mortgages. A weaker, but still positive relationship exists between these refinance mortgages and greater borrower leverage defined by the loan amount to income ratio. This conclusion is supported by prior academic research that shows a majority of subprime mortgages are refines. This is because of the structure of subprime mortgages that give borrowers a low introductory teaser rate that resets to higher monthly payments after two or three years. The underlying market assumption was that housing prices would continue to go up and interest rates would remain low so it would be possible to continue to refinance and subprime borrowers would eventually qualify for more favorable, prime loans.

Somewhat surprisingly, given critics claims, Fannie Mae and Freddie Mac did not purchase overleveraged mortgages with minority borrowers in order to fulfill government quotas for supporting affordable housing. This line of argument has gained a lot of traction and is often leveled at Fannie and Freddie. While these are strong results they are tempered by the fact that this analysis lacks credit score and loan to value information. These pieces of information alone can alter the previous analysis. But the
results of this study are important in building a risk profile of what mortgages the agencies were purchasing and where they were focusing their efforts. The results do show that the riskier mortgage purchases were in faster growing areas of the country that experiences greater than average home price appreciation from 2000 to 2006. These are areas on the country particularly in California and Florida where subprime and Alt-A loans were popular.

What role these mortgages had in the downfall of the agencies is unclear, but the last piece or regression analysis suggests they managed these particular risks reasonably well. The mortgage variables that the previous analysis found the most risky had a positive relationship with house prices as they were retreating quarter after quarter. What is clear is that the failure of these institutions is more a result of years of mismanagement and poor regulation than it is mortgage purchases that support affordable housing for low income citizens. Even after the accounting scandals that rocked the firms in 2004 regulators did not push for more accountability and better quality financial reporting they did not keep strong oversight even after the need for the companies to restate earnings.  

But the fact remains that despite being in conservatorship the companies continue have major roles to play in the housing market. They will play a key role in supporting the market especially at a time when many private lenders have gone out of business and

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22 Morgensen, Gretchen and Duhigg, Charles. “Mortgage Giant Overstated Size of Capital Base.” The New York Times. [Updated 7 September 2008; cited 5 April 2009] Available from http://query.nytimes.com/gst/fullpage.html?res=9B07E2D61ECF934... The Treasury Department hired Morgan Stanley to help advice on what to do with the GSEs. When Morgan looked over the firm’s books they saw that Freddie Mac was not marking all of their assets to market, was pushing millions of losses into 2009, and was not providing for loan losses at a fast enough rate
commercial banks are unwilling or incapable of lending. But once the housing market and broader economy recover, if the agencies exist in their current form there must be stronger oversight and stricter requirements. For one, the companies should either be wholly government or wholly private. The publicly chartered private corporation created a moral hazard that left taxpayers on the hook. If they are government entities then they will be able to borrow at a low rate but will not be driven to invest in riskier assets searching for yield and profits. If they are private, they can search for profits but will have to take a haircut in the form of increased borrowing costs. Finally, their operations should be restricted to only the buying, securitizing, and guaranteeing business. They should not again be allowed to trade and speculate in mortgage backed securities and financial derivatives.

This study is the first to examine the mortgage purchases of the government sponsored enterprises with a focus on identifying which investments had the same profiles as subprime and Alt-A mortgages in order to get a picture of just how much risk the GSEs were taking on and if they over stimulated the market for these risky assets. Continued research should examine the credit scores and LTV ratios of the individual mortgages in this data set. Default rates can be tracked over the life of these mortgages to see if Fannie and Freddie’s risky assets outperform the broader housing market as they have appeared to do in this study.


Hatzius shows how amidst the global credit crunch and their own financial problems the GSEs increased their contribution to credit growth in the economy. By June 2008 they had contributed nearly 620 billion dollars to lending offsetting the disruptions in the market for other securitizations. He says if they were to stop growing the downside risks to the economy would increase severely.
References


