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## *GSE Loan Purchases, the FHA, and Housing Outcomes in Targeted, Low-Income Neighborhoods*

RECENT YEARS HAVE witnessed ongoing research and policy debate regarding the effects on lower-income and underserved housing markets of the affordable housing goals set by government-sponsored enterprises (GSEs). While the GSEs were established to provide liquidity to mortgage markets and to mitigate severe cyclical fluctuations in housing, those entities are intended as well to support the provision of mortgage credit and the attainment of homeownership in lower-income and minority communities. Indeed, federal regulators have devoted much attention of late to the performance of Fannie Mae and Freddie Mac in promoting the flow of funds to, and hence the widespread availability of mortgage credit among, targeted and underserved communities.<sup>1</sup>

1. The secondary mortgage market derived largely from a recognized need to reduce the nonprice rationing of mortgage credit. Further, federal regulators sought to redistribute loanable funds geographically from areas of excess savings to areas of excess demand for those funds. Accordingly, academic research and policy analysis has focused largely on whether the increased liquidity and implicit federal guarantee associated with GSE operations have influenced the stability of mortgage market operations and the pricing of mortgages. Ambrose and Warga (1996) show that the GSEs have a cost of funds advantage over banking and other financial institutions on the order of 75 basis points. Hendershott and Shilling (1989) and Cotterman and Pearce (1996) compare the mortgage rates on conforming loans, which the GSEs can purchase, and jumbo loans, which the GSEs cannot, and show that the presence of the GSEs is associated with a 25 to 40 basis point reduction in interest rates. Other researchers argue that the GSEs have had at best a limited beneficial impact on mortgage pricing. For example, Passmore, Sherlund, and Burgess (2005) estimate that the GSEs reduce interest rates only on the order of 7 basis points. See also Heuson, Passmore, and Sparks (2001).

The Federal Housing Enterprise Financial Safety and Soundness Act of 1992 (GSE act) raised the level of support that the GSEs are required to provide to lower-income and minority communities and authorized the secretary of the Department of Housing and Urban Development (HUD) to establish “affordable housing goals” for the GSEs.<sup>2</sup> According to those goals, a defined proportion of each GSE’s annual loan purchases must derive from the following:

- Lower-income borrowers (the “low-moderate-income” goal),
- Borrowers residing in lower-income communities and borrowers in certain “high-minority” neighborhoods (jointly, the “geographically targeted” or “underserved areas” goal), and
- Very low-income borrowers and low-income borrowers living in low-income areas (the “special affordable” goal).

The GSE act defines lower-income borrowers (for purposes of the low-moderate-income goal) as those having incomes less than the metropolitan area median income. Under the geographically targeted goal, lower-income neighborhoods are defined as those having median incomes less than 90 percent of the area median income, and high-minority neighborhoods are defined as those having a minority population that is at least 30 percent of the total population and a median income of less than 120 percent of the area median. For the special affordable goal, very low-income borrowers are those with incomes of less than 60 percent of the area median income. The special affordable goal also includes borrowers living in low-income areas with incomes less than 80 percent of the area median income.

The goals specify a required percentage of GSE loan purchases in each category. The specific percentages are adjusted periodically, as market conditions shift. The most recent HUD rules, set in November 2004 for purchase activity from 2005 through 2008, established the low-moderate-income goal in a range from 52 to 56 percent of total GSE purchases, the geographically targeted goal in a range from 37 to 39 percent, and the special affordable goal in a range from 22 to 27 percent.<sup>3</sup> These categories are not mutually exclusive, so a single loan purchase can count toward multiple goals. Table 1 indicates how the HUD-specified affordable housing goal loan-purchase thresholds for the housing GSEs have evolved over time.

In this paper, we seek to determine whether the GSE mortgage-purchase goals are associated with improved housing conditions and homeownership

2. This additional responsibility was added in part because of a belief that returns to GSE shareholders benefited from the federal line of credit available to the GSEs.

3. HUD (2004).

**Table 1. HUD-Specified Affordable Housing Loan Purchase Goals<sup>a</sup>**

Percent

<i>Period</i>	<i>Low- and moderate-income goal</i>	<i>Underserved neighborhoods goal<sup>b</sup></i>	<i>Special affordable goal</i>
1994-95	30	30	In dollar amount
1996	40	21	12
1997-2000	42	24	14
2001-04	50	31	20
2005-08	52-56	37-39	22-27

Source: Department of Housing and Urban Development (1995, 2000, 2004).

a. All figures are percentages of the total number of units associated with the mortgages purchased by each GSE.

b. During 1994 and 1995, the definition of underserved neighborhoods was different from the current definition. The percentage thresholds for 1996-2000 were published on December 1, 1995, those for 2001-03 were published on October 31, 2000, and those for 2005-08 were published on November 2, 2004. According to HUD, the increase in the underserved neighborhoods goal from 31 percent in 2001-04 to 37 percent in 2005-08 largely reflects adjustments in the 2000 census data, whereby the 2001-04 goal of 31 percent would have been equivalent to 36 percent under the current definition. HUD used the 1990 census data to create housing goals prior to 2005 and used the 2000 census data to create goals for 2005-08.

attainment among targeted communities that are the focus of the GSE act and the HUD affordable housing goals. More generally, we seek to assess the effects of the GSE mortgage-purchase goals on the geographic distribution of GSE mortgage-purchase activity and to evaluate whether GSE mortgage purchases are associated with improved housing outcomes. This is done using a standard ordinary least squares framework as well as a two-stage least squares framework that accounts for potential endogeneity issues. Finally, the analysis seeks to corroborate whether the credit quality and performance of FHA-insured home mortgages deteriorated subsequent to enactment of the GSE mortgage-purchase goals. Such deterioration in the credit composition and performance of the FHA-insured mortgage pool could result from improved outreach and lending to underserved, lower-income, and minority borrowers on the part of conforming lenders, consistent with the objectives of the GSE affordable housing goals for home-loan purchases.

In the first test, we find that, after accounting for the endogeneity of GSE loan-purchase activity, the GSEs appear to increase their purchase intensity significantly in neighborhoods targeted by the GSE affordable goals, and there are significant GSE-related effects on local housing outcomes. Increases in GSE purchase intensity are associated with declines in neighborhood vacancy rates and increases in median home values, both of which might be interpreted as neighborhood improvements. For the second test, we observe significant deterioration in the average credit quality of FHA-insured borrowers after 1996. Further, Cox partial likelihood estimates of a proportional hazard model indicate elevated rates of prepayment among FHA-insured loans in GSE-targeted

tracts. Both findings are consistent with the notion that FHA borrowers in targeted tracts have improved access to less expensive conventional, conforming loans, perhaps owing to enhanced outreach on the part of conventional lenders.

