The 1992 GSE Act and Loan Application Outcomes

Job Market Paper

Shawn Moulton*
University of Notre Dame
Department of Economics

ABSTRACT

The 1992 "GSE Act" mandated that a specified percentage of Fannie Mae and Freddie Mac purchases come from underserved populations. A number of prominent observers have pointed to the GSE Act as a root cause of the recent housing crisis. In this paper, I evaluate the link between the GSE Act and relaxed mortgage market standards. Using loan application-level data from the Home Mortgage Disclosure Act, I analyze whether the GSE Act's affordable housing goals altered mortgage lending or purchasing decisions. To identify this effect, I use a regression discontinuity design that exploits arbitrary cutoffs used to determine whether a loan satisfies the GSE Act goals. I find that the GSE Act's affordable housing goals had little to no effect on mortgage lending or purchasing. Additionally, using census tract-level data, I find no relationship between the GSE Act's affordable housing goals and increased foreclosures, vacancies or other housing outcomes. These results suggest that the 1992 GSE Act had a negligible effect on the recent mortgage market crisis.

*Department of Economics, University of Notre Dame, 434 Flanner Hall, Notre Dame, IN 46556 (e-mail: smoulton@nd.edu). I thank my advisors for helpful comments- Bill Evans, Abigail Wozniak, and Jim Sullivan. I also benefited from conversations with Adam Bee, Neil Bhutta, Kasey Buckles, Luke Chicoine, Kirk Doran, Tom Gresik, Dan Hungerman, Mike Jones, Beth Munnich, Tom Murray, and Huyen Pham and comments from many seminar participants. Remaining errors are my own.

I. Introduction

Fannie Mae and Freddie Mac are government sponsored enterprises (GSE) whose mission is to provide liquidity, stability and affordability to the U.S. housing and mortgage market. Throughout most of their existence, these entities accomplished this goal solely by purchasing mortgages from lenders and thereby increasing the flow of funds available to mortgage borrowers. In an attempt to make sure the GSEs were benefitting all types of borrowers and communities, in 1992, Congress passed the Federal Housing Enterprises Financial Safety and Soundness Act (GSE Act) which for the first time established that a proportion of each GSEs' annual loan purchases come from low-income households and low-income and minority neighborhoods.

The recent collapse of the real estate market and escalating foreclosure rates has led some to suggest that the GSE Act's affordable housing goals contributed to the housing crisis.[1] Edward Pinto, the chief credit officer at Fannie Mae from 1987 to 1989, notes in the Wall Street Journal that "The 1992 GSE Act was the fuse, and the trillions of dollars in subsequent CRA [Community Reinvestment Act] and GSE affordable-housing loans would fuel the greatest housing bubble our nation has ever seen." Pinto goes on to note that loosened credit standards and a mandate by the GSE Act to facilitate affordable-housing loans resulted in "a tsunami of high risk lending that sank the GSEs, overwhelmed the housing finance system, and caused an expected $1 trillion in mortgage loan losses by the GSEs, banks, and other investors and guarantors, and most tragically an expected 10 million or more home foreclosures." Similar sentiments are expressed by others. Congressman Tom Davis of Virginia notes that "The transformation of Fannie Mae and Freddie Mac into the 'Affordable Housing Center' was a laudable goal, but to push predatory subprime lending to unspeakable heights and to encourage questionable lending practices believing housing prices would continue to soar was beyond reason." Popular economics columnist Robert Samuelson notes that "The Department of Housing and Urban Development sets affordable housing goals for Fannie Mae and Freddie Mac to dedicate a given amount of credit to poorer homeowners. One way Fannie and Freddie fulfilled these goals was to buy subprime mortgage securities -- many of which have now gone bad." Finally, Howard Husock of the Manhattan Institute concludes that "One cannot say with any certainty whether the more important cause of

[1]The S&P/Case-Shiller National Seasonally Adjusted Home Price Indices indicate that housing prices fell by 31 percent from a peak in the first quarter of 2006 to a trough in the first quarter of 2009. According to data from RealtyTrac, foreclosure filings were reported on 2.3 million properties in 2008, an 81 percent increase from 2007 and 225 percent increase from 2006.

the current housing crisis was affordable-housing mandates or the actions of investment banks and ratings agencies. There can be no doubt, however, that both contributed."

Despite these rather definitive statements about the GSE Act's contribution to the recent housing collapse, there is little econometric evidence linking the GSE Act to relaxed GSE or lender standards. Further, as I outline below, the GSE Act's loan purchase requirements have consistently been set below the levels at which the GSEs are purchasing targeted loans. If the GSE Act's affordable housing goal requirements are not binding, the goals may have little impact on GSE loan purchase decisions. Finally, not everyone is so quick to blame the GSE Act for the recent crisis. Stiglitz (2009) makes the claim that these accusations against affordable housing mandates are "clearly just an attempt to shift blame" as "the problems in America's mortgage markets began with the subprime market, while Fannie Mae and Freddie Mac primarily financed "conforming" (prime) mortgages.

Although there is no clear consensus about the GSE Act's role in the mortgage market crisis, the goals set by the GSE Act are still in effect. Therefore, examining the effects of the GSE Act is important for housing policy. As described above, many have accused the GSE Act of pressuring Fannie Mae and Freddie Mac to expand homeownership to low income borrowers and low income and minority neighborhoods, contributing to the recent housing crisis. In hopes of preventing future housing crises it is important to understand how, if at all, the GSE Act has contributed to the current housing crisis. Additionally, falsely accusing the GSE Act could lead policy makers to ignore other, more important determinants of the GSEs' failure and the mortgage market collapse. Finally, the original objective of the GSE Act was to increase credit access and homeownership among underserved populations. Policy makers should be interested in whether the GSE Act or related housing policies can alter the housing market in a way that achieves public policy ends.[2]

To that end, in this paper I use mortgage loan application-level data from mortgage lending institutions across the U.S. collected under the Home Mortgage Disclosure Act (HMDA) to examine whether the GSE Act's affordable housing goals altered the probability that 1) a loan application is originated by a mortgage lending institution, 2) an originated loan is purchased by Fannie Mae or Freddie Mac, or 3) an originated loan is a subprime or "high-price" loan. Additionally, census tract-level data from the Department of Housing and Urban Development is

[2] For instance, the Department of Housing and Urban Development (HUD) is responsible for setting GSE Act affordable housing goal requirements. If HUD is swayed by political pressure from the GSEs or other sources, they may set nonbinding affordable housing goals, hindering congress's ability to manipulate the housing market through this channel.

used to examine the effect of the GSE Act on foreclosures, vacancies, high-price loans, and other housing outcomes. I examine separately data from 1996-1997, a period just after the initial GSE Act goals were finalized, and 2006-2007, as loans originated in 2006 and 2007 have had the highest cumulative default rates of any recent vintage of mortgages (Jaffee, 2010).[3]

The GSE Act established three affordable housing goals for the GSEs. A specified percentage of GSE loan purchases must be from 1) very low-income borrowers and low-income borrowers living in low income areas, 2) lower income borrowers, and 3) low income and minority neighborhoods. I refer to these three goals as the Special Affordable Goal (SAG), the Low and Moderate Income Goal (LMIG), and the Underserved Areas Goal (UAG), respectively.

Whether a loan satisfies an affordable housing goal is determined by arbitrary cutoffs in an "assignment" variable. For example, a borrower is targeted by the LMIG if the borrower's income is less than the median family income of their respective metropolitan statistical area. These cutoff rules provide the foundation for use of a regression discontinuity (RD) design where the fundamental idea is that loan applications from individuals just above and below a relevant cutoff are similar except for goal satisfaction status. Therefore, if a significant difference in application or housing outcomes is observed for loans just above and below the cutoff, it can be attributed to the GSE Act's housing goals.

I find that the SAG increased GSE purchases from very low-income borrowers by four percent but had no effect on mortgage lending. Additionally, I find no evidence that the LMIG or UAG altered GSE purchase or mortgage lending decisions. Finally, using census tract-level data, I find no relationship between the GSE Act's affordable housing goals and increased foreclosures, vacancies or other housing outcomes. These results are robust to a number of specification and robustness checks.

While a number of papers document an increase in GSE purchases in underserved areas, only a handful of papers have examined whether there is a causal link between the GSE Act and housing market outcomes. Early work by Ambrose and Thibodeau (2004) used MSA-level variation in population share residing in tracts targeted by the GSE Act and found that the GSE Act had a positive, but small, impact on the supply of mortgage credit. Later work by An et al. (2007) used a two-stage regression approach and found that increased GSE intensity, defined as the proportion of mortgage loans in a tract purchased by the GSEs, is associated with decreased vacancies and increased home values, but found no effect on homeownership rates. More recent work by Bhutta (2009) used an RD model to analyze census tract-level data and found a three to

[3] Jaffee (2010) computes cumulative default rates through the third quarter of 2010 for loans originated in calendar years 2000-2008.

four percent increase in GSE purchasing activity and two to three percent increase in "GSE-eligible" originations attributable to the GSE Act's underserved areas goal. My paper most closely follows that of Bhutta (2009), but, as I outline in section II, the papers diverge in a number of ways.

As I find no evidence that the GSE Act increased loan originations, I conclude that the GSE Act could not have caused the recent housing crisis. Hence, attention should be moved away from the GSE Act to other potential causes of the crisis. This paper raises additional questions about the effectiveness of the GSE Act, or other related housing policies, at promoting homeownership opportunities among underserved populations.

II. Background

a. The GSE Act and Related Polices

Prior to 1992, the US had relatively high home ownership rates compared to other developed countries. However, home ownership rates varied considerably across race, ethnicity, and measures of socioeconomic status. Policy observers and Congress interpreted the disparities in ownership rates as a result of poor access to mortgage credit.[4] The lack of credit could be due to many factors including discrimination in mortgage lending (Munnell et al., 1996) and underinvestment in information lenders use to price mortgages (Lang and Nakamura, 1993). In response, Congress sought to increase credit access among lower-income and minority neighborhoods and households.[5]

The 1992 GSE Act's affordable housing goals were designed to focus on borrowers and neighborhoods with demonstrated need. Prior to the 1992 GSE Act, HUD designed housing goals for the GSEs that targeted borrowers based on the price of the house they were purchasing and whether they lived anywhere in a central city. However, these rules did a poor job of targeting underserved populations.[6] For instance, not all low-cost homes are purchased by low-income families, not all parts of central cities are underserved, and many underserved areas lie outside central cities.[7]

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[4] See http://www.huduser.org/Publications/pdf/private.pdf

[5] Benefits of increased homeownership include positive externalities such as reduced crime (Kubrin and Squires 2004) and improved child outcomes (Aaronson 2000). See Haurin et Al (2003) for a review of the economics literature.

[6] In 1978, HUD established affordable housing goals for Fannie Mae but the goals did not have any regulatory bite. Talk of housing goals was stagnant until 1989 when the Financial Institutions Reform, Recovery, and Enforcement Act (FIRREA) called on HUD to generate affordable housing goals for Freddie Mac, but the 1992 GSE Act was enacted before HUD completed promulgating the goals (Weicher 2000).

[7] See http://www.huduser.org/Publications/pdf/private.pdf

To facilitate the objective of increased mortgage credit access for underserved populations, Congress passed the 1992 GSE Act. HUD, by mandate from the GSE Act, established three affordable housing goals for the GSEs. A specified percentage of GSE loan purchases must be from 1) very low-income borrowers and low-income borrowers living in low income areas, 2) lower income borrowers, and 3) low income and minority neighborhoods.[8,9] I refer to these three goals as the special affordable goal (SAG), the low and moderate income goal (LMIG), and the underserved areas goal (UAG), respectively.

The SAG targets loans to borrowers with a "borrower income to Metropolitan Statistical Area (MSA) Median Family Income ratio," a ratio I refer to as the "*borrower-to-MSA median income ratio*," less than or equal to 0.60 and loans to borrowers with a *borrower-to-MSA median income ratio* less than or equal to 0.80 and a *tract-to-MSA median income ratio* less than or equal to 0.80. The LMIG targets loans from borrowers with a *borrower-to-MSA median income ratio* less than or equal to 1.00. Finally, the UAG targets loans with a *tract-to-MSA median income ratio* less than or equal to 0.90 or loans with a *tract-to-MSA median income ratio* less than or equal to 1.20 and a *tract minority share* greater than or equal to 0.30. Finally, the shaded regions in figures 1, 2, and 3 illustrate which borrowers and neighborhoods the affordable housing goals target.

Figure 4 shows the required share of GSE loan purchases that must satisfy each affordable housing goal and the GSEs' corresponding performance. The GSE loan shares required to satisfy the goals have increased since 1996. Despite a lack of well-defined penalties for failure to meet goals, the GSEs have repeatedly met their affordable housing goals. [10,11]

HUD considers a number of factors when choosing GSE loan purchase requirements, but one of the most important factors is the share of GSE-eligible originations that qualify for each of the goals.[12,13] For example, HUD projected that 23-26, 50-55, and 29-32 percent of GSE-eligible

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[8] HUD set transition goals for 1993-1995, before the goals were revised and the "final rule" GSE housing goals were established for 1996-1999. This transition period was important since, according to Senator Alfonse M. D'Amato, "It's critical that these goals are not unrealistic or unfeasible because defaults are counterproductive for everyone. We've got to be very careful in balancing housing needs with actuarial soundness."

[9] A single loan purchase can count towards multiple goals.

[10] If the GSEs fail to meet the goals, they are required to explain to the Secretary of HUD why they failed or to file an "affordable housing plan" that explains how they plan to meet these goals in the future. Additionally, Bhutta (2009) cites bad publicity and eventual loss of Congressional support as penalties of failure to meet the affordable housing goals.

[11] A similar graph appears in Bhutta (2009).

[12] GSE-eligible loans include conventional loans below the conforming loan limit. Conventional loans are loans not guaranteed or insured by the federal government under the Veterans Administration or the Federal Housing Administration.

originations qualified for the SAG, LMIG, and UAG, respectively for the 2001-2003 period. The GSE Act goal requirements increased sharply in 2001 from 14 to 20, 42 to 50, and 24 to 31 for the SAG, LMIG, and UAG, but these requirements fall within or below the projected share of available loans for each goal. In 2007, 25, 55, and 38 percent of GSE loan purchases must satisfy these three respective goals.

While the GSE Act focuses on GSE purchases from underserved populations, the Community Reinvestment Act (CRA) is a related policy that focuses on bank lending to underserved areas. The CRA was passed in 1977 to ensure that federally insured banks meet the mortgage credit needs of borrowers throughout their communities, including low income and minority neighborhoods. The CRA targets loans with a *borrower-to-MSA median income ratio* less than 0.80 and loans with a *tract-to-MSA median income ratio* less than 0.80.[14]

Two related programs that help increase mortgage credit access for underserved populations are the Veterans Administration and Federal Housing Administration loan programs. The Veterans Administration (VA) insures loans made by private lenders to veterans and the Federal Housing Administration (FHA) insures loans made by private lenders to lower income borrowers. The goal is for these underserved populations to have better access to affordable mortgage credit as a result of these programs. VA and FHA insured loans are not eligible to be purchased by the GSEs.

In general, the presence of the CRA and the FHA and VA loan insurance programs shouldn't confound my identification strategy. The one exception is that loans are targeted by both the CRA and the GSE Act's SAG if they have a *tract-to-MSA median income ratio* less than 0.80. If there was a significant jump in some outcome of interest at this cutoff, additional tests would be required to disentangle whether this effect was caused by the CRA or GSE Act. However, I find no evidence that outcomes changed discontinuously at this cutoff.

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[13] The 1992 GSE Act requires HUD to consider national housing needs, economic and demographic conditions, past performance on each goal, the size of the corresponding primary mortgage market, the ability of the GSEs to lead the industry, and the need to maintain the sound financial condition of the GSEs when setting affordable housing goals. See http://www.huduser.org/publications/pdf/gse.pdf.

[14] A number of papers have examined the effects of the CRA on the mortgage market. Bhutta (2008) used census tract level data to examine whether the CRA increased mortgage credit in lower income neighborhoods. Bhutta found that bank mortgage origination volume was four percent higher in targeted tracts between 1994 and 1996. After the 1997 reforms strengthened the CRA, bank mortgage origination volume was 8 percent higher in targeted tracts between 1997 and 2002. Berry and Lee (2007) used applicant level data to examine whether the CRA affected loan rejection rates and found no effect.

b. Related Literature

A number of studies have examined the effect of the 1992 GSE Act on the GSEs, the supply of mortgage credit, and housing outcomes. Early work evaluated to what extent the GSEs were purchasing loans from low-income borrowers and underserved areas. Studies by Bunce and Scheessele (1996), Manchester (1998), and Bunce (2002) showed that the share of loans originated to underserved populations remained greater than the share of loans purchased by GSEs from underserved populations. Since 1993, however, the GSEs have been closing this gap.