Appendix 1

.reg upbinc purpose gender code usa firsthome aa hispanic fedguar

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<td>R-squared = 0.0000</td>
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<tr>
<td>Total</td>
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<td>6112.58831</td>
<td>Root MSE = 78.182</td>
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</table>

| upbinc | Coef.   | Std. Err. | t    | P>|t| | [95% Conf. Interval] |
|--------|---------|-----------|------|-------|----------------------|
| purpose | .3743637 | .1444439  | 2.59 | 0.010 | .0912585    .6574688 |
| gender  | -0.0091671 | .1350148 | -0.07 | 0.946 | -.2737915    .2554573 |
| code    | -1.304792 | .2739413  | -4.76 | 0.000 | -1.841708    -.7678771 |
| usa     | -0.0179616 | .1334106 | -0.13 | 0.893 | -.2794418    .2435185 |
| firsthome | .0693034 | .1698935  | 0.41 | 0.683 | -.263682    .4022888 |
| aa      | -1.241217 | .2442072  | -0.51 | 0.611 | -.6027593    .3545159 |
| hispanic | .4323528 | .1906442  | 2.27 | 0.023 | .0586967    .8060089 |
| fedguar | -.6890033 | 2.514722  | -0.27 | 0.784 | -5.617772    4.239766 |
| _cons  | 3.353004 | 2.517463  | 1.33 | 0.183 | -1.581136    8.287144 |
Appendix 2

. areg upbinc purpose gender code usa firsthome aa hispanic fedguar, absorb(city)

Linear regression, absorbing indicators Number of obs = 1398190
F(  8,1398129) =  4.02
Prob > F =  0.0001
R-squared =  0.0001
Adj R-squared =  0.0000
Root MSE =  68.51

------------------------------------------------------------------------------
upbinc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
purpose |   .2456851   .1421241     1.73   0.084    -.0328733    .5242436
gender |   .0830547   .1262824     0.66   0.511    -.1644544    .3305638
code |  -1.150567   .2586973    -4.45   0.000    -1.657604   -.643529
usa |  -2.378134   .1305285    -1.82   0.068   -.4936448    .0180181
firsthome |  -.1982233   .1794622    -1.10   0.269   -.4935165    .0970663
aa |  -.048299   .228496   -0.21   0.833   -.4961434    .3995454
hispanic |  -.0116931   .2051629    -0.06   0.955   -.4138054    .3904192
fedguar |  -.5074525   2.244648    -0.23   0.821   -.4.906886    3.891982
_cons |   3.182532   2.247773     1.42   0.157   -1.223025    7.588089
-------------+----------------------------------------------------------------
city |    F(52, 1398129) = 1.734    0.001         (53 categories)
Appendix 3

reg upbinc purpose gender code usa firsthome aa hispanic fedguar if city==19|city==20|city==1|city==15|city==2|city==4 > |city==11|city==25|city==31|city==34|city==42|city==50|city==55|city==18|city==38|city==10|city==30|city==5|city==23|city==8|city==43|city==9|city==7|city==14

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<td>Adj R-squared = 0.0000</td>
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<tr>
<td>Total</td>
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<td>5766.11074</td>
<td>Root MSE = 75.934</td>
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| upbinc | Coef. | Std. Err. | t     | P>|t| | [95% Conf. Interval] |
|--------|-------|-----------|-------|------|---------------------|
| purpose | .6875135 | .2412793 | 2.85  | 0.004 | .2146139 - 1.160413 |
| gender  | -.0155415 | .2124148 | -0.07 | 0.942 | -.4318678 - .4007847 |
| code    | -.8337556 | .4609625 | -1.81 | 0.070 | -.1737227 - .6297162 |
| usa     | -.0277057 | .2067478 | -0.13 | 0.893 | -.4329248 - .3775133 |
| firsthome | .1275962 | .2526349 | 0.51  | 0.614 | -.3675601 - .6227524 |
| aa      | -.4630795 | .3835742 | -1.21 | 0.227 | -.1214873 - .2887137 |
Appendix 4

reg upbinc purpose gender code usa firsthome aa hispanic fedguar if city==17|city==16|city==6|city==33|city==35|city== >12|city==13|city==24|city==26|city==27|city==28|city==29|city==36|city==37|city==40|city==41|city==44|city==51|city==5 | >2|city==53|city==56
Source | SS | df | MS | Number of obs = 644675
-------------+----------------------------------
Model | 101252.685 | 8 | 12656.5856 | F( 8,644666) = 3.63
Residual | 2.2448e+09 | 3482.10924 | R-squared = 0.0000
-------------+----------------------------------
Total | 2.2449e+09 | 3482.22309 | Root MSE = 59.009
-------------+----------------------------------
upbinc | Coef. | Std. Err. | t | P>|t| | [95% Conf. Interval]
-------------+----------------------------------
purpose | .2159182 | .1715602 | 1.26 | 0.208 | -.1203344 | .5521707
gender | .1486511 | .161207 | 0.92 | 0.356 | -.1673094 | .4646115
code | -1.348101 | .3240698 | -4.16 | 0.000 | -1.983267 | -.7129349
usa | -.239274 | .1690317 | -1.42 | 0.157 | -.5705707 | .0920226
Appendix 5