The paper is organized as follows. The following section reviews the literature and provides some basic background on the topic. The second section provides a brief overview of the empirical analyses, while the third and fourth sections describe the two tests and detail the results. A final section provides concluding remarks.

## **Background**

In recent years, a sizable literature has examined the success of the GSEs in meeting the broad objectives of the GSE act. Bunce and Scheessele examine GSE purchase activity using data collected pursuant to the Home Mortgage Disclosure Act and find that the "shares of the GSEs' business going to lower-income borrowers and underserved neighborhoods typically fall short of the corresponding shares of other market participants."<sup>4</sup> Other researchers, including Manchester, Neal, and Bunce, Bunce, and Case, Gillen, and Wachter, have reached similar conclusions.<sup>5</sup> Of these, Case, Gillen, and Wachter use a different approach.<sup>6</sup> They augment the Home Mortgage Disclosure Act data with HUD public use database information on GSE purchases and compare the distribution of purchases to the distribution of mortgage originations. Looking at forty-four metropolitan areas between 1993 and 1996, they find that the GSEs are less likely to purchase loans extended to lower-income borrowers, minority borrowers, borrowers in lower-income neighborhoods, and borrowers in central cities.

Taking a different approach, Canner, Passmore, and Surette examine loans eligible for insurance under the Federal Housing Administration (FHA) rules and evaluate how the risk associated with those loans is distributed among four classes of institutions: government mortgage institutions, private mortgage insurers, the GSEs, and banking institutions that hold loans in their portfolio.<sup>7</sup> The results indicate that the FHA bears the largest share of risk associated with FHA-eligible lending to lower-income and minority populations, with the

4. Bunce and Scheessele (1996, p. 3).

5. Manchester, Neal, and Bunce (1998); Bunce (2002); Case, Gillen, and Wachter (2002).

6. Case, Gillen, and Wachter (2002).

7. Canner, Passmore, and Surette (1996).

GSEs lagging far behind. These findings are consistent with the discussed studies and further motivate our assessment of the effects of the GSE housing affordability goals on credit quality, composition, and performance of the FHA-insured loan pool.

However, other research has shown that the GSEs have responded to the affordable housing goals by enhancing their product offerings so as to facilitate more purchases of loans from targeted communities.<sup>8</sup> These new products often feature underwriting criteria that depart from industry norms and allow for higher risks. Moreover, Bunce and Scheessele, Bunce, and others have shown that, in the years following enactment of the GSE act, the GSEs have increased the proportion of loan purchases from targeted populations.<sup>9</sup> For example, between 1992 and 1995, Fannie Mae doubled the share of loan purchases from lower-income borrowers, and Freddie Mac increased its share by about 50 percent. Manchester documents considerable GSE improvement in loan purchases among lower-income and targeted communities.<sup>10</sup> In 1995 Fannie Mae and Freddie Mac both surpassed the affordable housing goals established by HUD. Overall, the emergent literature suggests that the GSEs have been among the players important in enhancing lower-income and minority access to mortgage credit. By some measures, the GSEs have been relatively small players. Nonetheless, since passage of the GSE act, their performance appears to have improved significantly.

The GSEs, however, might have enhanced their mortgage market functions and support of lower-income and minority communities independent of their direct loan-purchase activity. For example, Harrison and others focus on whether the GSEs reduce the prevalence of adverse informational externalities in mortgage lending markets.<sup>11</sup> Information externalities are potentially an important factor in the provision of mortgages to lower-income and minority communities because these areas often have a low volume of transactions (that is, they are thin markets), a characteristic shown to be negatively associated with the probability of mortgage loan approval.<sup>12</sup> If the GSEs help to elevate

8. See, for example, Listokin and Wyly (2000); Temkin, Quercia, and Galster (2001).

9. Bunce and Scheessele (1996); Bunce (2002).

10. Manchester (1998).

11. Harrison and others (2002).

12. Lang and Nakamura (1993) develop a model of mortgage lending that shows that, because of higher uncertainty, mortgage applications for properties located in neighborhoods with thin markets will be deemed riskier than applications from neighborhoods with high transaction volumes ("thick markets"). Many studies have since found empirical evidence in support of the theory, including Harrison (2001), Calem (1996), and Ling and Wachter (1998).

the number of transactions in thin markets, they can enhance the prospects for homeownership among individuals in lower-income and minority communities, regardless of whether the mortgage is subsequently purchased by a GSE or not. The authors find that the GSEs in general, and Fannie Mae in particular, do indeed help to increase the number of transactions in thin markets in Florida and thus help to mitigate the effects of adverse informational externalities.

In a related study, Myers examines the effects of GSE activity on loan origination.<sup>13</sup> He argues that lenders have a greater incentive to approve those loans most likely to be purchased by the GSEs, because increased liquidity is realized only if the GSEs purchase the originated loans. Myers specifically tests whether primary market lenders favor higher-income borrowers, white borrowers, borrowers in higher-income neighborhoods, and borrowers in the suburbs, since these populations have been shown to receive considerable GSE support. While Myers does find that loans with a lower probability of being sold to the GSEs have a lower likelihood of being approved overall, he does not find support for this incentive-based explanation in analyses of racial disparities in mortgage approvals. Findings from Ambrose and Thibodeau suggest that the affordable housing goals had a limited effect on the overall supply of mortgage credit to targeted groups in the largest 308 metropolitan statistical areas (MSAs) during 1995 and 1999.<sup>14</sup> Finally, Freeman and Galster similarly focus on housing market effects by looking at underserved neighborhoods in Cleveland between 1993 and 1999.<sup>15</sup> They find no links between secondary market activities, by the GSEs or others, and sales prices in these neighborhoods and only a limited relationship between secondary market activities and volume of sales.