These initial studies were largely descriptive. Only more recently have researchers attempted to examine the impact of the GSE Act. Ambrose and Thibodeau (2004) used MSA-level variation in population share residing in tracts targeted by the UAG to examine whether the UAG increased mortgage credit. Using data from 1995 through 1998, they found that the UAG had a positive, but small, impact on the supply of mortgage credit. However, this result could be biased if the share of an MSA's population living in underserved neighborhoods is correlated with unobserved MSA-level characteristics that affect MSA loan volume. As noted by Bhutta (2009), MSAs with a relatively large share of the population living in underserved areas may, on average, have lower levels of unobserved socioeconomic variables that predict loan outcomes.

Though there is limited evidence that the GSE Act was causing an increase in mortgage credit supply for underserved populations, the next generation of studies sought to examine whether the GSE Act was affecting housing outcomes. An et al. (2007) used a two-stage regression approach to examine the effect of the GSE Act on homeownership rates, vacancy rates, and home values. In the first stage, the authors examined whether GSEs increased loan purchases in census tracts that were heavily targeted by the GSE Act's affordable housing goals. While their second-stage estimates indicated that increased GSE purchases are associated with decreased vacancies and increased home values, their first-stage results were problematic. While the UAG appeared to increase GSE purchases, the SAG had no effect on GSE purchases and the LMIG actually decreased GSE purchases. Additionally, the GSE goal instruments are weak, explaining less than 2 percent of the observed variation in the GSE intensity variable in the first stage.

An and Bostic (2007) noted that GSE activity has increased in targeted communities, but there has been little measureable improvements in housing market conditions in these communities. To explain this phenomenon, the authors examined whether the GSEs have crowded out GSE-ineligible loans, namely those insured by the FHA. That is, the GSEs could "cream skim" the best FHA loans prompting the FHA to give out fewer loans to maintain average credit quality. Using a two-stage approach, the authors examined whether a negative relationship persists between GSE market share and FHA market share. Their second-stage results indicate a

negative relationship between GSE market share and FHA market share, but, like An et al., the first stage regression is problematic because there was no relationship between being a targeted census tract and GSE Market share.

Recent work has examined the link between the GSE Act's UAG and mortgage credit supply using an RD approach.[15] Bhutta (2009) used HMDA data to examine the effect of the GSE Act's UAG on 1) the number of GSE purchases, 2) the total number of GSE-eligible originations, and 3) the number of GSE-ineligible originations. Bhutta found that the UAG increased GSE purchasing activity and "GSE-eligible" originations by 3-4 percent and 2-3 percent, respectively. Bhutta found no evidence of a reduction in GSE-ineligible loans, which are primarily comprised of FHA and subprime loans, indicating that the UAG goal did not crowd out other sources of lending.

My work most closely follows that of Bhutta (2009), but the papers diverge in a number of ways. Bhutta uses data aggregated to the census tract-level, while I take advantage of variation in loan applicant-level data to examine individual loan outcomes, allowing me to examine the individual-level goals outlined in the LMIG and SAG. Bhutta found that the UAG increased both GSE purchases and GSE-eligible originations while I find that the UAG had a negligible effect on the actions of the mortgage lending institutions and the GSEs. Finally, I expand the analysis by examining the impact of the GSE Act on the origination of high-price loans (a proxy for high risk mortgages) and a number of census tract-level housing outcomes such as foreclosures and vacancies.

III. Empirical Method

The 1992 GSE Act established that a specified percentage of GSE loan purchases must satisfy each of three affordable housing goals. An individual loan counts toward satisfying a goal if its value for a relevant "assignment" variable surpasses a certain threshold or "cutoff". For instance, GSE purchases of loans with a *borrower-to-MSA median income ratio* less than or equal to 1.00 satisfy the LMIG, whereas loans with a ratio greater than 1.00 do not. If the LMIG is binding, this gives the GSEs an incentive to purchase loans at or just below the 1.00 threshold, but no added incentive to purchase loans just above the 1.00 threshold.

This paper examines whether the GSE Act's affordable housing goals altered the decisions of the GSEs or mortgage lending institutions. To examine whether the goals' had an

[15] Gabriel and Rosenthal (2008) use an RD design to analyze census tract level HMDA data and find no relationship between the UAG and applications, originations, or changes in homeownership rates. However, as Bhutta (2009) notes, the authors don't appear to control for the assignment variable.

effect, my empirical strategy uses a regression discontinuity design (RD), where the central idea is that loans just above and below the relevant cutoffs are, on average, similar except for goal-satisfaction status. Therefore, if a significant difference in application outcomes, housing outcomes, loan quality, or other relevant variables is observed for borrowers just above and below the cutoff, it can be attributed to the GSE Act's housing goals.

More formally, an assignment variable Z_i determines whether an entity, such as a census tract, loan, or loan application, receives special consideration (i.e. satisfies an affordable housing goal.) An entity receives this "treatment" if and only if Z_i surpasses a threshold z_0. Let D_i be a binary variable equal to one if an entity receives treatment, and D_i equals zero otherwise. As we're interested in the effect of treatment on some outcome Y_i, consider the following regression:

(1) $$Y_i = \alpha + \theta D_i + e_i,$$

where α is a constant and e_i is an error term representing all other determinants of an outcome, Y_i. Our goal is to obtain a consistent measure of θ, the causal effect of treatment, on some outcome Y_i. The underlying problem with this specification is that D_i is potentially endogenous, and as a result, we expect $E[e_i|D_i] \neq 0$. Entities that receive treatment have different characteristics than those that do not and differences in these characteristics are likely to bias our estimate of θ. Table 1 compares borrower characteristics and loan application outcomes for borrowers just above and below the UAG's 0.30 *tract minority share*, UAG's 0.90 *tract-to-MSA median income*, and the LMIG's 1.0 *borrower-to-MSA median income* cutoffs. Similarly, Table 2 compares census tract characteristics and housing outcomes for census tracts just above and below the UAG's 0.30 and 0.90 cutoffs. Indeed, Tables 1 and 2 show that targeted applicants and neighborhoods have different observable characteristics, motivating the need to account for differences in unobservable characteristics, correlated with treatment status, that affect our outcomes of interest.

To avoid this problem, I use a RD model that exploits the notion that, in absence of treatment, entities close to the cutoff z_0 are similar, as illustrated by the following expression:

(2) $$E[e_i|Z_i = z_0 + \Delta] \cong E[e_i|Z_i = z_0 - \Delta]$$

That is, analogous to a randomized controlled trial, entities with values of X_i just above or below the cutoff x_0 should, on average, have the same values of any predetermined characteristics (Hahn et al., 2001and Matsudaira, 2008).

Equation (2) motivates a key assumption needed for the RD model. The assumption is that the only variable changing discontinuously at the cutoff is treatment status so that $E[e_i|Z_i = z_0]$ is continuous in Z at z_o. Hahn et al. (2001) show that if this assumption holds, the treatment effect is identified by the difference in outcomes for entities just above and below the cutoff, or

(3) $\theta = \lim_{Z \to z_0^+} E[Y_i | Z_i = z_0] - \lim_{Z \to z_0^-} E[Y_i | Z_i = z_0]$.

Following Matsudaira (2008) and Imbens and Lemieux (2008), I estimate θ with equations of the form:

(4) $Y_i = \alpha + \theta D_i + \sum_{p=1}^{3} \beta_p (Z_i - z_0)^p D_i + \sum_{p=1}^{3} \beta'_p (Z_i - z_0)^p (1 - D_i) + e_i$.

That is, I control for a third order polynomial in Z_i, fully interacted with D_i, on either side of the cutoff. The expression Z_i-z_0 normalizes Z_i to be zero at the cutoff, which ensures that the intercepts of the polynomials on either side of the cutoff are equal to the average outcome for entities just above and below the cutoff. This allows us to interpret θ, the coefficient D_i, as the treatment effect of goal-satisfaction status.

If our assumption that $E[e_i | Z_i = z_0]$ is continuous in Z at z_o is valid, other covariates are not needed to obtain a consistent estimate of θ. That is, since all other covariates change continuously at the cutoff, controlling for the Z_i should be sufficient. However, including a set of controls provides a robustness check since our estimates of θ should not change considerably once they are added. Additionally, as Imbens and Lemieux (2008) note, including covariates can help with variance reduction.

While the RD model has a number of nice properties, it also has limitations. We can interpret our estimate of θ as the causal effect of treatment on our outcome of interest for entities just above and below the cutoff, but we can't say anything about the treatment effect for entities away from the cutoff. However, this is a limitation shared even by randomized controlled experiments. For instance, if we randomly gave housing vouchers to individuals below the poverty level, this would say little about the effect of giving housing vouchers to high income individuals.

IV. Data

The primary source of data used in my analysis is loan application-level data provided by mortgage lending institutions under the Home Mortgage Disclosure Act (HMDA). This data is designed to give a comprehensive picture of mortgage lending in the United States. An estimated 80% of all home lending nationwide comes from lenders covered by the act (Avery, Brevoort, and Canner 2007). Since 1990, data has been reported on applicant and loan characteristics for each calendar year.

I use HMDA data from 1996-1997, just after the GSE Act goals went into full effect, and 2006-2007, before the start of the recent rapid reduction in housing values.[16] Additionally, loans purchased by the GSEs that were originated in 2006 and 2007 have the highest default rates of any vintage loan (Jaffee 2010). HMDA data and the HMDA website contain all relevant applicant-, tract-, and MSA-level variables necessary for determining whether an individual loan satisfies a particular GSE housing goal.[17]

I use HUD neighborhood stabilization data to examine the effect of the GSE Act on housing outcomes.[18] The neighborhood stabilization data, released in 2008, includes census tract-level data on the number of foreclosures, vacancies, and high-price loans. Additionally, I use census data from 1990 and 2000 to control for tract-level housing and economic characteristics.

Since the RD design provides estimates of treatment near the discontinuity, I create six sub-samples that limit the data to loan applicants close to the relevant goal-satisfaction cutoffs. The sample is further restricted to ensure that applicants above and below the cutoffs all have the same treatment status. The goals cutoffs and sample restrictions are as follows:

Goal-Satisfaction Cutoff	**Sample Restriction**
SAG 0.60 *borrower-to-MSA median income ratio*	Limited to loans with 0.50 ≤ *borrower-to-MSA median income ratio* ≤ 0.70 and *tract-to-MSA median income ratio* >0.80.
SAG 0.80 *borrower-to-MSA median income ratio*	Limited to loans with 0.70 ≤ *Borrower-to-MSA median income ratio* ≤ 0.90 and *Tract-to-MSA median income ratio* ≤ 0.80.
SAG 0.80 *tract-to-MSA median income ratio*	Limited to loans with 0.70 ≤ *tract-to-MSA median income ratio* ≤ 0.90 and 0.60 ≤ *borrower-to-MSA median income ratio* < 0.80
LMIG 1.00 *borrower-to-MSA median income ratio*	Limited to loans with a 0.90 ≤ *borrower-to-MSA median income ratio* ≤ 1.10.
UAG 0.30 *tract minority share*	Limited to loans with 0.2 ≤ *tract minority share* ≤ 0.4 and 0.90 ≥ *tract-to-MSA median income ratio* ≤ 1.2.
UAG 0.80 *tract-to-MSA median income ratio*	Limited to loans with 0.80 ≤ *tract-to-MSA median income ratio* ≤ 1.00 and *tract minority share* < 0.30.

Loan applicants are dropped from the sample if the loan is not eligible to be purchased by a GSE, such as unconventional loans (i.e. FHA- or VA- insured), loans with loan amounts above the GSE single-family conforming loan limit, or loans originated by a lender from the HUD

[16] See http://www.criminallawlibraryblog.com/subprime_crisis_timeline.pdf.
[17] See http://www.ffiec.gov/hmda/.
[18] HUD neighborhood stabilization data can be found here: http://www.huduser.org/datasets/nsp.html.

subprime lender list.[19] Applicants are dropped if the property is in a rural area, as HMDA data from rural areas are unreliable (Avery et al. 2007).[20] Finally, I exclude home improvement loans and multi-family loans, limiting my sample to one-to-four family home purchase or refinance loans.

Table 1 contains summary statistics from 2006-2007 HMDA data for my three samples around the LMIG 1.00 *borrower-to-MSA median income ratio*, UAG 0.30 *tract minority share*, and UAG 0.80 *tract-to-MSA median income ratio* cutoffs. Across all three samples, 25-26 percent of loan applications were denied by lenders, while 65-66 percent were originated, where both the lender and borrower agree to the terms of the loan. Across all three samples, about 23 percent of originated loans are purchased by Fannie Mae or Freddie Mac and about 18 percent of originated loans are high-price loans. While denial, origination, GSE purchase, and high-price loan rates are nearly identical across samples, reported applicant income and loan amounts vary considerably across the three samples. For instance, average reported income for borrowers just above and below the UAG's 0.30 *tract minority share* cutoff is $92,900 compared to $64,900 for borrowers just above and below the LMIG's 1.0 *borrower-to-MSA median income ratio* cutoff.

V. Results

a. Graphical Analyses

The regression discontinuity design implies that the effect of treatment can be measured by the change in the average value of an outcome at the cutoff. If our outcome of interest is changing discontinuously at the cutoff, we should be able to observe this effect visually. I begin with graphical analyses of the relationship between the assignment variables (*borrower-to-MSA median income ratio*, *tract-to-MSA median income ratio*, and *tract minority share*) and loan outcomes around the goal eligibility cutoffs.

I examine three outcomes: a dummy variable equal to one if 1) a loan application was originated, 2) an originated loan was purchased by a GSE, and 3) an originated loan is a high-price loan (the interest rate is at least 3 percentage points higher than a comparable treasury security.) The effect of a loan being targeted (i.e. satisfies an affordable housing goal) on these outcomes is ambiguous. For instance, if the GSE Act affordable housing goals are binding, the

[19] When identifying subprime lenders, HUD treats the loans sold to the GSEs by subprime lenders as prime loans. While HUD may occasionally purchase loans from subprime lenders, in each of my three samples, less than 0.01% of loans originated by subprime lenders are purchased by the GSEs.

[20] Lenders located exclusively in rural areas are not required to report HMDA data. Additionally, loans made in rural areas by lenders with an office in an MSA who have asset levels below $250 million in 2004 and $1 billion in 2005 are not required to report geographic information about a loan.

GSEs will purchase more targeted loans. However, if there is a large increase in originated loans, the percentage of originated loans purchased by the GSEs could go down.[21] However, I find no evidence that the affordable housing goals increased loan applications or originations.

Recall, the SAG targets loans to borrowers with *borrower-to-MSA median income ratio* less than or equal to 0.60 and loans to borrowers with a *borrower-to-MSA median income ratio* less than or equal to 0.80 and a *tract-to-MSA median income ratio* less than or equal to 0.80. The LMIG targets loans to borrowers with a *borrower-to-MSA median income ratio* less than 1.0. Finally, the UAG targets loans from tracts with a *tract minority share* greater than or equal to 0.30 or *tract-to-MSA median income ratio* less than or equal to 0.90.[22]

I plot average values of the outcome variable for different values of the assignment variable. For instance, in figure 5, I plot the percent of loans originated (left axis) for all loan applications with a *borrower-to-MSA median income ratio* of at least 0.99 but less than 1.0. Additionally, I fit a third order polynomial to the data on either side of the cutoff.

Figures 5-9 use 2006-2007 data to graphically analyze the relationship between assignment variables and outcomes at the relevant cutoffs. Figure 5 focuses on the SAG's 0.60 *borrower-to-MSA median income ratio* cutoff. While there are no noticeable jumps in the fraction of loans originated or high-price at the discontinuity, targeted loans are about one percentage point more likely to be purchased by a GSE at the cutoff. In Figure 6 I report results for the SAG's 0.80 *borrower-to-MSA median income ratio* cutoff while Figure 7 focuses on the LMIG's 1.0 *borrower-to-MSA median income ratio* cutoff, while in Figures 8 and 9, I report results for the UAG's 0.30 *tract minority share* and 0.90 *tract-to-MSA median income ratio* cutoffs, respectively.[23] In all four of these cases, there is virtually no evidence that the loans targeted by the GSE act had a greater propensity to be originated, purchased by the GSE, or have

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[21] Additionally, the effect of being targeted on the probability that a loan application is originated is ambiguous. More targeted loans will be originated if targeted loans are more likely to be purchased by GSEs and lenders have greater incentive to approve loans more likely to be purchased by GSEs (Myers 2002). However, if there is a large increase in targeted loan applications, the percentage of loan applications originated could go down. Likewise, the effect of being targeted on the probability that an originated loan is a high-price loan is also ambiguous. Lenders may originate fewer high-price loans if they are trying to entice borrowers to apply for loans. However, lenders may originate more high-price loans to compensate for a higher risk associated with the marginal loan.