.reg upbinc purpose gender code usa fedguar missing_f missing_r

Source | SS    df MS          Number of obs = 3608178
-------------------------------+-------------------------------
Model | 518459.937     7 74065.7053    Prob > F      = 0.0000
Residual | 2.2085e+103608170  6120.88164           R-squared     = 0.0000
-------------------------------+-------------------------------
Adj R-squared = 0.0000
Total | 2.2086e+103608177  6121.01346           Root MSE      = 78.236
------------------------------------------------------------------------------
upbinc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-----------------------------+-------------------------------------------------------------
purpose |   .3181385   .0856081     3.72   0.000     .1503497    .4859272
gender |   .1631513   .0889648     1.83   0.067     -.0112165    .3375192
code |  -1.153945   .1696992    -6.80   0.000    -1.486549    -0.8213401
gender |  .0082482   .0846563     0.10   0.922     -.1576745    .174171
defguar |  -.3536842   .1482155    -2.42   0.015    -0.641356     .9340896
missing_f |  .1258765   .0846667     1.49   0.137     -.040672     .2918203
missing_r |  -.4519406   .1482155    -3.08   0.002     -.7667911    -.1370901
Appendix 6

```
reg upb purpose gender code usa fedguar missing_f missing_r missing_inc

Source | SS df MS Number of obs = 3735139
-------------+---------------------------------------------------------------
Model | 1.9410e+15 8 2.4262e+14 F( 8,3735130) =35759.79
Residual | 2.5342e+163735130 6.7848e+09 R-squared = 0.0711
-------------+---------------------------------------------------------------
Total | 2.7283e+163735138 7.3045e+09 Root MSE = 82370

-------------+---------------------------------------------------------------
        | Coef. Std. Err.  t  P>|t|  [95% Conf. Interval]
-------------+---------------------------------------------------------------
upb | purpose | -1327.682 88.62362 -14.98 0.000 -1501.382 -1153.983
     | gender  | -19072.33 91.8811 -207.58 0.000 -19252.42 -18892.25
     | code    | -34380.3 173.5235 -198.13 0.000 -34720.4 -34040.2
     | usa     | -26493.65 87.56162 -302.57 0.000 -26665.27 -26322.04
     | fedguar | 51283.89 1395.51 36.75 0.000 48548.74 54019.04
```
Appendix 7

reg upbinc purpose gender code usa missing_r missing_f fedguar if city==17|city==16|city==6|city==33|city==35|city==1 |city==2|city==13|city==24|city==26|city==27|city==28|city==29|city==36|city==37|city==40|city==41|city==44|city==51|city==52 > |city==53|city==56

Source | SS | df | MS | Number of obs = 1181910
-----------+----------------------------------|-----------+-----------+-----------
Model | 282780.305 | 7 | 40397.1865 | F( 7,1181902) = 7.92
Residual | 6.0294e+09 | 5101.47821 | R-squared = 0.0000
-----------+----------------------------------|-----------+-----------+-----------
Total | 6.0297e+09 | 5101.68726 | Root MSE = 71.425

| missing_f | 25346.68 | 87.61112 | 289.31 | 0.000 | 25174.96 | 25518.39 |
| missing_r | -7416.645 | 129.1644 | -57.42 | 0.000 | -7669.802 | -7163.487 |
| missing_inc | -11490.11 | 235.7126 | -48.75 | 0.000 | -11952.09 | -11028.12 |
| _cons | 139109.2 | 1396.787 | 99.59 | 0.000 | 136371.5 | 141846.8 |
| Variable     | Coef.    | Std. Err. | t     | P>|t| | 95% Conf. Interval |
|--------------|----------|-----------|-------|------|------------------|
| purpose      | 0.1423   | 0.1356    | 1.05  | 0.294| -0.1235 to 0.4082 |
| gender       | 0.2614   | 0.1427    | 1.83  | 0.067| -0.0184 to 0.5412 |
| code         | -1.3469  | 0.2818    | -4.78 | 0.000| -1.8992 to -0.7947 |
| usa          | -2.2285  | 0.1431    | -1.56 | 0.119| -0.5033 to 0.0575 |
| missing_r    | -0.4503  | 0.2062    | -2.18 | 0.029| -0.8544 to 0.0462 |
| missing_f    | 0.5558   | 0.1385    | 4.01  | 0.000| 0.2844 to 0.8271 |
| fedguar      | -0.1201  | 2.3954    | -0.05 | 0.960| -4.8149 to 4.5748 |
| _cons        | 2.6875   | 2.3962    | 1.12  | 0.262| -2.0089 to 7.3839 |