A portion of the current research focuses on whether and how GSE mortgage loan-purchase activity changes housing conditions and homeownership attainment among communities that are the focus of the GSE act and the affordable housing goals set by HUD. In this regard, this part of the study builds on a recent paper by Bostic and Gabriel, which focuses on such trends in California.<sup>16</sup> In that work, the authors find little evidence of a GSE effect associated with the affordable housing goal incentives. An and Bostic argue that such a finding need not imply that the affordable housing goals are ineffective.<sup>17</sup>

13. Myers (2002).

14. Ambrose and Thibodeau (2004).

15. Freeman and Galster (2004).

16. Bostic and Gabriel (2006).

17. An and Bostic (forthcoming).

Rather, they posit that any observed effects are likely to involve compositional changes between conventional conforming and higher-risk loan portfolios, with high-quality, higher-risk borrowers benefiting by shifting from higher-cost loans to less expensive conventional conforming loans. An and Bostic then present evidence for the FHA suggesting that such substitution has taken place.<sup>18</sup> Given the range of findings on this issue, further research is warranted.

## **Empirical Overview**

The remainder of the paper describes the results of two new tests of whether and how GSE mortgage-loan purchases significantly influence housing markets. Both tests seek to establish whether GSE purchases exert a positive force on the marketplace that results in welfare gains. The first test focuses on their relationship to outcomes in targeted, lower-income neighborhoods. The second test examines their influence on the performance of the portfolio of loans originated with insurance from the Federal Housing Administration. This research is described and summarized in the following two sections.

### **Test 1: The Affordable Housing Goals and Housing Market Outcomes**

We evaluate the impact of the affordable housing goals on housing market outcomes by exploiting variation in the rules governing the GSE act and those governing the banking-oriented Community Reinvestment Act (CRA) of 1977. The CRA directs the federal banking regulatory agencies to encourage federally insured banking institutions to assist in meeting the credit needs of all communities in their service areas, including lower-income areas, while maintaining safe and sound operations.<sup>19</sup> In the context of federal bank examinations, regulators are directed to assess the institution's record of meeting the credit needs of all communities in their service area and to consider the institution's CRA performance when assessing an application for merger, acquisition, or other structural change.

18. An and Bostic (forthcoming).

19. The Community Reinvestment Act derived, in part, from concerns that banking institutions were engaged in "redlining," a practice by which lenders fail to seek out credit-granting opportunities in minority or lower-income neighborhoods. The resultant lack of available capital, it was argued, held back the economic development of those communities. The federal regulatory agencies that are the CRA's focus are the Board of Governors of the Federal Reserve System, the Office of the Comptroller of the Currency, the Federal Deposit Insurance Corporation, and the Office of Thrift Supervision.

CRA examinations of banking institutions scrutinize the geographic distribution of lending activities. Among other tests, these examinations compare the proportion of loans extended within the institution's CRA assessment area to the proportion of loans extended outside its assessment area and the distribution of loans within the institution's CRA assessment area across neighborhoods with differing incomes, with lending in lower-income neighborhoods receiving particular weight.<sup>20</sup> Here, lower-income neighborhoods are defined as those (census tracts) that have a median family income of less than 80 percent of the median family income of the metropolitan area in which the census tract is located.<sup>21</sup>

Thus the CRA's regulatory threshold for defining lower-income neighborhoods (80 percent) differs from the 90 percent threshold used for the GSE geographically targeted loan-purchase goal under the GSE act. It is clear, then, that a subset of neighborhoods—those with median incomes between 80 and 90 percent of the area median income—is the focus of GSE, but not of banking institution regulation. We thus can use changes in measures of neighborhood and housing market activity in this latter set of census tracts, compared to changes in similar census tracts not covered by GSE regulation, as an indication of the impact of GSE loan-purchase activities driven by the affordable housing goals. This is a direct and relatively powerful test of the effects of GSE loan-purchase goals on local housing markets.

The form of the empirical test follows the work of Avery, Calem, and Canner as well as that of Bostic and Gabriel, who conduct similar analyses of the impact of the CRA and the GSE affordable housing goals on local communities.<sup>22</sup> As in those studies, the challenge is to establish the counter-

20. Banking institutions specify their CRA assessment area, a geographic area that corresponds roughly to the areas where the institution operates branches and where it does considerable lending, in order to facilitate CRA performance evaluations. CRA assessment areas must be approved by the federal regulatory agencies. The CRA regulations also require that examiners evaluate the distribution of loans within their assessment area across borrowers of different economic standing. For more information on the regulations implementing the CRA, see Board of Governors of the Federal Reserve System (2000).

21. Federal Reserve System (1990). There is considerable evidence indicating that banking institutions have responded to the CRA by increasing the resources and lending directed to lower-income areas within their assessment areas. Avery, Bostic, and Canner (2005), for example, show a limited increase in the percentage of institutions engaged in community lending activities because of the CRA. As another example, Schwartz (1998) and Bostic and Robinson (2003, 2004) examine the effects of CRA agreements, which are pledges lenders make to extend specified volumes of lending to targeted communities, and find evidence suggesting increased levels of lending on the part of banks.

22. Avery, Calem, and Canner (2003); Bostic and Gabriel (2006).



factual of local housing market activity in the absence of GSE loan-purchase activity. While it is relatively straightforward to identify the treatment group (census tracts with median incomes between 80 and 90 percent of the area median), there are no census tracts in the same median income range that do not receive regulatory treatment by either the banking institutions or the GSEs. As in the studies by Avery, Calem, and Canner and by Bostic and Gabriel, we address this challenge by identifying a control group as close as possible to the treatment group.<sup>23</sup>

The analysis here uses the lower-income threshold as defined by the GSE act as the key cutoff. Accordingly, our study focuses on the 90 percent threshold that defines the marginal impact of the GSE regulations alone. We compare outcomes among tracts distributed around the established threshold and use a range of 10 percentage points (80–90 percent versus 90–100 percent of area median income). The key outcomes of interest are changes in three indicators of the local housing market: the homeownership rate, the vacancy rate, and the median home value.

A key advantage of our approach is its simplicity. Because the tracts in the control and treatment groups are located in the same metropolitan areas and often are in close proximity to each other, they face many of the same economic and demographic forces that influence metropolitan housing markets. This obviates the need to control for many factors, including technology, metropolitan area economic performance, and new mortgage and other lending practices, since the influence is likely to be nearly identical within the treatment and control groups. That noted, demographic, economic, and housing-related controls are still needed because trends in the homeownership rate, vacancy rate, and median home values are influenced by factors beyond GSE activity and because the relationship between GSE activity and changes in housing market conditions might also be affected by these factors.