[22] See data section for discussion of sub-samples.

[23] Since treatment status for the SAG and LMIG is partially based on borrower income, I lose all observations which are missing income data (about 5% of my sample.) If the affordable housing goals are influencing the GSEs to purchase more of these loans, my results could be biased. However, my estimates around the UAG 0.30 *tract minority share* and 0.90 *tract-to-MSA median income ratio* cutoffs are similar regardless of whether I include borrowers with missing income. This indicates that leaving out borrowers with missing income data is less of a concern.

a high interest rate. Figures 5-9 demonstrate that for 2006-2007 the GSE Act's affordable housing goals appear to have had little to no effect on loan outcomes.

While there is little observable effect of the affordable housing goals in 2006-2007, the goals could have been more binding in previous years. Figures 10-14 contain the corresponding graphical analyses using 1996-1997 data. Data used to make the high-price loan variable was only available starting in 2004, so this outcome is not included.[24] Figures 10-14 tell much the same story as figures 5-9. In 1996-1997, there is little evidence that the GSE Act's affordable housing goals encouraged the GSEs to purchase or mortgage lenders to originate loans targeted by the Act.

While these graphical analyses give a sense of the magnitude of the GSE Act's impact at the cutoff, they don't tell us whether jumps in outcomes at the cutoff are statistically meaningful. With this in mind, we turn to our RD estimates.

b. Regression Discontinuity Analyses

Tables 3-5 contain the baseline estimates of the effects of the SAG, LMIG, and UAG, respectively, using 2006-2007 data. I examine the effect of the GSE Act's affordable housing goals on an indicator for whether a loan application was denied or originated, an indicator for whether an originated loan was purchased by a GSE or high-price, and the natural log of the loan amount for an originated loan. In addition to controlling for a third-order polynomial in the assignment variable on either side of the cutoff, all regressions include MSA fixed effects, tract-level covariates (see table 2 for list), and a year dummy. Standard errors are clustered at the MSA-level.

In table 3, panels A, B, and C contain the estimated treatments effects at the SAG's 0.60 *borrower-to-MSA median income ratio*, 0.80 *borrower-to-MSA median income ratio*, and 0.80 *tract-to-MSA median income ratio* cutoffs, respectively, using 2006-2007 data. In panel A, while we see no effect of the SAG on whether a loan application was denied, targeted loans are about 1.1 percentage points less likely to be originated, where both the mortgage lender and borrower agree to the terms of the loan, at the 0.60 *borrower-to-MSA median income ratio* cutoff. In table 3, panel A, column 3 we see that targeted loans are about 1.1 percentage points, or 4 percent, more likely to be purchased by a GSE at the cutoff. This estimate is statistically significant at the 5 percent level. There is no evidence of a statistically significant jump in the high-price loan or loan amount variables at the cutoff. In panels B and C, none of the estimated treatment effects at

[24] The high-price loan variable was first made available in the HMDA data in 2004.

the 0.80 *borrower-to-MSA median income ratio* or 0.80 *tract-to-MSA median income ratio* cutoffs are statistically significant.

Table 4 contains estimated treatment effects at the LMIG's 1.0 *borrower-to-MSA median income ratio* cutoff using 2006-2007 data. The estimates of the LMIG's effect are both small in magnitude (economically insignificant) and statistically insignificant. That is, I find no evidence that the LMIG affected lending or purchasing decisions in 2006-2007 at the cutoff.

Table 5 contains estimated treatment effects at the UAG's 0.30 *tract minority share* and 0.90 *tract-to-MSA median income ratio* cutoffs. In panel A, all of the estimated treatment effects at the 0.30 tract minority share cutoff are statistically insignificant. In panel B, while I find no evidence that the UAG affected the denied, GSE purchase, high-price loan, or loan amount outcomes, in column 2 we see that targeted loans are about 0.9 percentage points less likely to originated at the 0.90 *tract-to-MSA median income ratio* cutoff.

Tables 6-8 contain my baseline estimates of the effects of the SAG, LMIG, and UAG, respectively, using 1996-1997 data. None of the estimated treatment effects in tables 6-8 are statistically significant at the 5 percent level. Additionally, the vast majority of the point estimates are relatively small in magnitude, often less than one percentage point. That is, there is no evidence that the affordable housing goals induced lenders to originate more loans or GSEs to purchase more loans than they otherwise would in 1996-1997.

The estimates in tables 3-8 largely reaffirm the results of our graphical analyses: there appears to be little impact of the GSE act on loan outcomes. Most of the estimates from tables 3-8 are statistically insignificant and tend to be small in magnitude, often less than 1 percentage point. The lone exception is in Table 3 where I find that the SAG increased GSE purchases by about 4 percent at the 0.60 *borrower-to-MSA median income ratio* cutoff, but I find no evidence that the affordable housing goals increased originations.

c. Interpreting results

I consider the economic significance of my table 3, panel A, column 3 estimate, as it is the only estimate in tables 3-8 that is both statistically significant at the 5% level and indicates an increase in GSE purchases or mortgage lending caused by the GSE Act. I am 95% confident that a loan targeted by the SAG at the 0.60 *borrower-to-MSA median income ratio* cutoff is 0.16 to 2.01 percentage points more likely to be purchased by a GSE in 2006-2007. Using the upper bound of 2.01 percentage points, suppose loan applications with $0.40 \leq$ *borrower-to-MSA median income ratio*<0.60 all experience a 2.01 percentage point increase in

the probability they are purchased by a GSE.[25] In this range, there were 1,077,048 GSE-eligible originations in 2006-2007 with an average loan amount of $92,400. As I've found no evidence of a corresponding increase in loan applications or originations, my 2.01 percentage point estimate implies that about 21,648 additional loans will be purchased as a result of the SAG that would not have otherwise been purchased in 2006-2007.

In the second quarter of 2009, the quarter with the highest foreclosure rate during this most recent crisis, 15.05 % of all subprime loans were in the foreclosure process and an additional 25.35% of all subprime loans were delinquent.[26] If 25.35% of the 21,648 SAG induced loans lose their full original loan amount, this implies a loss of $500.1 million. For comparison, estimates indicate commercial and investment banks have reported losses totaling over $500 billion.[27] Though my estimated loss is generous, it explains only 0.10% of losses from the mortgage market crisis. More conservatively, if the SAG had a constant treatment effect for loans with $0.50 \leq$ *borrower-to-MSA median income ratio* <0.60 or $0.58 \leq$ *borrower-to-MSA median income ratio* <0.60, the corresponding losses would total $322,000,000 and $38,000,000, respectively. Despite the claims of many, the GSE Act appeared to have little impact on the behavior of Fannie Mae and Freddie Mac, on the loan application status of higher risk borrowers, and subsequently, it could not have been a catalyst for the current housing crisis.

VI. Robustness of Results

a. Sensitivity to Bandwidth and Polynomial Order

In Tables 9 and 10, I examine the sensitivity of the table 3-5 estimates by allowing the bandwidth (how big the window of included observations is around the cutoff) and order of the polynomial included in the regression equation to vary.[28] The estimates in columns 1-2, 3-4, and 5-6 of table 9 correspond to the estimates in panels A, B, and C of table 3, respectively, for the originated and GSE purchase outcomes. For clarity, the baseline results from table 3, with a bandwidth of ±0.10 and polynomial order of three, are shown in bold in table 9.

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[25] Recall that RD estimates are only reliable near the cutoff. If the GSEs are fulfilling the SAG by purchasing the least costly marginal loans, we might expect the GSEs to purchase loans as close to the cutoff as possible if GSE purchase costs are negatively related to borrower income. Therefore, it is likely that loans further away from the SAG 0.60 *borrower-to-MSA median income ratio* cutoff are less likely to be purchased than those near the cutoff.

[26] See http://www.mbaa.org/NewsandMedia/PressCenter/70050.htm.

[27] See http://fpc.state.gov/documents/organization/110097.pdf.

[28] Tables A1 and A2 in the appendix provide similar estimates using data from 1996-1997. The 1996-1997 estimates in tables 6-8 are quite robust to changes in specification.

In table 9, column 1 I see that our table 3, panel A, column 2 estimate is relatively sensitive to changes in bandwidth and polynomial order. The baseline estimate is the only one statistically significant at the 5 percent level. Additionally, when the bandwidth is increased to ±0.20, the estimated treatment effect is in the -0.3 to -0.2 percentage point range, a negligible effect. Finally, with a bandwidth of ±0.05 and polynomial order of four, the point estimate is 4.2 percentage points, positive and large in magnitude. Though, as Lee and Lemieux (2009) note, higher order polynomial RD models with small bandwidths tend to imprecisely estimate treatment effects as they "overfit" the data.

In table 9, column 2 we see that our table 3, panel A, column 3 estimate is relatively robust. Eight of the nine point estimates are in the 0.6 to 1.2 percentage point range, well within two standard deviations of the baseline 1.1 percentage point estimate. Additionally, six of these eight estimates are statistically significant at the 5 percent level. The one estimate not in this range, with a bandwidth of ±0.05 and polynomial order of four, likely overfits the data, as discussed earlier.

In table 3, panels B and C we found no evidence that the SAG was altering mortgage lending or purchasing decisions. Columns 3, 5, and 6 of table 9 largely reaffirm this finding. In columns 3, 5, and 6 of table 9, with the exception of the ±0.05 bandwidth, fourth order polynomial estimates, all of the estimates are statistically insignificant and most are close to zero.

In column 4 of table 9 I find some evidence that the SAG increased GSE purchases at the 0.80 *borrower-to-MSA median income ratio*. The baseline estimate in column 4 is marginally significant at the 10 percent level and indicates that the SAG increased GSE purchases by 1.0 percentage points at the cutoff, similar in magnitude to the statistically significant estimate we found at the 0.60 *borrower-to-MSA median income ratio* cutoff. Two of the estimates in column 4 are statistically significant at the 5 percent level, all point estimates are positive, and all are within roughly two standard deviations of our baseline point estimate. This point estimate of 1.0 percentage points is relatively small in magnitude, however, and I find no evidence that it was large enough to induce mortgage lenders to originate loans.

Table 10 examines the sensitivity of the baseline estimates from table 4-5. The estimates in columns 1-2 correspond to the estimated treatment effects of the LMIG presented in table 4. The estimates in columns 3-4 and 5-6 correspond to the estimated treatment effects of the UAG presented in panels A and B of table 5, respectively. The estimates in columns 1-6 largely confirm that the LMIG and UAG had a negligible effect on mortgage lending and purchasing. Most all estimates in columns 1-6 are statistically insignificant and relatively small in

magnitude.[29] Additionally, our column 5 baseline estimate, which is statistically significant at the 5 percent level, appears to be quite sensitive to changes in specification as all other estimates are statistically insignificant and many are close to zero.

b. Two-Goal-Interaction Model

The estimates in tables 4, 5, 7, and 8 indicate that the LMIG and UAG have had little to no effect on mortgage lending or GSE purchases. Table 11 examines whether The LMIG (UAG) has had an effect conditional on the loan satisfying the UAG (LMIG). This could be the case if the GSEs are purchasing more loans than they otherwise would from the pool of loans that satisfy multiple goals. Figure 15 illustrates the idea behind this analysis. The LMIG targets loans with a *borrower-to-MSA median income ratio*$\leq$1.00, the UAG targets loans with a *tract-to-MSA median income ratio*$\leq$0.90, and a loan is targeted by both the LMIG and UAG if it satisfies both of these criteria. To examine whether Goal *a* has an effect on outcome Y, conditional on satisfying goal *b*, I estimate a model similar to equation (4) while including relevant treatment indicator and assignment variable terms for goals *a* and *b*. That is, I include treatment indicators for whether a loan satisfies goal *a*, goal *b*, or goals *a* and *b*. Additionally, I include a third-order polynomial in the assignment variable for goal *a* fully interacted with a third order polynomial in the assignment variable for goal *b*. Finally, I include treatment indicator and polynomial interaction terms.

Table 11 reports the coefficients on the treatment indicators for goal *a*, goal *b*, and goals *a* and *b* from the two-goal-interaction model. Panel A presents estimated treatment effects at the LMIG's 1.00 *borrower-to-MSA median income ratio* and UAG's 0.30 *tract minority share* cutoffs. All of the estimated marginal effects of the LMIG (conditional on satisfying the UAG) and UAG (conditional on satisfying the LMIG) in panel A are statistically insignificant at the 5 percent level, but the standard errors are relatively large. For instance, the estimates in column 3 of panel A indicate that loans targeted by the LMIG are 1.98 percentage points less likely to be purchased by a GSE, conditional on the loan satisfying the UAG, but the standard error is 2.90 percentage points. Panel B presents estimated treatment effects at the LMIG's 1.00 *borrower-to-MSA median income ratio* and UAG's 0.90 *tract-to-MSA median income ratio* cutoffs. All of the estimated marginal effects of the LMIG and UAG are relatively small in magnitude and

[29] Targeted loan applications at the UAG 0.30 *tract minority share* cutoff are 18.3 percentage points more likely to be originated when the bandwidth is set to ±0.05 and a 4th order polynomial is included. Again, this is likely due to overfitting the data with a high order polynomial and small bandwidth. Indeed, in figure 8 it doesn't appear that the UAG is having an effect on originations at the 0.30 *tract minority share* cutoff.

statistically insignificant at the 5 percent level. For instance, the estimates in column 3 of panel B indicate that loans targeted by the LMIG are 0.21 percentage points more likely to be purchased by a GSE, conditional on the loan satisfying the UAG, but with a standard error of 1.29 percentage points, this estimate is statistically insignificant.

c. Census Tract Level Outcomes

I use HMDA and HUD neighborhood stabilization data from 2004-2008 to construct tract-level housing and economic outcomes. Ten outcomes are examined: the number of applications, originations, GSE purchased loans, applications for investment properties, originated loans for investment properties, foreclosures, vacancies, the unemployment rate, the number of high-price loans (from HMDA), and the number of high-price loans (from HUD). These outcomes are meant to give a sense of whether targeted tracts have been hit worse by the recent mortgage market crisis due to the SAG and UAG.

Table 12 contains estimated treatment effects for tracts near the SAG 0.80 *borrower-to-MSA median income ratio*, UAG 0.30 *tract minority share*, and 0.90 *tract-to-MSA median income ratio* cutoffs. [30] Following Bhutta (2009), all regressions include MSA fixed effects, covariates (see table 2 for list), and two tract-level scale variables measured in 2000: (ln) owner-occupied units and (ln) total housing units.

The estimates in Column 1 of Table 5 are of particular interest. In Panels A, B, and C we see that the SAG and UAG have had no effect on the number of applications in targeted census tracts. This is important, since we could be worried that borrowers with relatively high quality credit are moving to targeted areas to take advantage of better lending opportunities. For instance, when denied is our outcome of interest, our estimates could be biased downwards if average credit quality increases in targeted tracts. Finding no evidence of an increase in applications at the SAG 0.80 *tract-to-MSA median income ratio,* UAG 0.30 *tract minority share*, and 0.90 *tract-to-MSA median income ratio* cutoffs makes this less of a concern.

In columns 2-10 of table 12 I find no evidence that the SAG or UAG altered mortgage lending, GSE purchasing, or contributed to the recent mortgage market crisis. The estimate in column 6 of panel A is the only estimate in table 12 that is statistically significant at the 5 percent level and indicates that the SAG actually decreased foreclosures in targeted census tracts. That is, I find no evidence that the SAG or UAG undesirably affected the number of originations, GSE purchases, foreclosures, vacancies, high-priced loans or other census tract level outcomes.

[30] A corresponding table using data from 1996-1997 can be found in Table A3 of the Appendix. None of the estimated treatment effects are significant at the ten percent level when using 1996-1997 data.

VII. Conclusion

The 1992 GSE Act mandated that a specified percentage of GSE purchases come from low income borrowers and low income and minority neighborhoods. This paper analyzes whether the GSE Act's affordable housing goals altered the decisions of lenders or the GSEs. I analyze loan application-level data with a regression discontinuity design and find that the GSE Act's three affordable housing goals had a negligible effect on the probability that a loan application is originated, an originated loan is purchased by a GSE, or an originated loan is a "high-price" loan.

I attribute this zero result to non-binding GSE Act affordable housing goals. That is, it could be that HUD created non-binding goals due to political pressure from the GSEs or other sources or that HUD was afraid increasing the goals would create excessive risk.

I conclude that the GSE Act has had a relatively insignificant, if any, effect on the current mortgage market crisis. Hence, attention should be moved away from the GSE Act to other potential causes of the crisis. As the GSE Act appears to have little impact on the GSEs, mortgage lending institutions, or housing outcomes, this paper raises additional questions about the effectiveness of the GSE Act, or other related housing policies, at promoting homeownership opportunities among underserved populations.