Appendix 8

```
reg upbinc purpose gender code usa missing_r missing_f fedguar if
city==19|city==20|city==1|city==15|city==2|city==4|city==11|city==25|city==31|city==34|city==42|city==50|city==55|city==18|city==23|city==43|city==9|city==7|city==14

Source | SS   | df | MS   | Number of obs = 1956596
-----------+-------+----+------+-------------------
Model     | 2.47445 | 7  | 0.35349 | F( 7, 1956588) = 5.80
Residual  | 1.1935e+10 | 6099.76871 | Prob > F = 0.0000
Total     | 1.1935e+10 | 6099.87335 | R-squared = 0.0000
```

|        | Coef.   | Std. Err. |      t  | P>|t|  | [95% Conf. Interval] |
|--------|---------|-----------|--------|------|---------------------|
| purpose| .393337 | .1179899  | 3.33   | 0.001| .1620809 - .6245931 |
| gender | .1890002| .1199071  | 1.58   | 0.115| -.0460135 - .4240139|
| code   | -.9117533| .2259973 | -4.03  | 0.000| -.1.3547 - .4688064 |
| usa    | .023669 | .11359    | 21     | 0.21 | -.1.989676 - .2463056|
| missing_r| -.4895756| .1689007 | -2.90  | 0.004| -.8206151 - .1585361 |
| missing_fi~e | -.0716081| .1222469 | -0.59  | 0.558| -.3112079 - .1679916 |
| fedgar | - .4562883| 1.908227 | -0.24  | 0.811| -4.196347 - 3.28377 |
| _cons  | 3.21034 | 1.909868  | 1.68   | 0.093| -.532935 - 6.953614 |

Appendix 9
reg upb purpose gender code usa fedgar firsthome hispanic aa missing_inc if city==19|city==20|city==1|city==15|city==2|city==11|city==25|city==31|city==34|city==42|city==50|city==55|city==18|city==38|city==10|city==30|city==5|city==23|city==8|city==43|city==9|city==7|city==14