These controls include the share of youth, elderly, and minority populations, average household size, percentage of all units in the tract that are single-family units and that are owner-occupied, unemployment rate, central city location, and the like. Further, as appropriate, we control for variations across tracts in nominal housing affordability and in the growth rate of home prices,

23. In the Avery, Calem, and Canner (2003) study, the control group is the set of census tracts just above the lower-income neighborhood threshold as defined by the CRA regulations, under the reasoning that these tracts could be CRA-eligible with only a slight change in their populace.

with the latter being a proxy for expected homeownership capital gains, a primary component of the user costs of homeownership.<sup>24</sup> Finally, we control for variability across MSAs in housing supply elasticities.

The analysis further seeks to establish whether GSE attention to the low-moderate-income and special affordable goals is associated with improved housing market outcomes. Our interest is to test whether changes in neighborhood housing conditions are sensitive to the incentive structure established by the HUD affordable housing goals, from which we draw conclusions as to whether GSE activity has had a significant positive effect on neighborhood housing markets. Further, we evaluate the robustness of estimated findings across disparate local housing markets.

For purposes of our analyses, a key variable is the intensity of GSE activity in a particular census tract, defined as the proportion of mortgage loans in a tract purchased by the GSEs. This metric reflects the relative penetration of GSE activity in a neighborhood, which is one measure of the importance of GSE activity for the flow of mortgage capital to a neighborhood. This measure reflects the objective of the affordable housing goals, which is to increase the GSE presence and influence in the mortgage markets of underserved neighborhoods and populations.<sup>25</sup>

One concern regarding the use of GSE purchase intensity is that it might be endogenous. That is, GSE loan-purchase intensity might be a function of housing market trends rather than the other way around. For example, it is entirely plausible that the GSEs might shift their purchase activity to those neighborhoods showing the largest increases in homeownership or home prices. To address the potential endogeneity of GSE intensity, we also estimate the relationships of interest using a two-stage least squares approach.

In the first-stage equation, we estimate models of GSE purchase intensity using the tract-level characteristics and housing market conditions at the beginning of the sample period. That equation also controls for the effects of the GSE affordable housing goals. We then use this model to generate fitted values of predicted GSE intensity that are then used as regressors in the second-stage estimates of the relationships associated with changes in three housing market conditions: the homeownership rate, the vacancy rate,

24. See table A-1 in the appendix for variable definitions.

25. GSE intensity is preferred to variables such as the number of purchased loans in a tract because it is a better comparative measure of relative influence. Some tracts might have large objective numbers of GSE purchases, yet relatively small GSE intensities because of very large numbers of nonpurchased loans as well.

**Table 2. GSE Purchase Intensity of Home Purchase Loans, by Tract Characteristics<sup>a</sup>**

<i>Tract characteristic</i>	1995	1996	1997	1998	1999	2000	<i>1995–2000 average</i>
<i>All tracts</i>	0.276	0.248	0.240	0.287	0.252	0.272	0.264
<i>Relative to median income</i>							
120 percent or more	0.360	0.329	0.329	0.389	0.331	0.348	0.348
100–120 percent	0.304	0.278	0.276	0.332	0.290	0.306	0.298
90–100 percent	0.270	0.243	0.240	0.289	0.255	0.271	0.262
80–90 percent	0.244	0.217	0.207	0.246	0.227	0.247	0.232
Less than 80 percent	0.203	0.174	0.152	0.185	0.167	0.196	0.181
<i>Percentage minority</i>							
Minority less than 30	0.295	0.270	0.269	0.324	0.283	0.298	0.291
Minority over 30 percent	0.230	0.195	0.168	0.196	0.175	0.209	0.197
Total number of tracts							37,545

Source: Authors' calculations, based on Home Mortgage Disclosure Act data.

a. These are means of GSE purchase intensities by specific tract characteristics. Tract relative income is defined as census tract median family income divided by MSA median. GSE purchase intensity is defined as the number of conforming loans purchased by either of the two housing GSEs (Fannie Mae and Freddie Mac) divided by the total number of conforming loans originated in each census tract.

and the median home value. We include both the predicted level of GSE intensity as well as the predicted change in GSE intensity as regressors in this second-stage estimation.

#### *Summary Information on GSE Loan-Purchase Activity*

Table 2 contains annual information on GSE home loan-purchase activity drawn from data collected via the Home Mortgage Disclosure Act. The unit of observation is the census tract; our sample here includes all MSA tracts in the United States. For all sampled tracts, GSE purchase intensity fluctuates modestly between 1995 and 2000 in the range of 24 to 29 percent. However, little trend is indicated, as the 2000 ratio at 27 percent is close to that of 1995. As would be expected, GSE purchase intensity varies markedly across tracts stratified by income and minority status. Indeed, loan-purchase intensity declines monotonically with tract median income, from about 35 percent for tracts with median income at 120 percent or greater than the MSA average to about 18 percent among tracts at less than 80 percent of MSA median income. Similarly, little trend is indicated over time in those purchase ratios; indeed, for each tract income category, purchase intensity in 2000 is close to that in 1995. Finally, purchase intensities among tracts with minority populations of less than 30 percent, at about 30 percent, are significantly elevated relative to the approximate 20 percent purchase ratio evidenced among tracts with more elevated minority populations.

*Data and the Sample*

The study uses data from the 1990s to assess the effects of GSE home loan-purchase activity on local housing market outcomes.<sup>26</sup> Annual GSE home loan-purchase activity from 1995 to 2000 is measured using data collected via the Home Mortgage Disclosure Act. Housing market conditions as well as control variables within a census tract are compiled using the 1990 and 2000 censuses. With these data, we are able to establish initial conditions in a neighborhood and to measure how those conditions changed over the decade. These data also allow us to identify those tracts that rank highly as regards the low-moderate-income borrower and “special affordable” housing goals. Definitions of all variables are contained in table A-1 in the appendix.

In accordance with the identification strategy described above, the analysis is restricted to U.S. metropolitan area census tracts with median family incomes between 80 and 100 percent of the area median family income. The final sample includes 7,602 census tracts.<sup>27</sup> Table 3 presents summary information on the estimation sample as a whole as well as on subgroups of tracts on either side of the 90 percent GSE eligibility threshold. Also included is summary information on the universe of all MSA tracts in the United States. Tract-level data are included from both the 1990 and 2000 censuses.