Caveats and Future Work

GSE purchases of seasoned loans (loans originated prior to the year they were purchased) and loans originally sold to an intermediate institution other than a GSE are missing from HMDA data (Bhutta 2009).[31, 32] A potential concern is that the affordable housing goals differentially influence GSE purchases of loans from these missing groups. However, while these loans will not be recorded as being purchased by a GSE, they will be recorded as being originated. As I find no effect of the affordable housing goals on originations, these missing GSE purchase data are less of a concern.

The regression discontinuity design is only reliable for loans near the relevant goal satisfaction cutoffs. If the GSEs are fulfilling the goal requirements by purchasing the least costly marginal loans, we might expect the GSEs to purchase loans as close to the cutoff as possible if GSE purchase costs are negatively related to, say, borrower or tract income. However, it is

[31] As an example of missing seasoned loan data, loans originated in 2007 but purchased by a GSE in 2008 will not appear in HMDA data as being purchased.

[32] The share of GSE purchases that are seasoned loans has varied over the years. For instance, the seasoned loan share was 24 percent in 1995-1996, 15 percent in 2001, 20 percent in 2002, and 17-18 percent in 2005 (Manchester 1998, 2008).

possible that the affordable housing goals are forcing the GSEs to purchase loans away from the cutoff. For instance, if the GSEs focus is to purchase loans that satisfy multiple goals there could be an affordable housing goal effect away from the cutoff. For future work, I plan on incorporating pre-GSE Act data in a difference-in-difference analysis to examine whether targeted tracts have had large increases in GSE purchases or originations relative to non-targeted tracts after the GSE Act affordable housing goals went into effect. This analysis should help alleviate concerns of an affordable housing goal effect away from the cutoff.

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Figure 1: Loans targeted by the Special Affordable Goal

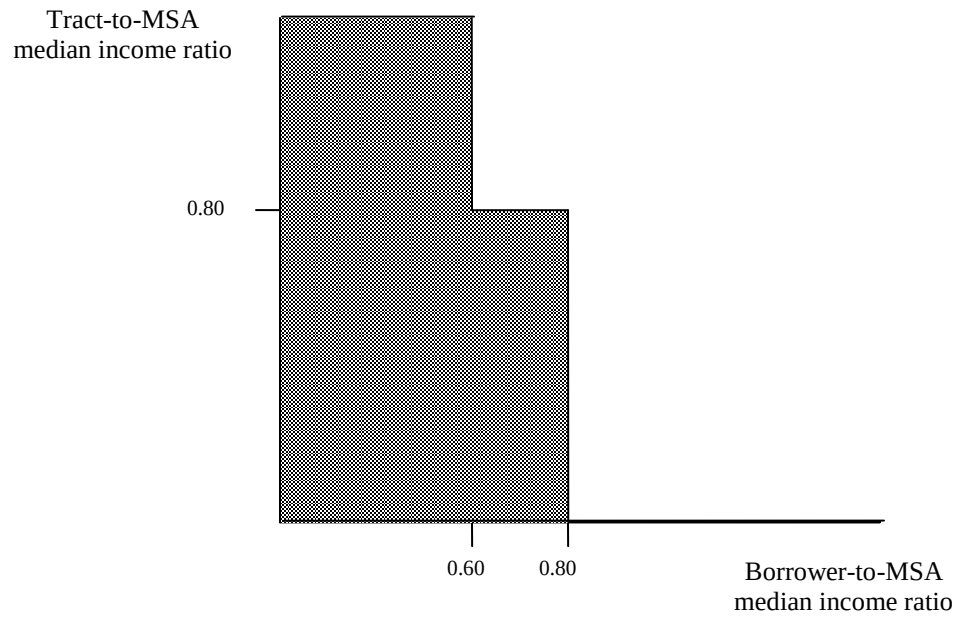


Figure 2: Loans targeted by the Low and Moderate Income Goal

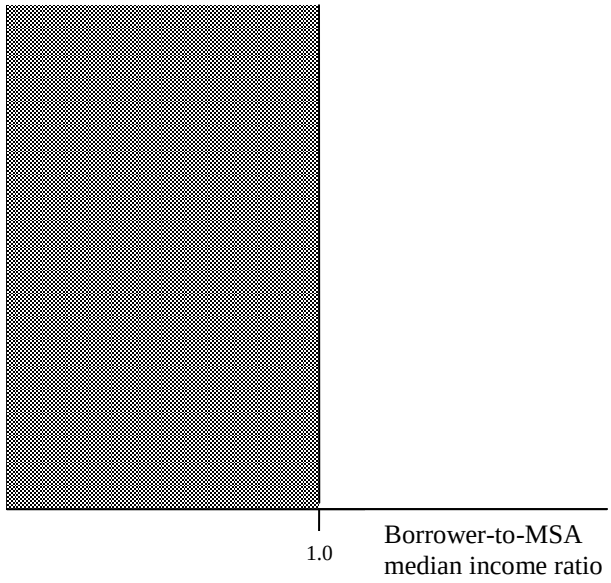


Figure 3: Loans targeted by the Underserved Areas Goal

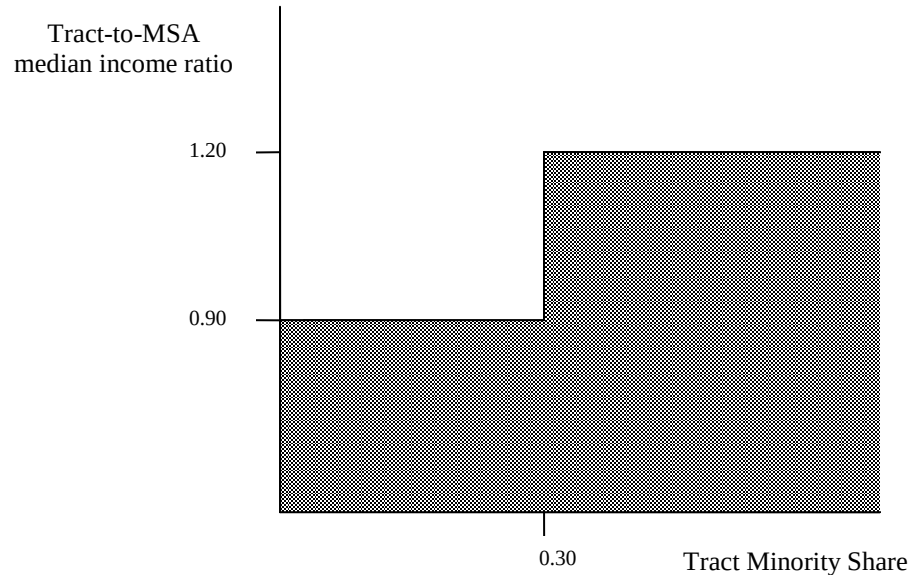
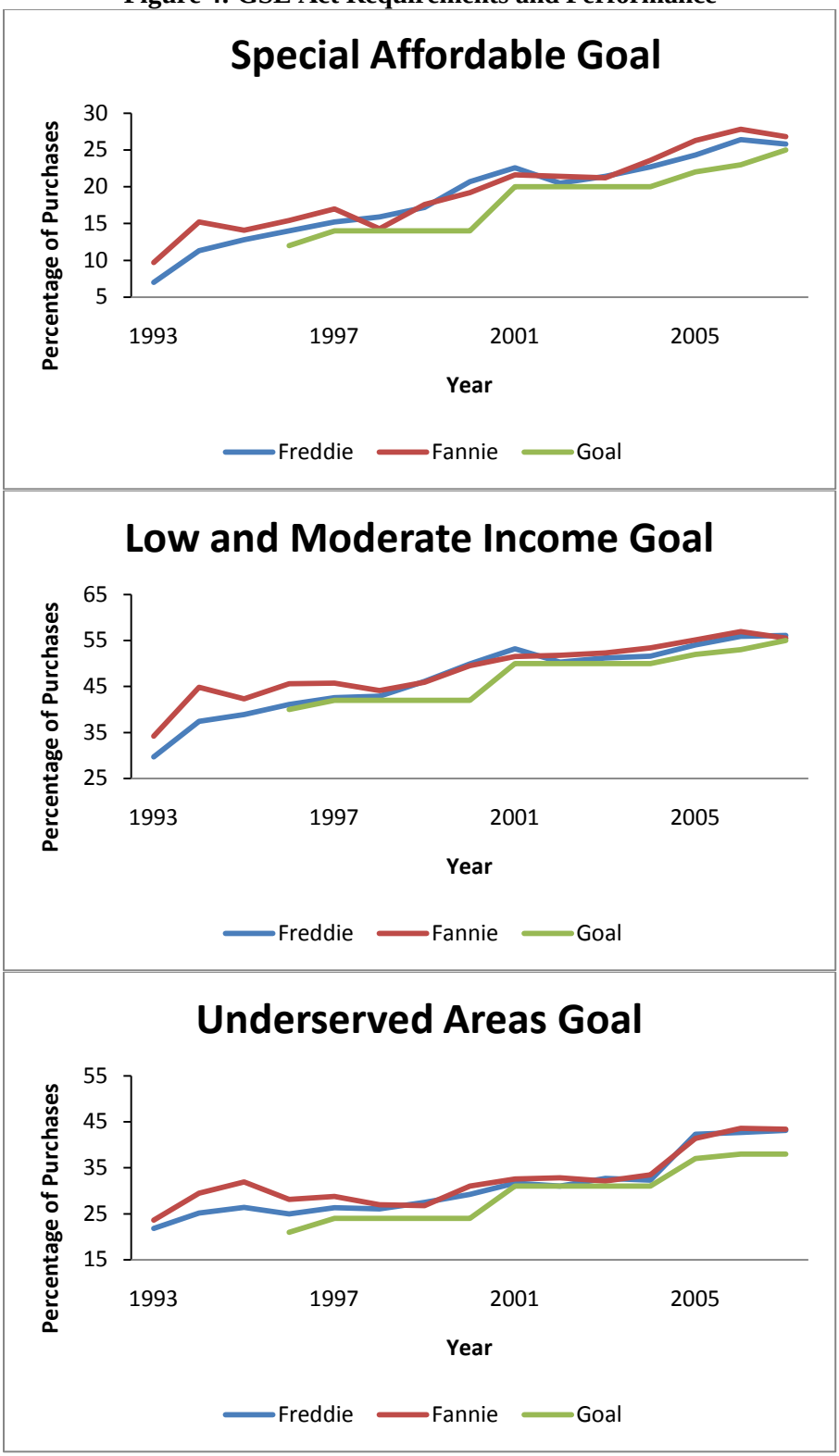


Figure 4: GSE Act Requirements and Performance



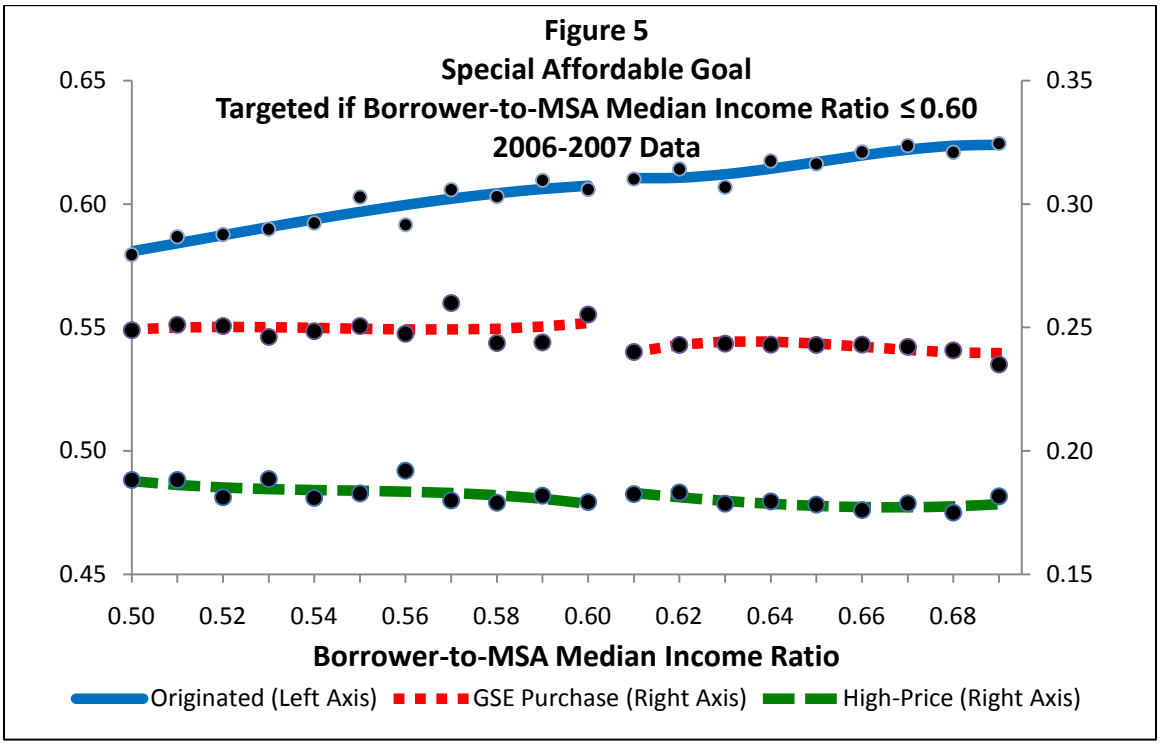


Figure 5
Special Affordable Goal
Targeted if Borrower-to-MSA Median Income Ratio ≤ 0.60
2006-2007 Data
0.65
0.60
0.55
0.50
0.45
0.35
0.30
0.25
0.20
0.15
0.50 0.52 0.54 0.56 0.58 0.60 0.62 0.64 0.66 0.68
Borrower-to-MSA Median Income Ratio
Originated (Left Axis)
GSE Purchase (Right Axis)
High-Price (Right Axis)

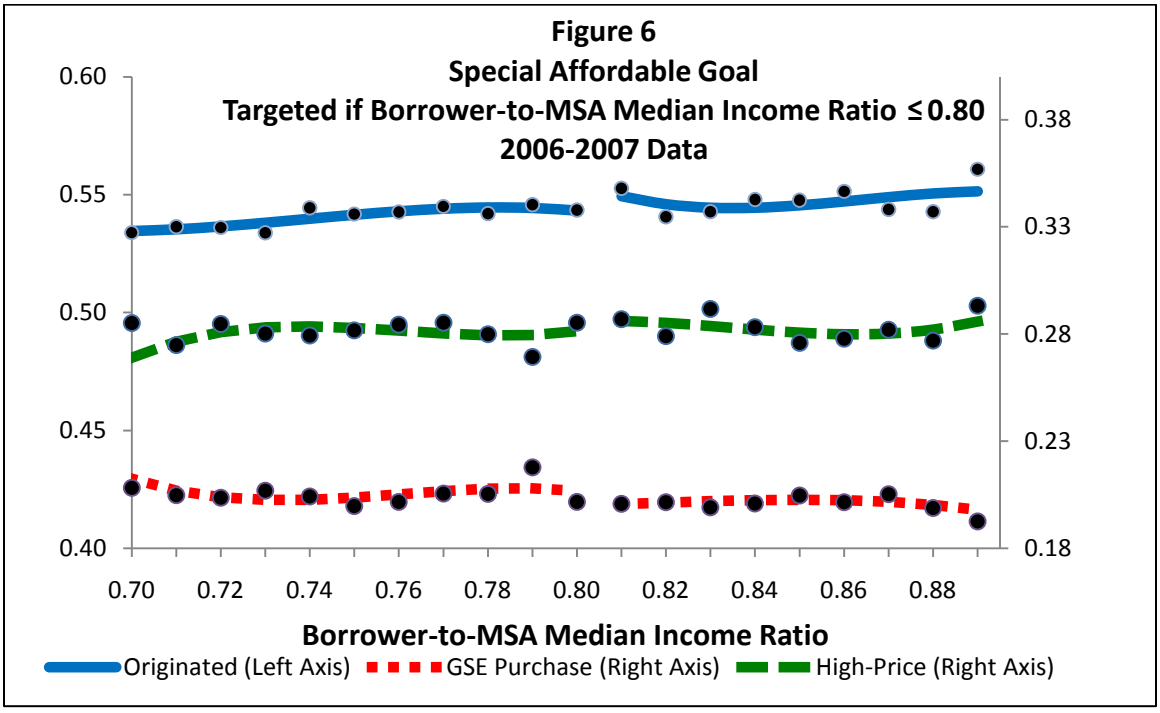


Figure 6
Special Affordable Goal
Targeted if Borrower-to-MSA Median Income Ratio ≤ 0.80
2006-2007 Data
0.60
0.55
0.50
0.45
0.40
0.38
0.33
0.28
0.23
0.18
0.70 0.72 0.74 0.76 0.78 0.80 0.82 0.84 0.86 0.88
Borrower-to-MSA Median Income Ratio
Originated (Left Axis)
GSE Purchase (Right Axis)
High-Price (Right Axis)