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<th>MS</th>
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<td>2.4728e+14</td>
<td>9</td>
<td>2.7475e+13</td>
<td>F( 9, 612774) = 4267.10</td>
</tr>
<tr>
<td>Residual</td>
<td>3.9456e+15612774</td>
<td>6.4389e+09</td>
<td>R-squared = 0.0590</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4.1929e+15612783</td>
<td>6.8423e+09</td>
<td>Adj R-squared = 0.0590</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Root MSE = 80243</td>
</tr>
</tbody>
</table>
Appendix 10

```
. reg upb purpose gender code usa fedguar firsthome aa hispanic missing_inc if city==17|city==16|city==6|city==33|city==35|city==12|city==13|city==24|city==26|city==27|city==28|city==29|city==36|city==37|city==40|city==41|city==44|city==51|city==52|city==53|city==56

Source | SS      df MS
--------|---------|------------
Model   | 5.950e+14  9 6.61e+13  Prob > F = 0.0000
Residual| 3.787e+14 26 5.726e+09  R-squared = 0.1358
--------|----------|-------------
Total   | 4.3826e+14 26 6.626e+09  Root MSE = 75674

| upb | Coef.  Std. Err.  t  P>|t|  [95% Conf. Interval] |
|-----|---------|-----|---------|-----------------------|
| purpose | 15996.39 249.9538 64.00 0.000  15506.49  16486.29 |
| gender  | -15670.99 220.5844 -71.04 0.000 -16103.33 -15238.65 |
| code    | -20145.37 472.6343 -42.62 0.000 -21071.72 -19219.02 |
| usa     | -23727.77 214.9532 -110.39 0.000 -24149.07 -23306.47 |
| fedguar | 32245.35 3681.58  8.76 0.000   25029.58   39461.13 |
| firsthome | 5561.032 396.7911  21.10 0.000   5044.412   6077.653 |
| hispanic | -9646.319 278.915 -34.59 0.000  -10192.98  -9099.655 |
| aa      | -30019.87 398.911 -75.25 0.000  -30801.72  -29238.01 |
| missing_inc | -10999.48 590.6794 -18.62 0.000  -12157.19  -9841.764 |
| _cons  | 158231 3688.226 42.90 0.000     151002.2    165459.8 |
```
|          | Coef.   | Std. Err. |     t  |     P>|t|  |  [95% Conf. Interval] |
|----------|---------|-----------|--------|------|------------------------|
| mopre    | 5.322   | .053002   | 100.41 | 0.000| 5.218107               | 5.425871               |
| area_med_inc04 | 2.51e-06 | 8.58e-08 | 29.30  | 0.000| 2.35e-06               | 2.68e-06               |
| upb      | -5.53e-07 | 5.77e-09 | -95.85 | 0.000| -5.64e-07              | -5.42e-07              |
|                  | Coef.  | Std. Err. |     t   | P>|t|  |   [95% Conf. Interval] |
|------------------|--------|-----------|---------|------|------------------------|
| purpose          | 6.704192 | 0.0241592 | 277.50  | 0.000 | 6.656841 - 6.751543    |
| area_med_inc04   | 4.90e-06 | 3.60e-08  | 136.09  | 0.000 | 4.83e-06 - 4.97e-06    |
Appendix 13

. reg purpose mopre area_med_inc04 upbinc gender usa code lih liaa if
  city==19|city==20|city==1|city==15|city==2|city==4
> |city==11|city==25|city==31|city==34|city==42|city==50|city==18|city==38|city==10|city==30|city==5|city==23|city==8|city==43|city==9|city==7|city==14

Source | SS      df     MS        Number of obs = 1710755
-----------------------------------------------
Model   | 19859.1675     8  2482.39594          Prob > F      =  0.0000
Residual | 401862.5261710746  .234904846           R-squared     =  0.0471
-----------------------------------------------
Adj R-squared = 0.0471
Total    | 421721.6931710754  .246512177           Root MSE      =  .48467

purpose | Coef. Std. Err.     t    P>|t|    [95% Conf. Interval]
-----------------------------------------------
mopre   |   6.248064   .0245273  254.74   0.000     6.199992    6.296137
area_med_inc04 |  4.69e-06  3.89e-08  120.42   0.000     4.61e-06  4.76e-06
upbinc  |   7.09e-06  4.44e-06  1.60   0.110  -1.61e-06  .0000158
gender  |   -1.02545  .008021   -15.64   0.000    -0.014117  -0.010973
usa     |   .0066026  .0007917   8.34   0.000     .005051   .0081543

-----------------------------------------------
|     | Coef. | Std. Err. | t     | P>|t| | [95% Conf. Interval] |
|-----|-------|-----------|-------|-----|----------------------------|
| code | -.1208541 | .0015 | -80.57 | 0.000 | -.123794 | -.1179142 |
| lih  | .0413355  | .001719 | 24.05 | 0.000 | .0379663 | .0447047 |
| liaa | .0760932  | .0022646 | 33.60 | 0.000 | .0716547 | .0805317 |
| _cons| .0707617  | .0027491 | 25.74 | 0.000 | .0653736 | .0761498 |