The first column in table 3 includes tracts from all income ranges. The second to fourth columns contain tracts with a minority population of less than 30 percent of the tract’s population and a median family income of 80–100 percent, 90–100 percent, and 80–90 percent of the MSA median, respectively.<sup>28</sup> The GSE affordable housing goals’ geographic target is defined as census

26. While changes in housing market conditions at the level of the census tract are measured for the period between the decennial censuses of 1990 and 2000, the GSE act was not passed until 1992. However, federal legislation rarely occurs without broad debate, and in that regard it is plausible to assume that the GSEs were aware of likely provisions in advance of passage of the legislation. If true, then prior to the act’s passage, the GSEs might have internalized a number of its incentives, which would suggest a behavioral response earlier in the decade. Further, California experienced a deep recession in the early 1990s, with house prices tumbling by upward of 15 percent. The state’s economy started to regain its footing only in 1993 and only returned to its 1990 position by the late 1990s (State of California 1999). In this view, much of the benefit that GSEs accord would have been evidenced primarily during the post-recession years of the 1990s.

27. For the comparisons to be meaningful, the 1990 and 2000 data must pertain to the same geographic space. Because tract boundaries sometimes change between each decennial census, we restrict our sample to those tracts that did not record a boundary change over the decade of the 1990s.

28. We use the minority threshold to account for the fact that the GSE geographic goal also includes census tracts with median family income less than 120 percent of MSA median and minority population in excess of 30 percent.

Table 3. Selected Sample Average for MSA Census Tracts in the United States<sup>a</sup>

<i>Indicator</i>	<i>All tracts</i> (1)	<i>Selected sample</i> (2)	<i>Tracts above GSE margin</i> (3)	<i>Tracts below GSE margin</i> (4)
<i>Housing market indicators</i>				
Homeownership rate, 1990	56.83	60.47	62.82	57.67****
Vacancy rate, 1990	7.78	7.62	7.10	8.25****
Median house value, 1990 (thousands)	110.46	84.40	88.83	79.11****
Homeownership rate, 2000	57.22	60.88	63.37	57.91****
Vacancy rate, 2000	7.17	7.07	6.50	7.75****
Median house value, 2000 (thousands)	142.57	113.27	119.20	106.17****
Percentage single-family homes, 1990	67.22	68.82	72.23	66.77****
Number of units, 1990	1,664	1,777	1,974	1,937
Number of owner-occupied units, 1990	953	1,065	1,255	1,133****
Change in homeownership rate, 1990s	2.28	1.35	1.62	1.02**
Change in vacancy rate, 1990s	6.93	7.34	6.89	7.89
Change in median home value, 1990s	41.72	45.31	44.41	46.39
Change in percentage single-family homes, 1990s	8.87	4.56	3.50	5.83****
Change in number of units, 1990s	10.60	11.01	11.79	10.09****
Change in owner-occupied units, 1990s	13.96	13.16	14.26	11.83****
<i>Demographic characteristics</i>				
Percentage age 17 or younger, 1990	24.75	23.62	23.75	23.81
Percentage age 65 or older, 1990	13.16	14.84	14.20	14.31
Percentage minority, 1990	26.30	8.93	17.28	19.94****
Percentage Asian, 1990	3.51	1.47	2.63	2.77
Household size, 1990	2.74	2.59	2.55	2.52****
Central city, 1990	0.51	0.37	0.35	0.40
Urban tract, 1990	0.89	0.80	0.80	0.82****
Change in percentage age 17 or younger, 1990s	3.04	2.70	1.96	3.60****
Change in percentage age 65 or older, 1990s	8.57	1.06	4.12	-2.60****
Change in percentage minority, 1990s	99.19	148.83	148.17	149.62
Change in percentage Asian, 1990s	102.47	122.29	125.85	117.84
Change in household size, 1990s	-1.26	-1.91	-2.31	-1.42****
<i>Economic characteristics</i>				
Median family income, 1990 (thousands)	37.83	34.08	50.64	45.20****
Unemployment rate, 1990	4.72	4.10	3.40	3.94****
Poverty rate, 1990	13.93	10.66	9.49	12.25****
House price to income, 1990	2.85	2.39	2.32	2.36
House price to rent, 1990	209.39	181.47	193.21	181.96****
Change in median family income, 1990s	41.34	42.02	41.67	42.44**
Change in unemployment rate, 1990s	6.48	1.03	0.57	1.58
Change in poverty rate, 1990s	23.98	15.34	18.63	11.41****

(continued)

Table 3. Selected Sample Average for MSA Census Tracts in the United States<sup>a</sup> (Continued)

Indicator	All tracts (1)	Selected sample (2)	Tracts above GSE margin (3)	Tracts below GSE margin (4)
Change in house price to income, 1990s	-0.09	-0.05	-0.05	-0.06
Change in house price to rent, 1990s	6.26	7.69	7.78	7.58
Per capita income in primary metropolitan statistical area (PMSA), 1990 (thousands)	29.28	28.65	28.62	28.67
Per capita wages in PMSA, 1990 (thousands)	33.67	32.42	32.44	32.40
Change in PMSA per capita income, 1990s	51.25	52.02	51.90	52.15
Change in PMSA per capita wage, 1990s	47.40	46.88	46.86	46.91
MSA annual home price growth rate, 1995-2000	0.77	0.77	0.76	0.79
Supply-constraint index	21.07	20.52	20.55	20.50
Number of tracts	37,545	7,602	4,140	3,462

Source: Census of Population and Housing, 1990, 2000.

\*\*\* $p < 0.001$ .

\*\* $p < 0.01$ .

\* $p < 0.05$ .

a. All the change variables are in percentages. We obtain tract-level data for the 1990 and the 2000 censuses for the whole nation. Non-MSA tracts are excluded from our analysis. 1990 and 2000 census data are matched to calculate the percent change variables; those tracts with boundary changes are excluded from the analysis. We further exclude tracts with less than 100 total housing units to alleviate problems of outliers in the statistical analysis. We form subsamples based on census tract relative income (tract median family income relative to MSA median) and other criteria in order to assess the robustness of results to sample stratification. The first column includes tracts from all income ranges. Columns 2-4 contain tracts with minority ratios of less than 30 percent and median family incomes of 80-100 percent, 90-100 percent, and 80-90 percent of MSA median, respectively. The targets for the geographic goal of the GSE affordable housing goals are defined as census tracts with median family income of less than 90 percent of MSA median or tracts with median family income of less than 120 percent of MSA median and more than 30 percent of minority population, respectively. Column 4 includes GSE targeted tracts, and column 3 comprises nontarget tracts. In column 4, an asterisk indicates a value that is statistically different from the above-margin sample (column 3).

tracts with median family income of less than 90 percent of the MSA median. Accordingly, column 4 includes GSE targeted tracts, and column 3 includes nontargeted tracts. In column 4, an asterisk indicates a value that is statistically different from the margin sample (column 3).