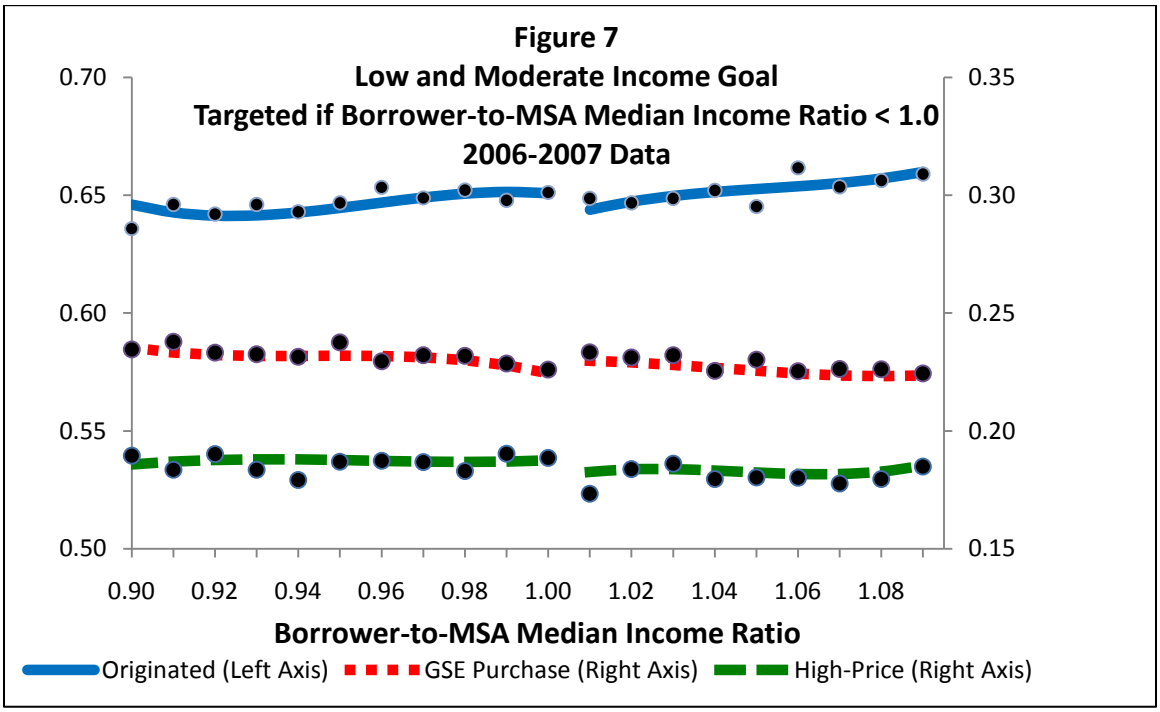


Figure 7
Low and Moderate Income Goal
Targeted if Borrower-to-MSA Median Income Ratio < 1.0
2006-2007 Data
0.70
0.65
0.60
0.55
0.50
0.35
0.30
0.25
0.20
0.15
0.90
0.92
0.94
0.96
0.98
1.00
1.02
1.04
1.06
1.08
Borrower-to-MSA Median Income Ratio
Originated (Left Axis)
GSE Purchase (Right Axis)
High-Price (Right Axis)

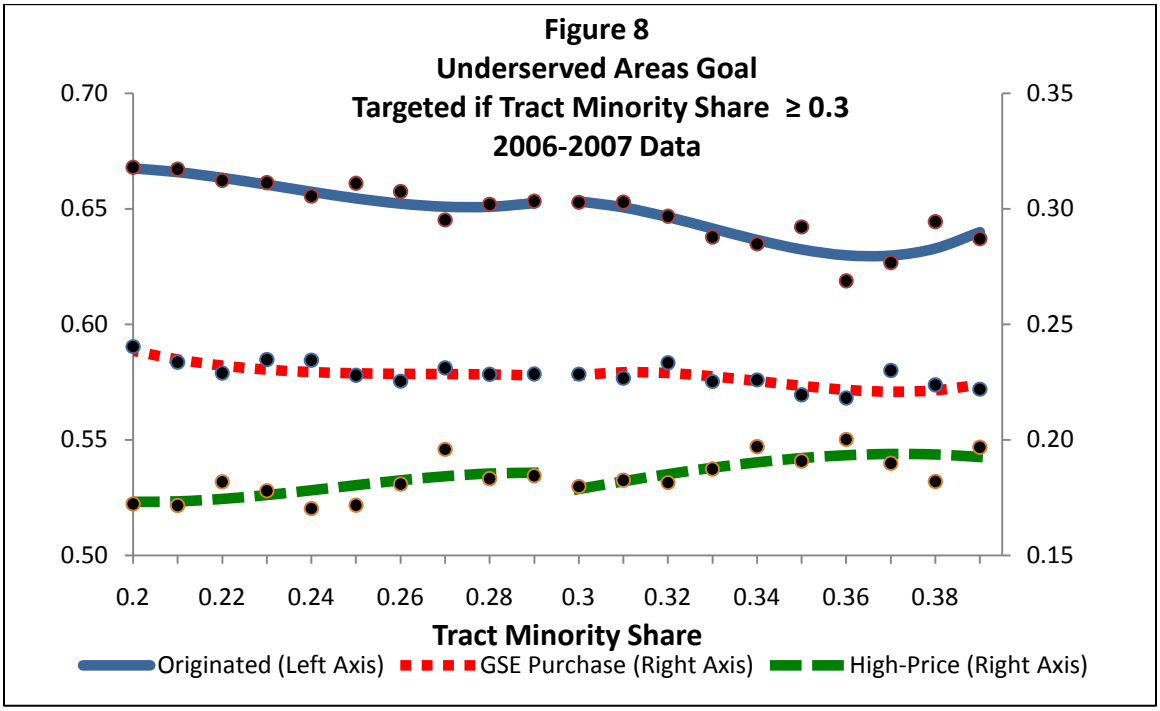


Figure 8
Underserved Areas Goal
Targeted if Tract Minority Share ≥ 0.3
2006-2007 Data
0.70
0.65
0.60
0.55
0.50
0.35
0.30
0.25
0.20
0.15
0.2
0.22
0.24
0.26
0.28
0.3
0.32
0.34
0.36
0.38
Tract Minority Share
Originated (Left Axis)
GSE Purchase (Right Axis)
High-Price (Right Axis)

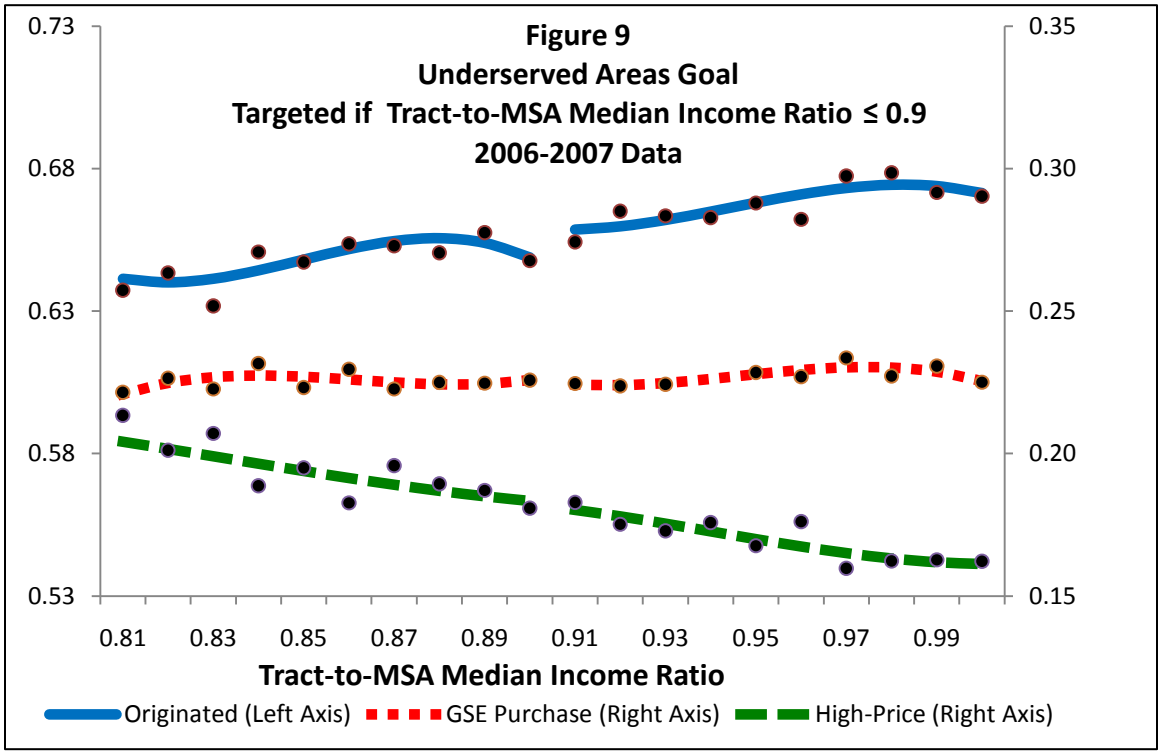


Figure 9
Underserved Areas Goal
Targeted if Tract-to-MSA Median Income Ratio ≤ 0.9
2006-2007 Data
0.73
0.68
0.63
0.58
0.53
0.35
0.30
0.25
0.20
0.15
0.81
0.83
0.85
0.87
0.89
0.91
0.93
0.95
0.97
0.99
Tract-to-MSA Median Income Ratio
Originated (Left Axis)
GSE Purchase (Right Axis)
High-Price (Right Axis)

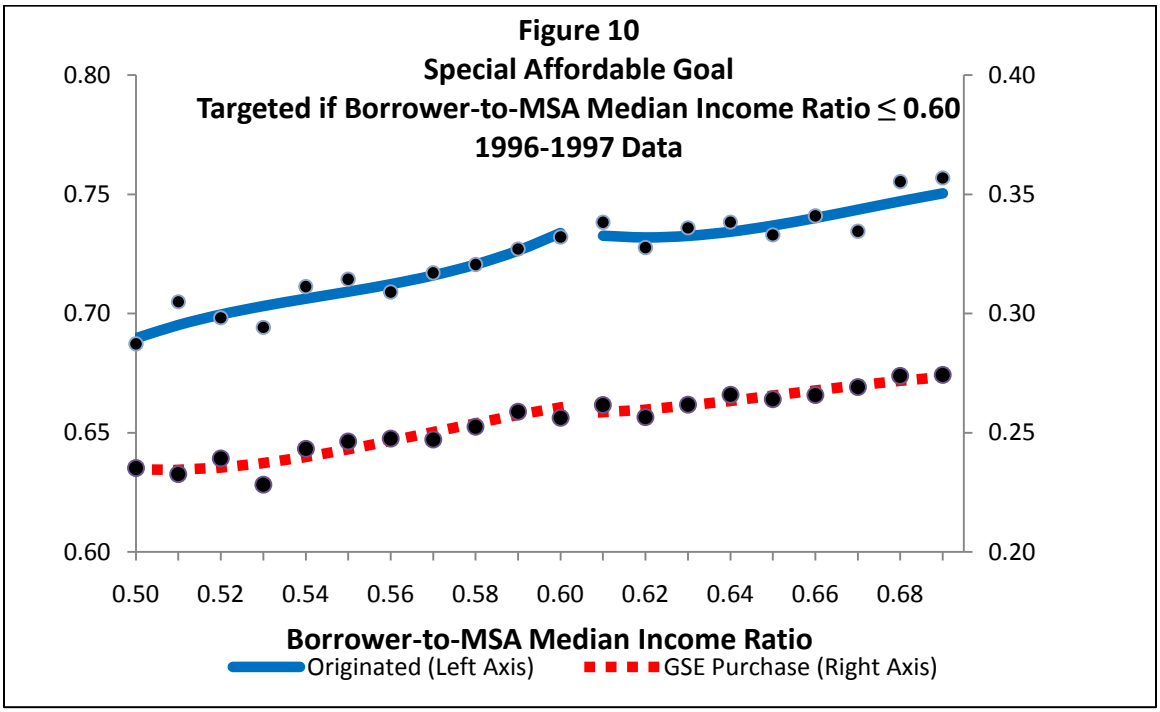


Figure 10
Special Affordable Goal
Targeted if Borrower-to-MSA Median Income Ratio ≤ 0.60
1996-1997 Data
0.80
0.75
0.70
0.65
0.60
0.40
0.35
0.30
0.25
0.20
0.50
0.52
0.54
0.56
0.58
0.60
0.62
0.64
0.66
0.68
Borrower-to-MSA Median Income Ratio
Originated (Left Axis)
GSE Purchase (Right Axis)

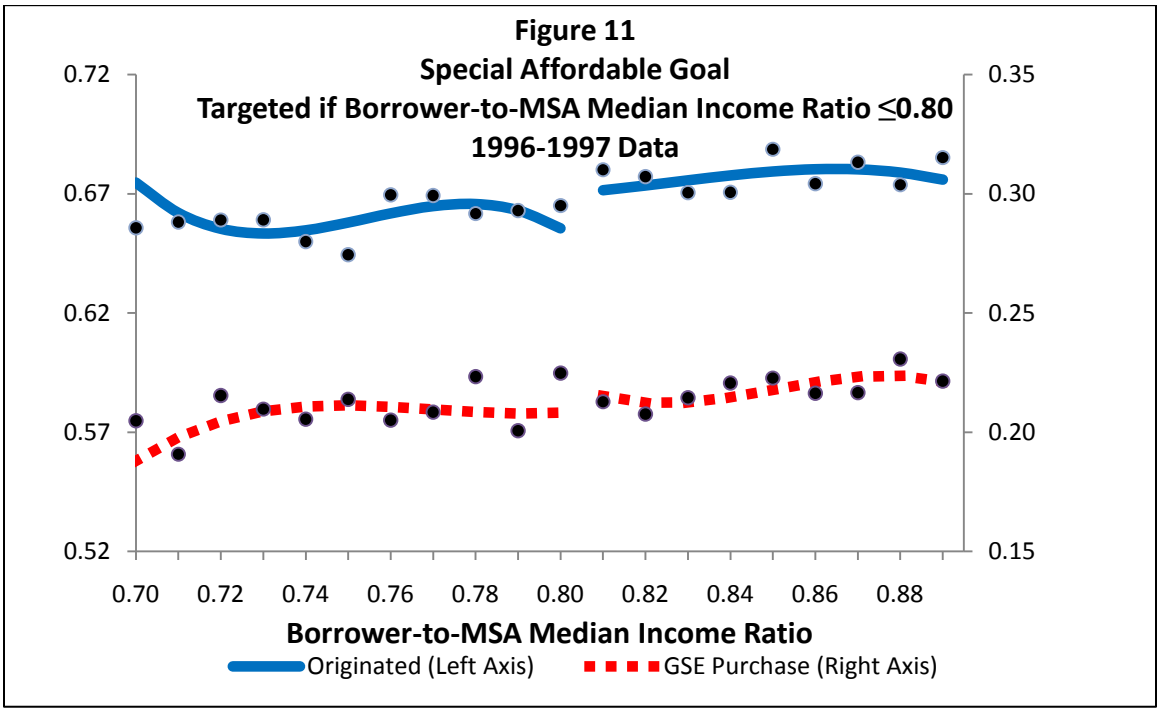


Figure 11
Special Affordable Goal
Targeted if Borrower-to-MSA Median Income Ratio ≤0.80
1996-1997 Data
0.72
0.67
0.62
0.57
0.52
0.35
0.30
0.25
0.20
0.15
0.70 0.72 0.74 0.76 0.78 0.80 0.82 0.84 0.86 0.88
Borrower-to-MSA Median Income Ratio
Originated (Left Axis)
GSE Purchase (Right Axis)