Appendix 14

```
. reg purpose mopre area_med_inc04 upbinc gender usa code lih liaa if city==17|city==16|city==6|city==33|city==35|city==12|city==13|city==24|city==26|city==27|city==28|city==29|city==36|city==37|city==40|city==41|city==44|city==51|city==5 > 2|city==53|city==56

Source | SS     | df   | MS      | Number of obs = 1045237  
|--------|--------|-------|---------|--------------------------------|
| Model  | 3047.89868 | 8 | 380.987335 | F( 8,1045228) = 1547.71  
| Residual | 257296.1571045228 | .24616271 | R-squared = 0.0117  
| Total  | 260344.0561045236 | .249076817 | Root MSE = .49615  

|     | Purpose | Coef. | Std. Err. | t     | P>|t| | [95% Conf. Interval] |
|-----|---------|-------|-----------|-------|-----|----------------------------|
| mopre | 3.768568 | .0563378 | 66.89 | 0.000 | 3.658148 | 3.878988 |
| area_med_inc04 | 1.90e-06 | 9.29e-08 | 20.42 | 0.000 | 1.71e-06 | 2.08e-06 |
| upbinc | 9.05e-06 | 6.39e-06 | 1.42 | 0.157 | -3.48e-06 | .0000216 |
| gender | -.0258415 | .0010627 | -24.32 | 0.000 | -.0279243 | -.0237587 |
| usa | -.0149092 | .0010847 | -13.74 | 0.000 | -.0170352 | -.0127831 |
| code | -.0598187 | .0020813 | -28.74 | 0.000 | -.0638979 | -.0557395 |
Appendix 15

```
.reg purpose mopre area_med_inc04 upbinc gender usa code lih liaa

Source |       SS       df       MS              Number of obs = 2956466
-------------+-------------------------------------------------------------
Model |  26497.5895     8  3312.19868           Prob > F      =  0.0000
Residual |   706641.962956457  .239016485           R-squared     =  0.0361
-------------+-------------------------------------------------------------
Adj R-squared =  0.0361
Total |   733139.552956465 .24797843           Root MSE      =  .48889

------------------------------------------------------------------------------
purpose |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------------------------------------------------------------------------
mopre |   5.667536   .0202836   279.41   0.000      5.62778    5.707291
area_med_inc04 |   4.23e-06   3.16e-08    134.05   0.000     4.17e-06    4.29e-06
upbinc |   7.40e-06   3.56e-06     2.08    0.038     4.19e-07    .0000144
gender |  -.0175102   .0006182   -28.32   0.000    -.0187218   -.0162986
usa |   .0059748   .0006153     9.71   0.000     .0047688    .0071808
code |  -.0942052   .0011695   -80.55   0.000    -.0964974   -.091913
lih |   .0237826   .0015503    15.34   0.000     .0207441    .0268211
liaa |   .0630568   .0017723    35.58   0.000     .0595831    .0665305
_cons |   .1185748   .0021558    55.00   0.000     .1143496    .1228001
------------------------------------------------------------------------------
```
### Appendix 16

```bash
reg purpose mopre area_med_inc04 upb gender usa code missing_r missing_inc
```

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<td>4457.2611</td>
<td>Prob &gt; F = 0.0000</td>
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<tr>
<td>Residual</td>
<td>824461.4664</td>
<td>.23675998</td>
<td>.23675998</td>
<td>R-squared = 0.0415</td>
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<tr>
<td>Total</td>
<td>860119.5553</td>
<td>.246999319</td>
<td>.246999319</td>
<td>Root MSE = .48658</td>
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</table>

| purpose | Coef. Std. Err. t P>|t| [95% Conf. Interval] |
|---------|-----------------|-------|-----------------|---------------------------------|
| mopre   | 6.391771 .0198491 322.02 0.000 6.352867 6.430674 |
| area_med_~04 | 4.80e-06 2.94e-08 163.61 0.000 4.75e-06 4.86e-06 |
| upb     | -3.41e-07 3.43e-09 -99.39 0.000 -3.48e-07 -3.35e-07 |
| gender  | -.0210886 .0005657 -37.28 0.000 -.0221974 -.0199799 |
| usa     | -.0030488 .0005646 -5.40 0.000 -.0041553 -.0019423 |
| code    | -.1159084 .0010606 -109.28 0.000 -.1179872 -.1138296 |
| missing_r | .0338488 .0008028 42.16 0.000 .0322754 .0354222 |
### Appendix 17