The table shows that sample tracts generally witnessed improvements in housing market conditions between 1990 and 2000, in that homeownership rates and median house values increased, while vacancy rates declined (column 2). However, sampled tracts had far lower shares of minority populations, relative to the national norms. Further, sampled tracts trailed metropolitan areas as a whole with regard to median house values and median family incomes. In marked contrast, sampled tracts exhibited somewhat higher levels of homeownership—at about 61 percent in 2000—relative to the 57 percent recorded for all tracts in U.S. metropolitan areas.

In a comparison of tracts just above and below the GSE income eligibility threshold, the data show that the tracts are similar along certain dimensions. For example, tracts with family incomes of 80–90 percent of the metropolitan area median income (column 4) and tracts with family incomes of 90–100 percent of the metropolitan area median income (column 3) had statistically similar distributions of population age and shares of Asian population as well as statistically similar central city locations. However, they did differ in some important respects, as GSE-eligible tracts had statistically elevated percentages of minorities. Tracts just below the GSE threshold with 80–90 percent of area median income had about a 20 percent minority population, compared with 17 percent for those tracts with 90–100 percent of area median income. Further, the GSE-eligible tracts are further characterized by statistically depressed income levels as well as statistically elevated rates of poverty and unemployment, relative to tracts above the GSE margin.

Finally, in terms of housing market indicators, tracts just below the GSE threshold began the decade with an average homeownership rate and an average median house value significantly lower than tracts just above the 90 percent GSE threshold. In both cases, the average values for tracts below the GSE threshold were about 10 percent lower than those for tracts just above the threshold. GSE-eligible tracts also had statistically elevated vacancy rates of approximately 8.25 percent.

Despite these initial differences, tracts with median family incomes just above and below the GSE threshold did not show substantial differences in housing market performance during the 1990s. These groups of tracts recorded comparable and modest increases in homeownership rates of about 1 percentage point. Average declines in the vacancy rate were of statistically similar magnitude across the two sample groups, as was the percentage increase in the median home value. These small differences in the average housing market experiences of tracts that fall just below and beyond the GSE threshold suggest that GSE activity might not have had a significant impact on local housing market outcomes. However, the univariate statistics in table 2 do not take into account the correlations between housing outcomes and other important determinants thereof and thus leave open the possibility that these correlations mask the effects of GSE activity.

### *Estimation Results*

The regressions estimate the effects of levels and changes in census tract sociodemographic, local housing market, economic, and other characteristics

on the percent change in tract housing market conditions (homeownership rate, vacancy rate, and median home values). Table 4 presents the ordinary least squares estimates, which include proxies for each of the three HUD-specified GSE loan-purchase goals (geographically targeted, low-moderate-income, and special affordable). None of the controls for the affordability loan-purchase goal enters the analysis with an appropriate degree of statistical significance. Accordingly, estimation results suggest that the GSE targeting of underserved and low-income populations and neighborhoods has had little impact on the evolution of tract-level housing markets.<sup>29</sup>

Although these results suggest that the GSE affordable housing goals have had minimal effect on housing market outcomes, there are reasons to be skeptical. One issue is that tracts with median incomes above the 90 percent threshold used to identify the geographically targeted tracts, which we use as controls, are themselves likely to be affected by the targeting through the other goals. This fact is one motivation for including metrics indicating the likely salience of all the goals in the specification presented in table 4, although there are certainly other approaches to incorporating them into the specification. We also repeated the analysis using successively narrow bands around the 90 percent threshold (that is, 81–90 percent versus 91–99 percent through to 89–90 percent versus 90–91 percent), speculating that the likelihood of significant variation in these ancillary influences across treatment and control tracts is minimized. The results of these analyses (not shown) are virtually identical to those reported.

As noted earlier, a key variable to consider is GSE purchase intensity, as the affordable housing goals are designed to affect the level and rate of increase of this intensity in targeted tracts. Because intensity is potentially endogenous, as noted, we employ a two-stage technique to account for this. In the first stage, we develop models of intensity and change in intensity based on tract attractiveness across the three HUD-specified affordable housing goals and other census tract characteristics thought to influence purchase decisions. We use

29. Numerous other robustness checks were run. Regression estimates were obtained for specifications including state-level fixed effects and including each GSE loan-purchase goal individually as the sole factor. In addition, regression estimates using the baseline specification were obtained for stratified subsamples. Estimates were obtained to test for robustness of results across central city and non-central city areas, markets experiencing elevated versus damped rates of increase in home prices (top and bottom quartiles in 1995–2000 home price appreciation), markets that are highly affordable relative to those that are highly unaffordable (top and bottom quartiles in price-to-income ratio), and markets characterized by few housing supply constraints. Table A-2 provides summary information for these stratifications of the sample. The results (available on request) are largely robust to specification or sample stratification, with the estimated GSE housing goal coefficients generally failing to achieve an acceptable level of statistical significance.



Table 4. Regression Results for the Percent Change in the Homeownership Rate, Vacancy Rate, and Median Home Value (1990–2000) with Three GSE Incentive Controls<sup>a</sup>

<i>Independent variable</i>	<i>Change of homeownership</i>	<i>Change of vacancy rate</i>	<i>Change of median home value</i>
Intercept	0.032 (0.018)	-0.059**** (0.018)	-0.084**** (0.017)
GEOG	-0.018 (0.030)	0.003 (0.029)	0.031 (0.028)
LOW-MOD	-0.004 (0.034)	-0.024 (0.033)	-0.025 (0.031)
AFFORD	0.012 (0.030)	0.028 (0.029)	0.077*** (0.028)
Price to income, 1990	0.127**** (0.016)	-0.114**** (0.016)	
Change in price to income	0.007 (0.013)	0.042**** (0.013)	
MSA annual house price growth rate, 1995–2000	0.074**** (0.012)	-0.141**** (0.011)	
Supply-constraint index	-0.084**** (0.013)	-0.005 (0.013)	-0.158**** (0.011)
Percentage single-family homes, 1990	0.024 (0.014)	-0.089**** (0.013)	0.228**** (0.012)
Change in percentage single-family homes	0.057**** (0.012)	-0.018 (0.012)	0.032**** (0.011)
Percentage age 65 or older, 1990	-0.085**** (0.014)	0.094**** (0.014)	-0.143**** (0.013)
Change in percentage age 65 or older	0.052**** (0.013)	0.015 (0.013)	-0.128**** (0.012)
Percentage minority, 1990	0.025 (0.014)	-0.062**** (0.014)	-0.157**** (0.013)
Change in percentage minority	-0.055**** (0.012)	0.056**** (0.012)	-0.020 (0.011)
Percentage Asian, 1990	-0.033** (0.015)	-0.040*** (0.014)	0.090**** (0.013)
Change in percentage Asian	-0.016 (0.011)	-0.016 (0.011)	-0.029**** (0.011)
Household size, 1990	-0.012 (0.014)	0.058**** (0.014)	-0.002 (0.013)
Change in household size	0.042*** (0.013)	-0.015 (0.012)	-0.039*** (0.012)
Unemployment rate, 1990	-0.034*** (0.013)	-0.011 (0.012)	0.171**** (0.012)
Change in unemployment rate	0.014 (0.012)	0.052**** (0.012)	0.067**** (0.011)
Central city, 1990	-0.069*** (0.025)	0.150**** (0.025)	0.149**** (0.023)
Number of units, 1990	0.088**** (0.012)	-0.122**** (0.011)	-0.035*** (0.011)