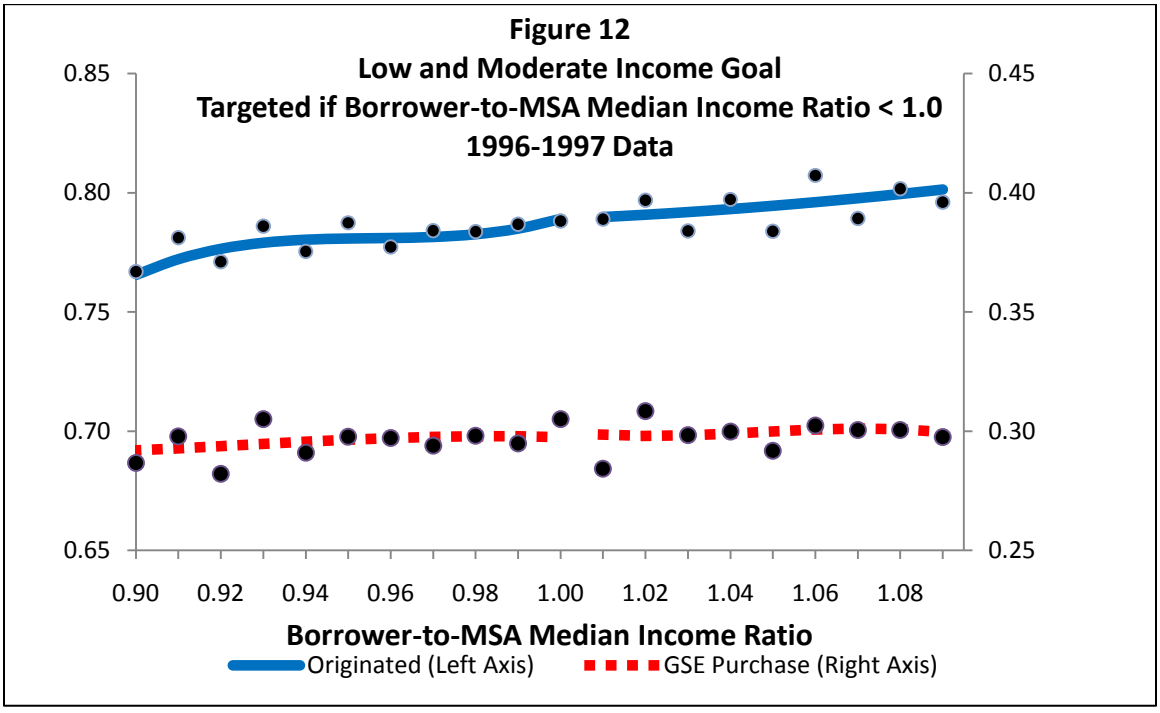


Figure 12
Low and Moderate Income Goal
Targeted if Borrower-to-MSA Median Income Ratio < 1.0
1996-1997 Data
0.85
0.80
0.75
0.70
0.65
0.45
0.40
0.35
0.30
0.25
0.90 0.92 0.94 0.96 0.98 1.00 1.02 1.04 1.06 1.08
Borrower-to-MSA Median Income Ratio
Originated (Left Axis)
GSE Purchase (Right Axis)

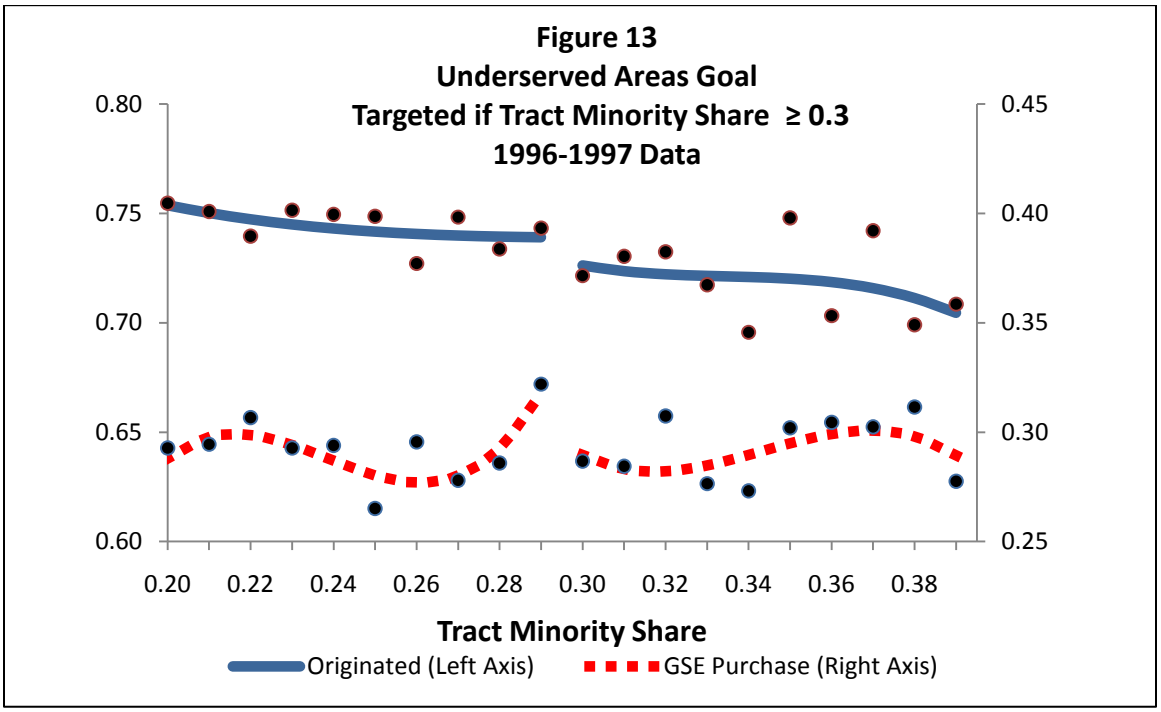


Figure 13
Underserved Areas Goal
Targeted if Tract Minority Share ≥ 0.3
1996-1997 Data
0.80
0.75
0.70
0.65
0.60
0.45
0.40
0.35
0.30
0.25
0.20 0.22 0.24 0.26 0.28 0.30 0.32 0.34 0.36 0.38
Tract Minority Share
Originated (Left Axis)
GSE Purchase (Right Axis)

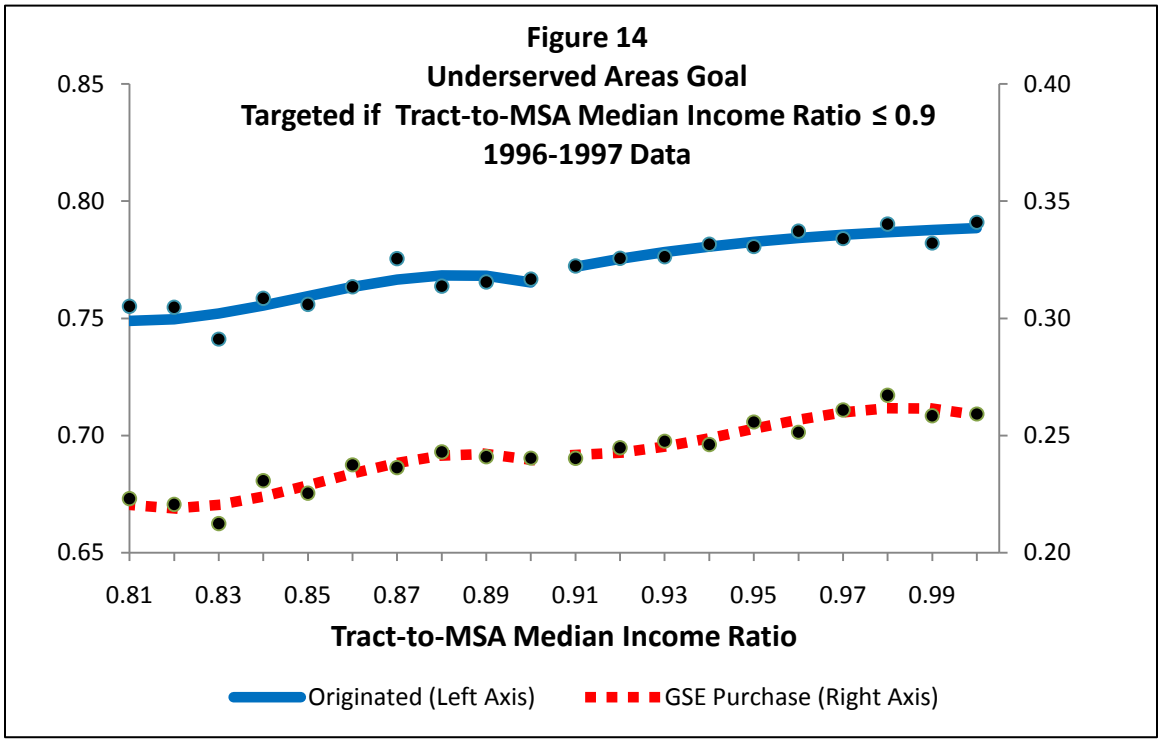


Figure 14
Underserved Areas Goal
Targeted if Tract-to-MSA Median Income Ratio ≤ 0.9
1996-1997 Data
0.85
0.80
0.75
0.70
0.65
0.40
0.35
0.30
0.25
0.20
0.81 0.83 0.85 0.87 0.89 0.91 0.93 0.95 0.97 0.99
Tract-to-MSA Median Income Ratio
Originated (Left Axis)
GSE Purchase (Right Axis)

Figure 15

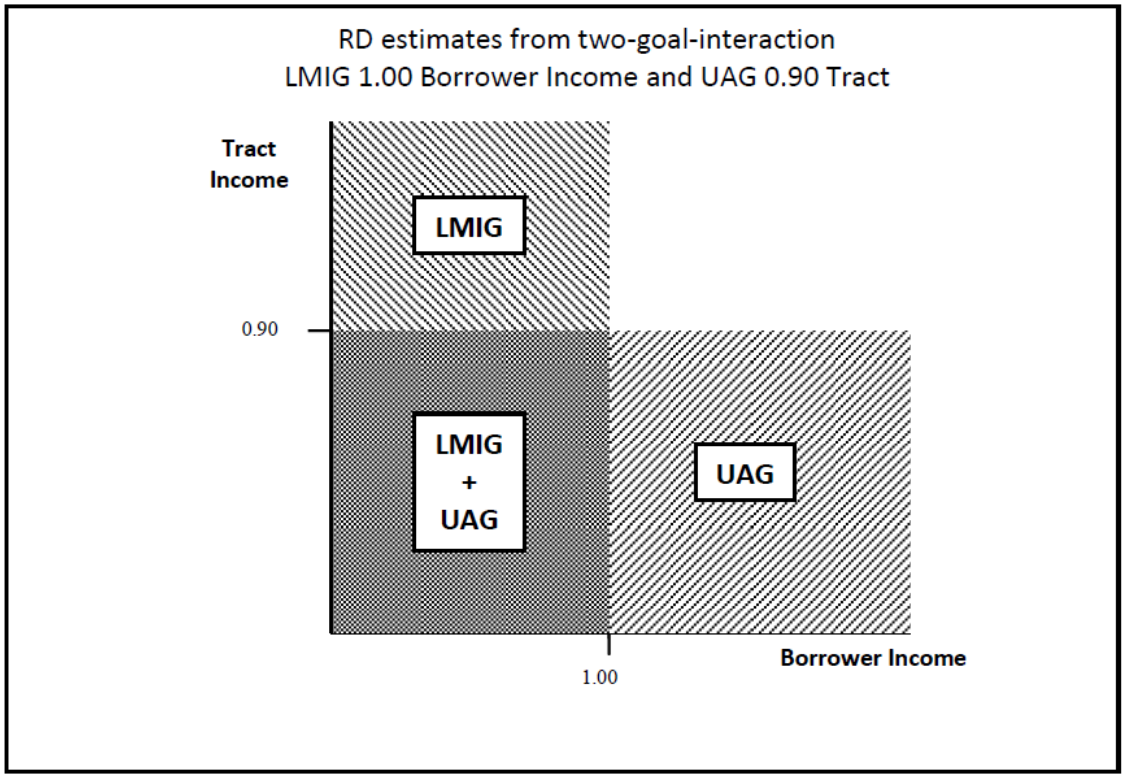

RD estimates from two-goal-interaction
LMIG 1.00 Borrower Income and UAG 0.90 Tract
Tract Income
LMIG
0.90
LMIG + UAG
UAG
1.00
Borrower Income

Table 1: Summary Statistics for Applicant Level Data (2006-2007)

	A. Underserved Areas Goal: 0.30 *tract minority share* (MIN) cutoff					
	0.2≤MIN≤0.3		0.3<MIN≤0.4		0.2≤MIN≤0.4	
Sample Size: Loan Applicants	897,943		572,627		1,470,570	
Percent denied	0.245**	(0.430)	0.259	(0.438)	0.251	(0.433)
Percent originated	0.659**	(0.474)	0.641	(0.480)	0.652	(0.476)
Applicant Income (1000s)	92.2	(109.1)	94.1	(105.9)	92.9	(107.8)
Percent black	0.107**	(0.309)	0.140	(0.347)	0.120	(0.325)
Percent White	0.828**	(0.378)	0.768	(0.422)	0.804	(0.397)
Sample Size: Originated Loans	591,418		366,907		958,325	
Percent high-price loan| originated	0.179	(0.383)	0.188	(0.391)	0.183	(0.386)
Percent purchased by GSE| originated	0.232	(0.422)	0.226	(0.418)	0.229	(0.420)
Loan Amount (1000s)| originated	152.1*	(101.1)	160.5	(106.9)	155.3	(103.5)
	B. Underserved Areas Goal: 0.90 *tract-to-MSA median income ratio* (TM) cutoff					
	0.8≤TM≤0.9		0.9<TM≤1.0		0.8≤TM≤1.0	
Sample Size: Loan Applicants	1,309,941		1,740,260		3,050,201	
Percent denied	0.266**	(0.442)	0.247	(0.431)	0.255	(0.436)
Percent originated	0.648**	(0.478)	0.667	(0.471)	0.659	(0.474)
Applicant Income (1000s)	77.5**	(91.6)	80.5	(92.8)	79.2	(92.3)
Percent black	0.054**	(0.226)	0.046	(0.210)	0.049	(0.217)
Percent White	0.913**	(0.282)	0.922	(0.269)	0.918	(0.275)
Sample Size: Originated Loans	848,541		1,161,376		2,009,917	
Percent high-price loan	0.194**	(0.395)	0.170	(0.375)	0.180	(0.384)
Percent purchased by GSE	0.225	(0.417)	0.227	(0.419)	0.226	(0.418)
Loan Amount (1000s)	122.9**	(89.2)	128.8	(91.9)	126.3	(90.8)
	C. Low and Moderate Income Goal: 1.0 *borrower-to-MSA median income ratio* (LOW) cutoff					
	0.9≤LOW≤1.0		1.0<LOW≤1.1		0.9≤LOW≤1.1	
Sample Size: Loan Applicants	1,128,562		1,192,598		2,321,160	
Percent denied	0.262**	(0.439)	0.254	(0.435)	0.258	(0.437)
Percent originated	0.648**	(0.478)	0.652	(0.476)	0.650	(0.477)
Applicant Income (1000s)	61.8**	(10.7)	67.9	(11.8)	64.9	(11.7)
Percent black	0.127**	(0.333)	0.120	(0.325)	0.123	(0.329)
Percent White	0.815*	(0.388)	0.820	(0.384)	0.817	(0.386)
Sample Size: Originated Loans	731,122		777,923		1,509,045	
Percent high cost loan	0.186**	(0.389)	0.180	(0.385)	0.183	(0.387)
Percent purchased by GSE	0.232**	(0.422)	0.228	(0.420)	0.230	(0.421)
Loan Amount (1000s)	138.0**	(91.0)	144.6	(96.5)	141.4	(93.9)

Standard deviations in parentheses. I test whether there is a statistically significant difference in means between individuals below and above the relevant cutoffs. Standard errors are clustered at MSA-level, * p<0.05, ** p<0.01.