```
reg motrough mopre mopeak upbinc purpose gender usa code hispanic aa firsthome area_med_inc04 anninc fedguar liah liah
> relih reliaa
```

<table>
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<td>15.9541858</td>
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<tr>
<td>Residual</td>
<td>95.18019191398011</td>
<td>.000068083</td>
<td>R-squared = 0.7402</td>
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</tr>
<tr>
<td>Total</td>
<td>366.401351398028</td>
<td>.000262084</td>
<td>Root MSE = 0.00825</td>
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</tr>
</tbody>
</table>

| motrough | Coef. | Std. Err. | t     | P>|t| | [95% Conf. Interval] |
|----------|-------|-----------|-------|-------|---------------------|
| mopre    | -0.863883 | .0005679 | -1521.17 | 0.000 | -0.8649961 -0.8627699 |
| mopeak   | -0.0774747 | .0005619 | -137.89 | 0.000 | -0.0785759 -0.0763735 |
| upbinc   | -1.83e-07 | 1.02e-07 | -1.79 | 0.073 | -3.82e-07 1.68e-08 |
| purpose  | .0000251 | .000017 | 1.47 | 0.141 | -8.30e-06 .0000584 |
| gender   | -0.001096 | .000153 | -7.16 | 0.000 | -0.001396 -0.000796 |
| usa      | -0.009384 | .000156 | -60.09 | 0.000 | -0.00969 -0.009078 |
| code     | .0001403 | .000315 | 4.45 | 0.000 | 0.000784 .0002021 |
| hispanic | -0.0015947 | .0000291 | -54.84 | 0.000 | -0.0016517 -0.0015377 |
| aa       | 0.0011764 | .0000341 | 34.46 | 0.000 | 0.0011095 .0012433 |

---

missing inc |  .060008  .001439  41.70  0.000  .0571877  .0628283
_cons |  .1324352  .0019645  67.41  0.000  .1285848  .1362856
| Variable   | Coef.    | Std. Err. | t     | P>|t|  | [95% Conf. Interval] |
|------------|----------|-----------|-------|-----|---------------------|
| firsthome  | -0.0007032  | 0.000019  | -37.03 | 0.000 | -0.0007404 - 0.000666 |
| area_med_~04 | 4.07e-07  | 9.45e-10  | 430.33 | 0.000 | 4.05e-07 4.09e-07 |
| anninc     | 4.41e-10   | 1.06e-10  | 4.17   | 0.000 | 2.34e-10 6.49e-10 |
| fedguar    | .0003059   | .0002703  | 1.13   | 0.258 | -.0002238 .0008357 |
| lih        | .0013185   | .0000542  | 24.31  | 0.000 | .0012122 .0014248 |
| liah       | -.0020426  | .0000617  | -33.12 | 0.000 | -.0021635 -.0019217 |
| relih      | -.0027759  | .0000771  | -36.01 | 0.000 | -.002927 -.0026248 |
| reliaa     | .00329     | .0000821  | 40.05  | 0.000 | .003129 .003451   |
| _cons      | -.0094705  | .0002771  | -34.18 | 0.000 | -.0100135 -.0089274 |

Appendix 18

. reg motrough mopre mopeak upb purpose gender usa code area_med_inc04 fedguar missing_f missing_r missing_inc

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<td>38.6879939</td>
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</tr>
<tr>
<td>Residual</td>
<td>277.4192593</td>
<td>.00007967</td>
<td>0.6260</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>741.6751863</td>
<td>.000212994</td>
<td>Root MSE = .00893</td>
<td></td>
</tr>
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</table>

motrough | Coef. Std. Err. t P>|t| [95% Conf. Interval]
-----------|----------|--------|-------|-----|---------------------|
-0.6913592 | .0004057 | -1703.96 | 0.000 | -0.6921544 -0.690564 |
-0.645468 | .0003439 | -187.69 | 0.000 | -0.652208 -0.638727 |
2.22e-09 | 6.35e-11 | 34.99 | 0.000 | 2.10e-09 2.35e-09 |
0.001865 | .0000101 | 18.39 | 0.000 | 0.001666 0.002064 |
0.000963 | .000104 | 9.28 | 0.000 | 0.000759 0.001166 |
-0.005139 | .0000104 | -49.48 | 0.000 | -0.005342 -0.004935 |
-0.000876 | .0000195 | -4.48 | 0.000 | -0.001259 -0.000493 |
4.23e-07 | 6.00e-10 | 705.47 | 0.000 | 4.22e-07 4.24e-07 |
-0.000243 | .000153 | -1.47 | 0.143 | -0.0005242 .0000756 |
-0.0040596 | .0000105 | -386.24 | 0.000 | -0.0040802 -0.004039 |
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<td>missing_r</td>
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<td>0.840</td>
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<tr>
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<tr>
<td>_cons</td>
<td>-0.0156023</td>
<td>0.0001577</td>
<td>-98.91</td>
<td>0.000</td>
<td>-0.0159115</td>
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