(continued)

**Table 4. Regression Results for the Percent Change in the Homeownership Rate, Vacancy Rate, and Median Home Value (1990–2000) with Three GSE Incentive Controls<sup>a</sup> (Continued)**

<i>Independent variable</i>	<i>Change of homeownership</i>	<i>Change of vacancy rate</i>	<i>Change of median home value</i>
Change in number of units	0.026** (0.012)	0.011 (0.011)	0.124**** (0.011)
Number of observations	7,602	7,602	7,602
Adjusted <i>R</i> <sup>2</sup>	0.051	0.101	0.177

\*\*\*\**p* < 0.001.

\*\*\**p* < 0.01.

\*\**p* < 0.05.

a. Standard errors are in parentheses. All change variables are in percentages. GEOG is an indicator of whether the tract qualified according to the “geographically targeted/underserved area” GSE affordable housing loan-purchase goal (indicated by whether the census tract had a median income in the range of 80–90 percent of area median income); LOW-MOD is an indicator of whether the tract is ranked among the top 25 percent of tracts in the metropolitan area by share of families qualifying for the low-moderate-income GSE affordable housing goal; AFFORD is an indicator of whether the tract is ranked among the top 25 percent of tracts in the metropolitan area by share of families qualifying for the GSE special affordable housing goal. All continuous variables are standardized before the regressions are run.

this model to estimate fitted values of levels and changes in GSE purchase intensities for each tract. These “exogenous” fitted values are then used in a second-stage regression similar to that presented in table 4, except that the variables obtained via the fitted values replace the GSE incentive controls. The premise underlying this approach is that one can model GSE home loan-purchase activity and that GSE impacts will be most visible in those locations where this activity (or a change in this activity) is greatest.

Tables 5 and 6 report the results of this process. The first-stage estimates reported in table 5 indicate that the *level* of GSE purchase intensity is lower in areas qualifying as geographically underserved and in areas rating high for the low-moderate-income goal (column 1). GSE purchase intensity is similarly significantly depressed in tracts with higher levels of minority populations as well as in urban tracts and tracts with high unemployment rates. The GSE ratio of loan-purchase intensity does appear to vary positively with the scale of the conforming mortgage market, as evidenced in the number of conforming loans originated in the tract. Column 2 of the table shows that GSE purchase intensity increased significantly in tracts targeted under the geographically targeted goal, which is consistent with the previous finding suggesting that the GSEs responded affirmatively to the incentives established via the affordable housing goals. GSE intensity also increased significantly in areas with a high initial unemployment rate and a growing elderly presence. GSE intensity grew more slowly in Asian neighborhoods and urban tracts. A surprising finding is that GSE intensities also increased less in areas where there was a higher proportion of low- and moderate-income households and in areas where more conforming conventional loans were originated.

Table 5. First-Stage Estimates of the Levels and Changes of GSE Purchase Intensity<sup>a</sup>

<i>Independent variable</i>	<i>Average GSE intensity, 1995–2000</i>	<i>Percent change of GSE intensity, 1995–2000</i>
Intercept	0.138**** (0.029)	0.186**** (0.032)
GEOG	-0.128**** (0.03)	0.068** (0.032)
LOW-MOD	-0.174**** (0.033)	-0.099*** (0.036)
AFFORD	0.023 (0.029)	0.021 (0.032)
Total number of conforming loans in 1995	0.059**** (0.011)	-0.013 (0.012)
Central city indicator, 1990	-0.145**** (0.024)	-0.036 (0.026)
Percentage Asian	0.228**** (0.011)	-0.046**** (0.012)
Percentage age 65 or older	0.112**** (0.011)	0.019 (0.013)
Unemployment rate, 1990	-0.196**** (0.012)	0.057**** (0.016)
Urban tract indicator	0.003 (0.031)	-0.218**** (0.034)
Change in total number of conforming loans (1995–2000)		-0.067**** (0.015)
Change in percentage Asian		-0.014 (0.012)
Change in percentage age 65 or older		0.039*** (0.013)
Change in unemployment rate		0.007 (0.014)
Number of observations	7,246	6,996
Adjusted $R^2$	0.123	0.019

\*\*\*\* $p < 0.001$ .\*\*\* $p < 0.01$ .\*\* $p < 0.05$ .

a. Standard errors are in parentheses. All change variables are in percentages. All continuous variables are standardized before running the regressions. We lose 356 and 606 observations in the level and change equations, respectively, because of missing values in the dependent variables.

One caveat regarding these first-stage estimates is that the model fits are relatively low. This is particularly true for the estimates of the percentage change in GSE intensity, where only three variables show a significant relationship with a change in GSE purchase intensity. This suggests that the fitted values might not have as much power as one might prefer. The ensuing results of the second-stage estimates should be considered with this caveat in mind.