Table 2: Summary Statistics for Census Tract Level Data (2006-2007)

	Underserved Areas Goal: 0.30 *tract minority share* (MIN) cutoff						Underserved Areas Goal: 0.90 *tract-to-MSA median income ratio* (TM) cutoff					
	0.2≤MIN≤0.3		0.3<MIN≤0.4		0.2≤MIN≤0.4		0.8≤TM≤0.9		0.9<TM≤1.0		0.8≤TM≤1.0	
Sample Size: # of census tracts	2015		1367		3382		3748		4576		8324	
Panel A: Tract-level outcomes												
# originated loans	346.7	(343.4)	318.3	(309.2)	335.2	(330.3)	267.1**	(208.3)	298.4	(217.5)	284.3	(213.9)
# purcahsed by GSEs	79.4*	(82.8)	70.9	(69.7)	76.0	(77.9)	59.0**	(51.9)	67.1	(56.4)	63.4	(54.6)
# High Cost -HMDA (06-07)	64.1	(77.2)	61.5	(71.0)	63.1	(74.7)	54.8	(47.7)	53.7	(46.8)	54.2	(47.2)
# High Cost - HUD (04-06)	165.7	(150.0)	175.6	(157.6)	169.7	(153.2)	133.1	(112.2)	133.3	(111.3)	133.2	(111.7)
# Investment Loans	41.4	(86.8)	37.0	(52.9)	39.6	(75.0)	33.1*	(44.9)	30.9	(44.6)	31.9	(44.7)
# Foreclosures (Jan, 07-June, 08)	62.5	(79.6)	62.0	(74.9)	62.3	(77.7)	51.4	(51.4)	50.9	(51.6)	51.1	(51.5)
# Vacant 90 days or longer as of June, 2008	53.8	(64.1)	54.5	(65.7)	54.1	(64.8)	66.9**	(74.3)	50.7	(62.7)	58.0	(68.7)
Unemployment rate as of June, 2008	0.055	(0.015)	0.057	(0.016)	0.056	(0.016)	0.058**	(0.015)	0.057	(0.015)	0.057	(0.015)
# Applications	544.7	(540.1)	513.3	(508.0)	532.0	(527.5)	429.6**	(328.5)	465.1	(332.6)	449.1	(331.2)
Panel B: Tract Characteristics, 2000												
# of Housing Units	1,589.9**	(790.7)	1,502.9	(726.9)	1,554.7	(766.6)	1,623.1*	(782.8)	1,667.7	(784.5)	1,647.6	(784.0)
# of owner Occupied Housing Units	1,228.7**	(639.0)	1,138.7	(597.9)	1,192.3	(624.2)	1,174.6**	(591.8)	1,276.3	(594.2)	1,230.5	(595.2)
Population	4,817.7	(2,098.9)	4,820.3	(2,096.1)	4,818.7	(2,097.5)	4,286.1**	(1,880.7)	4,484.2	(1,891.9)	4,395.0	(1,889.3)
Lower quartile home value (in thousands)	119.3	(68.3)	124.9	(75.7)	121.6	(71.4)	832.5**	(40.2)	93.9	(43.2)	89.1	(42.2)
Median home value (in thousands)	148.9	(86.9)	157.61	(102.1)	152.4	(93.4)	104.8**	(49.7)	117.7	(54.9)	111.8	(53.0)
Upper quartile home value (in thousands)	190.1	(117.6)	199.0	(129.2)	193.72	(122.5)	133.1**	(66.0)	150.1	(75.0)	142.4	(71.6)
% of housing units that are detached	0.604**	(0.242)	0.566	(0.252)	0.589	(0.246)	0.609**	(0.216)	0.661	(0.202)	0.637	(0.210)
% of housing units that are mobile homes	0.065	(0.118)	0.058	(0.112)	0.062	(0.116)	0.101**	(0.147)	0.089	(0.127)	0.095	(0.136)
% of housing units built 1980-1989	0.192	(0.145)	0.189	(0.157)	0.191	(0.150)	0.129**	(0.110)	0.138	(0.109)	0.134	(0.110)
% of housing units built 1940-1969	0.324	(0.225)	0.334	(0.235)	0.328	(0.229)	0.376	(0.201)	0.365	(0.209)	0.370	(0.205)
% of housing units built pre-1940	0.093	(0.155)	0.099	(0.167)	0.095	(0.160)	0.198**	(0.196)	0.166	(0.171)	0.181	(0.184)
% of housing units in multifamily building	0.268**	(0.242)	0.305	(0.259)	0.283	(0.250)	0.237**	(0.214)	0.202	(0.197)	0.218	(0.205)
% of population Age 65+	0.123**	(0.060)	0.114	(0.055)	0.119	(0.058)	0.155**	(0.081)	0.147	(0.076)	0.150	(0.078)
% of population black	0.088**	(0.074)	0.127	(0.109)	0.104	(0.092)	0.042**	(0.052)	0.036	(0.049)	0.039	(0.050)
% of population hispanic	0.036**	(0.029)	0.055	(0.044)	0.043	(0.037)	0.018**	(0.023)	0.015	(0.019)	0.016	(0.021)
% of population living in group quarters	0.025	(0.069)	0.024	(0.077)	0.025	(0.072)	0.020	(0.057)	0.019	(0.050)	0.020	(0.053)

Standard deviations in parentheses. I test whether there is a statistically significant difference in means between individuals below and above the relevant cutoffs. Standard errors are clustered at MSA-level, * p<0.05, ** p<0.01.

Table 3
Special Affordable Goal: 2006-2007 data
Parameter Estimates (Standard Errors) and [R^2]

	Denied	Originated	Purchased by GSE	Ln(Loan amount)	High-Price loan
	(1)	(2)	(3)	(4)	(5)
A) D_i = **1**[*Borrower-to-MSA median income ratio*≤0.6]					
	0.0059	-0.0107**	0.0109*	0.0029	-0.0063
	(0.0040)	(0.0041)	(0.0047)	(0.0092)	(0.0042)
	[0.025]	[0.024]	[0.019]	[0.125]	[0.049]
Sample mean	0.28	0.64	0.25	107.69	0.17
Observations	1,604,633	1,604,633	1,027,182	1,027,182	1,027,182
B) D_i = **1**[*Borrower-to-MSA median income ratio*≤0.8]					
	0.0089	-0.0100	0.0105	0.00775	-0.0062
	(0.0077)	(0.0083)	(0.0065)	(0.0116)	(0.0083)
	[0.033]	[0.029]	[0.020]	[0.205]	[0.067]
Sample mean	0.34	0.56	0.20	122.03	0.28
Observations	562,873	562,873	317,274	317,274	317,274
C) D_i = **1**[*Tract-to-MSA median income ratio*≤0.8]					
	0.0068	-0.0108	0.0142	-0.0230	-0.0084
	(0.0084)	(0.0084)	(0.0081)	(0.0273)	(0.0108)
	[0.025]	[0.023]	[0.018]	[0.162]	[0.050]
Sample mean	0.31	0.60	0.22	111.47	0.23
Observations	748,530	748,530	432,473	432,473	432,473

Notes: Standard errors, clustered at MSA-level, shown in parentheses. * p<0.05, ** p<0.01. All regressions include MSA fixed effects, covariates (see table 2 for list), and a year dummy. The sample in panel A is limited to applicants with 0.50 ≤ *Borrower-to-MSA median income ratio* ≤ 0.70 and *Tract-to-MSA median income ratio* > 0.80. The sample in panel B is limited to loans with 0.70 ≤ *Borrower-to-MSA median income ratio* ≤ 0.90 and *Tract-to-MSA median income ratio* ≤ 0.80. The sample in Panel C is limited to applicants with 0.70 ≤ *Tract-to-MSA median income ratio* ≤ 0.90 and 0.60 ≤ *Borrower-to-MSA median income ratio* < 0.80. See data section for discussion of sample selection.

Table 4
Low and Moderate Income Goal: 2006-2007 Data
Parameter Estimates (Standard Errors) and [R^2]

	Denied	Originated	Purchased by GSE	Ln(Loan amount)	High-Price loan
	(1)	(2)	(3)	(4)	(5)
	-0.0076	0.0078	-0.0022	0.0098	0.0051
	(0.0046)	(0.0052)	(0.0045)	(0.0126)	(0.0051)
	[0.029]	[0.027]	[0.017]	[0.147]	[0.051]
Sample mean	0.25	0.65	0.23	141.40	0.18
Observations	2,321,160	2,321,160	1,509,045	1,509,045	1,509,045

Notes: D_i = **1**[*borrower-to-MSA median income ratio*≤1.0]. Standard errors, clustered at MSA-level, shown in parentheses. * p<0.05, ** p<0.01. All regressions include MSA fixed effects, tract-level covariates (see table 2 for list), and a year dummy. The sample is limited to applicants with 0.90 ≤ *borrower-to-MSA median income ratio* ≤ 1.10. See data section for discussion of sample selection.

Table 5
Underserved Areas Goal: 2006-2007 Data
Parameter Estimates (Standard Errors) and [R^2]

		Denied	Originated	Purchased by GSE	Ln(Loan amount)	High-Price loan
		(1)	(2)	(3)	(4)	(5)
	A)	D_i = **1**[*tract minority share*≥.3]				
		-0.0041	0.0014	0.0026	-0.0215	0.0027
		(0.0097)	(0.0100)	(0.0085)	(0.0212)	(0.0103)
		[0.017]	[0.016]	[0.028]	[0.129]	[0.016]
Sample mean		0.25	0.65	0.22	155.34	0.18
Observations		1,470,570	1,470,570	958,325	958,325	958,325
	B)	D_i = **1**[*tract-to-MSA median income ratio*≤ 0.90]				
		0.0073	-0.0091*	0.0004	-0.0029	0.0032
		(0.0044)	(0.0046)	(0.0046)	(0.0157)	(0.0051)
		[0.017]	[0.015]	[0.018]	[0.140]	[0.023]
Sample mean		0.25	0.65	0.22	126.30	0.18
Observations		2992,215	2992,215	1,973,216	1,973,216	1,973,216

Notes: Standard errors, clustered at MSA-level, shown in parentheses. * p<0.05, ** p<0.01. All regressions include MSA fixed effects, covariates (see table 2 for list), and a year dummy. The sample in panel A is limited to loans with 0.2 ≤ *tract minority share* ≤ 0.4 and 0.90 ≥ *tract-to-MSA median income ratio* ≤ 1.2. The sample in Panel B is limited to applicants with 0.80 ≤ *tract-to-MSA median income ratio* ≤ 1.0 and *tract minority share* < 0.30. See data section for discussion of sample selection.

Table 6
Special Affordable Goal: 1996-1997 data
Parameter Estimates (Standard Errors) and [R^2]

	Denied	Originated	Purchased by GSE	Ln(Loan amount)
	(1)	(2)	(3)	(4)
	A) D_i = **1**[*Borrower-to-MSA median income ratio*≤0.6]			
	-0.0069	0.0039	0.0003	0.0057
	(0.0052)	(0.0058)	(0.0064)	(0.0174)
	[0.030]	[0.035]	[0.045]	[0.160]
Sample mean	0.21	0.73	0.26	54.76
Observations	973,919	973,919	638,343	638,343
	B) D_i = **1**[*Borrower-to-MSA median income ratio*≤0.8]			
	0.0132	-0.0147	-0.0033	-0.0316
	(0.0102)	(0.0119)	(0.0130)	(0.0335)
	[0.030]	[0.035]	[0.045]	[0.160]
Sample mean	0.26	0.67	0.21	53.75
Observations	199,280	199,280	133,559	133,559
	C) D_i = **1**[*Tract-to-MSA median income ratio*≤0.8]			
	0.0028	-0.0080	0.0067	-0.0243
	(0.0131)	(0.0154)	(0.0135)	(0.0405)
	[0.034]	[0.041]	[0.054]	[0.194]
Sample mean	0.23	0.70	0.23	52.95
Observations	282,548	282,548	198,789	198,789

Notes: Standard errors, clustered at MSA-level, shown in parentheses. * p<0.05, ** p<0.01. All regressions include MSA fixed effects, covariates (see table 2 for list), and a year dummy. The sample in panel A is limited to applicants with 0.50 ≤ *Borrower-to-MSA median income ratio* ≤ 0.70 and *Tract-to-MSA median income ratio* > 0.80. The sample in panel B is limited to loans with 0.70 ≤ *Borrower-to-MSA median income ratio* ≤ 0.90 and *Tract-to-MSA median income ratio* ≤ 0.80. The sample in Panel C is limited to applicants with 0.70 ≤ *Tract-to-MSA median income ratio* ≤ 0.90 and 0.60 ≤ *Borrower-to-MSA median income ratio* < 0.80. See data section for discussion of sample selection.

Table 7
Low and Moderate Income Goal: 1996-1997 Data
Parameter Estimates (Standard Errors) and [R^2]

	Denied	Originated	Purchased by GSE	Ln(Loan amount)
	(1)	(2)	(3)	(4)
	0.0075	-0.0010	-0.0026	-0.0141
	(0.0041)	(0.0047)	(0.0072)	(0.0176)
	[0.034]	[0.038]	[0.041]	[0.177]
Sample mean	0.15	0.79	0.30	77.10
Observations	1,162,442	1,162,442	917,394	917,394

Notes: D_i = **1**[*borrower-to-MSA median income ratio*≤1.0] Standard errors, clustered at MSA-level, shown in parentheses. * p<0.05, ** p<0.01. All regressions include MSA fixed effects, tract-level covariates (see table 2 for list), and a year dummy. The sample is limited to applicants with 0.90 ≤ *borrower-to-MSA median income ratio* ≤ 1.10. See data section for discussion of sample selection.

Table 8
Underserved Areas Goal: 1996-1997 Data
Parameter Estimates (Standard Errors) and [R^2]

		Denied	Originated	Purchased by GSE	Ln(Loan amount)
		(1)	(2)	(3)	(4)
	A)	D_i = **1**[*tract minority share*≥.3]			
		0.0359	-0.0327	-0.0344	-0.103
		(0.0242)	(0.0247)	(0.0205)	(0.0998)
		[0.018]	[0.020]	[0.036]	[0.170]
Sample mean		0.20	0.74	0.29	82.55
Observations		440,205	440,205	324,602	324,602
	B)	D_i = **1**[*tract-to-MSA median income ratio*≤ 0.90]			
		0.0087	-0.0107	-0.00611	-0.0329
		(0.0058)	(0.0068)	(0.0080)	(0.0225)
		[0.015]	[0.019]	[0.044]	[0.131]
Sample mean		0.17	0.77	0.24	64.93
Observations		1,796,899	1,796,899	1,388,628	1,388,628

Notes: Standard errors, clustered at MSA-level, shown in parentheses. * p<0.05, ** p<0.01. All regressions include MSA fixed effects, covariates (see table 2 for list), and a year dummy. The sample in panel A limited to loans with 0.2 ≤ *tract minority share* ≤ 0.4 and 0.90 ≥ *tract-to-MSA median income ratio* ≤ 1.2. The sample in Panel B is limited to applicants with 0.80 ≤ *tract-to-MSA median income ratio* ≤ 1.0 and *tract minority share* < 0.30. See data section for discussion of sample selection.

Table 9
Sensitivity
Special Affordable Goal: 2006-2007 data
Parameter Estimates (Standard Errors)

		D_i = **1**[*Borrower-to-MSA median income ratio*≤0.60]		D_i = **1**[*Borrower-to-MSA median income ratio*≤0.80]		D_i = **1**[*Tract-to-MSA median income ratio*≤0.80]	
Bandwidth	Order of polynomial	Originated	Purchased by GSE	Originated	Purchased by GSE	Originated	Purchased by GSE
		(1)	(2)	(3)	(4)	(5)	(6)
observations		1,020,245	620,416	355,092	193,241	356,919	204,960
Sample Mean		0.64	0.25	0.56	0.20	0.60	0.22
±0.05	2	-0.0110	0.0123*	-0.0188	0.0169	-0.0113	0.0078
		(0.0065)	(0.0054)	(0.0112)	(0.0086)	(0.0095)	(0.0078)
±0.05	3	-0.0141	0.0068	-0.0540	0.0260	-0.0045	0.0267
		(0.0144)	(0.0117)	(0.0278)	(0.0310)	(0.0187)	(0.0145)
±0.05	4	0.0415	-0.0409	-0.0550*	0.0255	0.0207	0.0706
		(0.0335)	(0.0347)	(0.0278)	(0.0312)	(0.0553)	(0.0488)
Observations		1,919,668	1,167,673	695,566	378,493	748,530	432,473
Sample mean		0.64	0.25	0.56	0.20	0.60	0.22
±0.10	2	-0.00121	0.0093**	-0.0024	0.0100*	0.0013	-0.0004
		(0.0031)	(0.0029)	(0.0061)	(0.0045)	(0.0054)	(0.0049)
±0.10	**3**	**-0.0107****	**0.0109***	**-0.0100**	**0.0105**	**-0.0108**	**0.0142**
		(0.0041)	**(0.0047)**	**(0.0083)**	**(0.0065)**	**(0.0084)**	**(0.0081)**
±0.10	4	-0.0169	0.0071	-0.0183	0.0083	-0.0113	0.0201
		(0.0090)	(0.0075)	(0.0139)	(0.0116)	(0.0158)	(0.0136)
Observations		3,485,785	2,117,630	1,401,918	758,681	1,456,738	846,233
Sample Mean		0.64	0.25	0.56	0.20	0.60	0.22
±0.20	2	-0.00185	0.0056**	0.0002	0.0042	-0.0002	-0.0031
		(0.0020)	(0.0020)	(0.0034)	(0.0029)	(0.0035)	(0.0025)
±0.20	3	-0.00166	0.0085**	-0.0027	0.0044	0.0011	-0.0018
		(0.0029)	(0.0027)	(0.0050)	(0.0045)	(0.0052)	(0.0041)
±0.20	4	-0.00321	0.0108**	-0.0037	0.0125*	-0.0033	0.0063
		(0.0040)	(0.0040)	(0.0074)	(0.0052)	(0.0066)	(0.0057)

Notes: Baseline Model in Bold. Standard errors, clustered at MSA-level, shown in parentheses. * p<0.05, ** p<0.01. All regressions include MSA fixed effects, covariates (see table 2 for list), and a year dummy. See data section for discussion of sample selection.

Table 10
Sensitivity
LMIG and UAG: 2006-2007 data
Parameter Estimates (Standard Errors)

		Low and Moderate Income Goal: D_i = **1**[*borrower-to-MSA median income ratio*≤1.0]		Underserved Areas Goal: D_i = **1**[*tract minority share*≥.3]		Underserved Areas Goal: D_i = **1**[*tract-to-MSA median income ratio*≤ 0.90]	
Bandwidth	Order of polynomial	Originated	Purchased by GSE	Originated	Purchased by GSE	Originated	Purchased by GSE
		(1)	(2)	(3)	(4)	(5)	(6)
observations		1,209,723	786,475	778,849	505,637	1,621,865	1,065,766
Sample Mean		0.65	0.23	0.65	0.23	0.66	0.23
±0.05	2	0.0119*	-0.0035	-0.0109	-0.0012	-0.0018	0.0047
		(0.0056)	(0.0047)	(0.0111)	(0.0096)	(0.0054)	(0.0053)
±0.05	3	0.0156	-0.0020	0.0306	0.0003	0.0066	-0.0058
		(0.0160)	(0.0030)	(0.0175)	(0.0231)	(0.0127)	(0.0112)
±0.05	4	-0.0144	-0.0011	0.183**	-0.0170	-0.0236	-0.0087
		(0.0448)	(0.0018)	(0.0631)	(0.0689)	(0.0391)	(0.0351)
Observations		2,321,160	1,509,045	2,321,160	958,325	2,992,215	1,973,216
Sample mean		0.65	-0.23	0.65	0.23	0.66	0.23
±0.10	2	0.0052	0.0096	0.00429	-0.0014	-0.0022	0.0018
		(0.0039)	(0.0097)	(0.0061)	(0.0072)	(0.0035)	(0.0032)
±0.10	**3**	**0.0078**	**-0.0022**	**0.00143**	**0.0026**	**-0.0091***	**0.0004**
		(0.0052)	**(0.0045)**	**(0.0100)**	**(0.0085)**	**(0.0046)**	**(0.0046)**
±0.10	4	0.0053	-0.0021	-0.00095	-0.0126	0.0105	0.0052
		(0.0101)	(0.0024)	(0.0143)	(0.0124)	(0.0076)	(0.0072)
Observations		4,798,779	3,116,619	3,366,055	2,227,224	5,177,688	3,435,589
Sample Mean		0.65	0.23	0.66	0.23	0.66	0.23
±0.20	2	0.0049*	-0.0106	-0.00027	-0.0006	-0.00423	0.0038
		(0.0024)	(0.0281)	(0.0053)	(0.0054)	(0.0025)	(0.0024)
±0.20	3	0.0073*	0.0032	0.00539	-0.0006	-0.0023	0.0030
		(0.0034)	(0.0083)	(0.0063)	(0.0072)	(0.0032)	(0.0031)
±0.20	4	0.0062	-0.0031	0.00416	0.0010	-0.0065	0.0009
		(0.0047)	(0.0037)	(0.0068)	(0.0074)	(0.0043)	(0.0042)

Notes: Baseline Model in Bold. Standard errors, clustered at MSA-level, shown in parentheses. * p<0.05, ** p<0.01. All regressions include MSA fixed effects, covariates (see table 2 for list), and a year dummy. See data section for discussion of sample selection.

Table 11
RD estimates from two-goal-interaction: 2006-2007 data
Parameter Estimates (Standard Errors)

	Denied	Originated	Purchased by GSE	High-price loan	Ln(Loan amount)
	(1)	(2)	(3)	(4)	(5)
A) LMIG 1.00 *borrower-to-MSA median income ratio* and UAG 0.30 *tract minority share* cutoffs					
Da= 1[*borrower-to-MSA median income ratio*≤1.0]	-0.0254	0.0100	0.0099	0.0466*	-0.0279
	(0.0196)	(0.0223)	(0.0197)	(0.0210)	(0.0440)
Db= 1[*tract minority share*≥.3]	-0.0452	0.0262	0.0187	0.0110	-0.0245
	(0.0328)	(0.0377)	(0.0286)	(0.0305)	(0.0572)
Da*Db	0.0469	-0.0246	-0.0297	-0.0174	0.0309
	(0.0343)	(0.0400)	(0.0282)	(0.0292)	(0.0578)
Sample mean	0.28	0.63	0.24	0.18	128.68
Observations	3,197,126	3,197,126	2,015,655	2,015,655	2,015,655
B) LMIG 1.00 *borrower-to-MSA median income ratio* and UAG 0.90 *tract-to-MSA median income ratio* cutoffs					
Da= 1[*borrower-to-MSA median income ratio*≤1.0]	0.0013	0.0061	0.0177	0.0028	0.0035
	(0.0106)	(0.0110)	(0.0103)	(0.0103)	(0.0236)
Dc= 1[*tract-to-MSA median income ratio*≤0.90]	0.0122	-0.0055	0.0119	0.0003	-0.0151
	(0.0106)	(0.0114)	(0.0113)	(0.0124)	(0.0271)
Da*Dc	-0.0059	0.0014	-0.0156	0.0072	-0.0045
	(0.0126)	(0.0128)	(0.0123)	(0.0135)	(0.0293)
Sample mean	0.30	0.61	0.23	0.20	106.46
Observations	5,681,984	5,681,984	3,545,870	3,545,870	3,545,870

Notes: Standard errors, clustered at MSA-level, shown in parentheses. * p<0.05, ** p<0.01. All regressions include MSA fixed effects, covariates (see table 2 for list), and a year dummy. The sample in panel A is limited to applicants with *tract minority share* < 0.30, *borrower-to-MSA median income ratio* ≤ 1.20, and *tract-to-MSA median income ratio* ≤ 1.10. Additionally, observations are dropped if *borrower-to-MSA median income ratio* < 0.80 *and tract-to-MSA median income ratio* ≤ 0.70. The sample in panel B is limited to applicants with 0.90 ≤ *tract-to-MSA median income ratio* ≤ 1.20, *borrower-to-MSA median income ratio* ≤ 1.20, and *tract minority share* < 0.50. Additionally, observations are dropped if *tract minority share* < 0.10 and *borrower-to-MSA median income ratio* ≤ 0.80. See data section for discussion of sample selection.

Table 12
Housing Outcomes: 2004-2008 Census Tract Level Data
Parameter Estimates (Standard Errors)

ln(# Applications	ln(# Originated Loans)	ln(# Loans Purchased by GSEs)	ln(# Applications for Investment Properties)	ln(#Originated Loans for Investment Properties)	ln(# Foreclosures, 2007-2008)	ln(# Vacancies June, 2008)	Unemploy-ment Rate June, 2008	ln(# High-price Loans HMDA)	ln(# High-price Loans HUD, 2004-2006)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A) Special Affordable Goal: D_i = **1**[*Tract-to-MSA median income ratio*≤0.8]									
-0.0308	-0.0472	0.0323	-0.0284	-0.0331	-0.0862*	-0.00694	0.00106	-0.00402	-0.0800
(0.0421)	(0.0465)	(0.0626)	(0.0735)	(0.0740)	(0.0419)	(0.0890)	(0.00127)	(0.0682)	(0.0442)
B) Underserved Areas Goal: D_i = **1**[*tract minority share*≥.3]									
0.0014	0.0102	-0.0151	0.1720	0.167	-0.0771	0.140	-0.0008	-0.0124	-0.0815
(0.0564)	(0.0636)	(0.0727)	(0.112)	(0.115)	(0.0666)	(0.194)	(0.0012)	(0.0613)	(0.0670)
C) Underserved Areas Goal: D_i = **1**[*tract-to-MSA median income ratio*≤ 0.90]									
0.00244	-0.00857	-0.0167	-0.0520	-0.0362	0.0315	0.0457	-0.000189	0.00904	0.0275
(0.0269)	(0.0295)	(0.0401)	(0.0607)	(0.0608)	(0.0429)	(0.106)	(0.00108)	(0.0450)	(0.0426)

Notes: Standard errors, clustered at MSA-level, shown in parentheses. * p<0.05, ** p<0.01. Dependent variables in columns 1-5, 9 are from 2006-2007 HMDA Data. Dependent variables in columns 6-8, 10 are from HUD's neighborhood stabilization data. All egressions include MSA fixed effects, covariates (see table 2 for list.) The sample in panel A is limited to census tracts with 0.2 ≤ *tract minority share* ≤ 0.4 and 0.90≥ *tract-to-MSA median income ratio* ≤ 1.2. The sample size for regressions in panel A is 3,382. The sample in Panel B is limited to census tracts with 0.8 ≤ *tract-to-MSA median income ratio* ≤ 1.0 and *tract minority share* < 0.30. The sample size for regressions in panel B is 8,324. See data section for discussion of sample selection.

Table A1
Sensitivity
Special Affordable Goal: 1996-1997 data
Parameter Estimates (Standard Errors)

		D_i = **1**[*Borrower-to-MSA median income ratio*≤0.60]		D_i = **1**[*Borrower-to-MSA median income ratio*≤0.80]		D_i = **1**[*Tract-to-MSA median income ratio*≤0.80]	
Bandwidth	Order of polynomial	Originated	Purchased by GSE	Originated	Purchased by GSE	Originated	Purchased by GSE
		(1)	(2)	(3)	(4)	(5)	(6)
observations		454,225	330,356	101,622	67,796	134,199	93,476
Sample Mean		0.73	0.26	0.67	0.21	0.70	0.23
±0.05	2	0.0040	-0.0010	-0.0176	-0.0021	-0.0096	0.0190
		(0.0068)	(0.0071)	(0.0119)	(0.0140)	(0.0137)	(0.0134)
±0.05	3	0.0012	-0.0077	-0.0035	-0.0655*	-0.0033	0.0181
		(0.0153)	(0.0159)	(0.0270)	(0.0265)	(0.0274)	(0.0278)
±0.05	4	0.0111	-0.0627	0.0029	-0.0336	-0.0313	0.1100
		(0.0479)	(0.0831)	(0.1042)	(0.0849)	(0.0880)	(0.0929)
Observations		866,108	629,748	199,680	133,360	282,548	198,789
Sample mean		0.73	0.26	0.67	0.21	0.70	0.23
±0.10	2	-0.0024	0.0057	0.0018	-0.0071	-0.0078	-0.0010
		(0.0037)	(0.0039)	(0.0073)	(0.0076)	(0.0086)	(0.0098)
±0.10	**3**	**0.0039**	**0.0003**	**-0.0147**	**-0.0033**	**-0.0080**	**0.0067**
		(0.0058)	**(0.0064)**	**(0.0119)**	**(0.0130)**	**(0.0154)**	**(0.0135)**
±0.10	4	0.0073	-0.0032	-0.0380	-0.0209	-0.0025	0.0407
		(0.0100)	(0.0098)	(0.0215)	(0.0232)	(0.0222)	(0.0216)
Observations		1,580,877	1,148,953	408,229	271,070	550,788	390,992
Sample Mean		0.73	0.26	0.67	0.21	0.70	0.23
±0.20	2	-0.0015	0.0023	-0.0010	-0.0012	-0.0005	-0.0002
		(0.0031)	(0.0028)	(0.0061)	(0.0044)	(0.0060)	(0.0058)
±0.20	3	-0.0002	0.0045	-0.0049	-0.0051	-0.0048	0.0051
		(0.0037)	(0.0041)	(0.0079)	(0.0066)	(0.0080)	(0.0077)
±0.20	4	-0.0017	0.0031	-0.0001	-0.0047	-0.0064	-0.0004
		(0.0050)	(0.0051)	(0.0089)	(0.0094)	(0.0116)	(0.0113)

Notes: Baseline Model in Bold. Standard errors, clustered at MSA-level, shown in parentheses. * p<0.05, ** p<0.01. All regressions include MSA fixed effects, covariates (see table 2 for list), and a year dummy. See data section for discussion of sample selection.

Table A2
Sensitivity
LMIG and UAG: 1996-1997 data
Parameter Estimates (Standard Errors)

		Low and Moderate Income Goal: D_i = **1**[*borrower-to-MSA median income ratio*≤1.0]		Underserved Areas Goal: D_i = **1**[*tract minority share*≥.3]		Underserved Areas Goal: D_i = **1**[*tract-to-MSA median income ratio*≤ 0.90]	
Bandwidth	Order of polynomial	Originated	Purchased by GSE	Originated	Purchased by GSE	Originated	Purchased by GSE
		(1)	(2)	(3)	(4)	(5)	(6)
observations		610,417	482,397	209,843	153,649	951,538	733,755
Sample Mean		0.79	0.30	0.73	0.29	0.77	0.24
±0.05	2	-0.0063	-0.0003	-0.0319	-0.0292	-0.0048	0.0014
		(0.0055)	(0.0075)	(0.0233)	(0.0219)	(0.0068)	(0.0084)
±0.05	3	0.0087	0.0015	-0.0457	-0.1120*	-0.0119	0.0136
		(0.0108)	(0.0042)	(0.0471)	(0.0475)	(0.0153)	(0.0193)
±0.05	4	0.0388	0.0009	0.0089	-0.1530	0.0193	0.0348
		(0.0422)	(0.0021)	(0.1350)	(0.1200)	(0.0653)	(0.0629)
Observations		1,162,442	917,394	440,205	324,602	1,796,899	1,388,628
Sample mean		0.79	0.30	0.74	0.29	0.77	0.24
±0.10	2	-0.0019	0.0104	-0.0153	-0.0110	-0.0039	0.0136
		(0.0028)	(0.0156)	(0.0140)	(0.0126)	(0.0041)	(0.0193)
±0.10	**3**	**-0.0010**	**-0.0026**	**-0.0327**	**-0.0344**	**-0.0107**	**-0.0061**
		(0.0047)	**(0.0072)**	**(0.0247)**	**(0.0205)**	**(0.0068)**	**(0.0077)**
±0.10	4	-0.0067	0.0018	-0.0608	-0.0658	-0.0099	0.0031
		(0.0091)	(0.0036)	(0.0399)	(0.0352)	(0.0097)	(0.0129)
Observations		2,391,540	1,882,079	1,109,264	836,846	3,134,819	2,441,983
Sample Mean		0.79	0.30	0.75	0.29	0.78	0.25
±0.20	2	-0.0003	0.0708	-0.0119	-0.0062	-0.0038	-0.0001
		(0.0018)	(0.0567)	(0.0085)	(0.0067)	(0.0037)	(0.0035)
±0.20	3	0.0000	0.0041	-0.0151	-0.0080	-0.0057	0.0013
		(0.0027)	(0.0116)	(0.0145)	(0.0116)	(0.0042)	(0.0051)
±0.20	4	-0.0028	-0.0013	-0.0257	-0.0155	-0.0062	0.0008
		(0.0036)	(0.0054)	(0.0208)	(0.0164)	(0.0057)	(0.0070)

Notes: Baseline Model in Bold. Standard errors, clustered at MSA-level, shown in parentheses. * p<0.05, ** p<0.01. All regressions include MSA fixed effects, covariates (see table 2 for list), and a year dummy. See data section for discussion of sample selection.

Table A3
Census Tract Level Outcomes: 1996-1997 Data
Parameter Estimates (Standard Errors)

Ln(# applications)	ln(# Originated Loans)	ln(# Loans Purchased by GSEs)	ln(# Applications for Investment Properties)	ln(#Originated Loans for Investment Properties)
(1)	(2)	(3)	(4)	(5)
A) Special Affordable Goal: D_i = **1**[*Tract-to-MSA median income ratio*≤0.80]				
-0.113*	-0.0873	-0.0204	0.0563	0.170*
(0.0567)	(0.0563)	(0.0810)	(0.0718)	(0.0813)
B) Underserved Areas Goal: D_i = **1**[*tract minority share*≥.30]				
-0.0271	-0.0467	-0.0746	-0.1460	-0.2020
(0.1160)	(0.1160)	(0.1330)	(0.1490)	(0.1450)
C) Underserved Areas Goal: D_i = **1**[*Tract-to-MSA median income ratio*≤0.90]				
0.0229	0.0249	0.0220	0.0697	0.0557
(0.0376)	(0.0408)	(0.0501)	(0.0703)	(0.0745)

Notes: Standard errors, clustered at MSA-level, shown in parentheses. * p<0.05, ** p<0.01. All regressions include MSA fixed effects, covariates (see table 2 for list.) The sample in panel A is limited to census tracts with 0.2 ≤ *tract minority share* ≤ 0.4 and 0.90 ≥ *tract-to-MSA median income ratio* ≤ 1.2. The sample size for regressions in panel A is 2,330. The sample in Panel B is limited to census tracts with 0.80 ≤ *tract-to-MSA median income ratio* ≤ 1.0 and *tract minority share* < 0.30. The sample size for regressions in panel B is 8,390. See data section for discussion of sample selection.