The second-stage estimates, reported in table 6, show that predicted levels of GSE purchase intensity are associated with significantly higher changes in

Table 6. Second-Stage Results of Homeownership Rate, Vacancy Rate, and Median House Value Regressions<sup>a</sup>

<i>Independent variable</i>	<i>Change of homeownership</i>	<i>Change of vacancy rate</i>	<i>Change of median house value</i>
Intercept	0.012 (0.015)	-0.025 (0.015)	-0.128**** (0.012)
GSE intensity ( $\wedge$ )	0.289**** (0.086)	0.010 (0.087)	0.027 (0.069)
Change in GSE intensity ( $\wedge$ )	0.208 (0.120)	-0.830**** (0.111)	0.878**** (0.088)
Price to income, 1990	0.126**** (0.016)	-0.117**** (0.016)	
Change in price to income	0.027 (0.014)	0.053**** (0.015)	
MSA annual home price growth rate, 1995-2000	0.070**** (0.011)	-0.133**** (0.011)	
Supply-constraint index	-0.088**** (0.013)	-0.001 (0.013)	-0.173**** (0.009)
Percentage single-family homes, 1990	0.008 (0.013)	-0.070**** (0.014)	0.242**** (0.01)
Change in percentage single-family homes	0.059**** (0.011)	-0.015 (0.012)	0.033**** (0.009)
Percentage age 65 or older, 1990	-0.126**** (0.017)	0.102**** (0.017)	-0.162**** (0.013)
Change in percentage age 65 or older	0.066**** (0.013)	0.030** (0.013)	-0.156**** (0.01)
Percentage minority	0.031** (0.014)	-0.073**** (0.014)	-0.145**** (0.011)
Change in percentage minority	-0.059**** (0.011)	0.055**** (0.012)	-0.017 (0.009)
Percentage Asian	-0.093**** (0.025)	-0.090**** (0.025)	0.127**** (0.02)
Change in percentage Asian	-0.011 (0.011)	-0.038**** (0.011)	-0.013 (0.009)
Household size, 1990	-0.083**** (0.014)	0.046**** (0.014)	-0.057**** (0.011)
Change in household size	0.079**** (0.012)	-0.014 (0.013)	-0.035**** (0.01)
Unemployment, 1990	0.024 (0.024)	0.048 (0.025)	0.056*** (0.02)
Change in unemployment	-0.037*** (0.013)	0.045**** (0.013)	0.024** (0.01)
Central city, 1990	-0.037 (0.028)	0.078*** (0.028)	0.221**** (0.022)
Number of units, 1990	0.060**** (0.012)	-0.116**** (0.012)	-0.020** (0.009)
Change in number of units	0.024** (0.012)	0.021 (0.012)	0.128**** (0.009)
Number of observations	6,989	6,989	6,989
Adjusted R <sup>2</sup>	0.067	0.110	0.243

\*\*\*\* $p < 0.001$ .\*\*\* $p < 0.01$ .\*\* $p < 0.05$ .

a. Standard errors are in parentheses. All change variables are in percentages. The fitted values of levels and changes of GSE purchase intensity are used as instruments. All continuous variables are standardized before running the regressions. We lose 613 observations in the regressions because of the missing values in the instrumental variables.

the tract rate of homeownership. Regarding *changes* in GSE intensity, the results show benefits of the GSE activities: changes in GSE intensity are associated with significant reductions in vacancy rates and increases in median home values. The results of the two-stage analysis are noteworthy, in that they indicate that the endogeneity of GSE activity is an important consideration for those seeking to assess the effects of GSE-related incentives on housing markets. While analyses not explicitly accounting for this endogeneity find little efficacy of the affordable housing goals (table 5), an empirical approach using instrumental variable methods indicates significant beneficial GSE effects regarding vacancy rates and home values.

Other results of table 6 conform to expectations. For example, central cities show smaller changes in homeownership rates, and minority communities show lower increases in median home values. Other variables, however, yield some surprises. Supply constraints are found to be associated with declines in median home values. This runs counter to theoretical predictions and may reflect some interaction with other regressors, such as variables involving changes in the number of units in a tract. More investigation of these ancillary relationships is warranted.

## Test 2: GSE Activity and the FHA

In this section, we seek to corroborate and assess any decline in the credit quality or performance of the pool of FHA-insured home mortgage borrowers subsequent to enactment of the GSE affordable housing goals. The analysis derives from the hypothesis that enhanced outreach and purchase by the GSEs of conforming loans originating among lower-income, minority, and other underserved borrowers could measurably affect underserved borrowers' choice among FHA-insured and conforming mortgages. Changes at the margin in borrower choice among FHA-insured and conforming, conventional instruments, subsequent to and as a result of implementation of the GSE goals, could result in deterioration in the quality and performance of the FHA pool, as better-qualified underserved and minority borrowers seek to obtain lower-cost conventional, conforming loans.<sup>30</sup> As Deng and Gabriel show, lower-credit-quality borrowers are less likely to exercise ruthlessly the call option, suggesting diminished rates of prepayment among residual borrowers

30. An and Bostic (forthcoming).

in the FHA-insured loan pool.<sup>31</sup> In that regard, we compare the credit quality of FHA-insured mortgage loans originated before and after implementation of the affordable housing goals. We then employ a hazard model to assess FHA-insured mortgage default and prepayment risks.

The principal data set used in this study consists of a large random sample of FHA-insured home-purchase loans originated during 1992–96.<sup>32</sup> All loans are fully amortizing, most with thirty-year terms. The individual loan records contain information on a large number of loan-, borrower-, and property-related characteristics and also indicate the termination date of each loan and the reason for termination. Attached to the loan record files are borrower credit scores at time of loan application as well as measures of local housing market performance, including home price appreciation and variance. In accordance with methods used in Deng and Gabriel, contemporaneous mortgage default and prepayment option values are computed for each month subsequent to loan origination.<sup>33</sup> The data also include neighborhood socioeconomic and housing market indicators at the level of the census tract as well as economic variables from the 1990 census and FHA data on the race of the borrower at the level of the metropolitan area. The FHA data set encompasses nearly 300 metropolitan areas, allowing for substantial variability in the structure of local lending markets.

For purposes of our first task, the data first were stratified by year of origination, so as to enable characterization of average FHA-insured loan pool characteristics prior and subsequent to implementation of the GSE affordable housing goals. Because the GSE affordable housing goals were implemented in 1995, we treat loans originated in 1992 as pretreatment observations and loans originated in 1996 as treatment observations. Loans in those pools were followed through termination or until the end of 2000. Our hypothesis suggests that, comparing the 1992 and 1996 loan pools, we should observe deterioration in the quality and performance of loans that originated in 1996.

Table 7 compares mean values of variables from the 1992 and 1996 samples of FHA-insured home-purchase loans. Those results suggest some decline in

31. Deng and Gabriel (2006).

32. The final sample consists of 12,021 loans randomly drawn from the 120,342 endorsed loan applications from 1992 to 1996. The loan database was provided by Unicon Research and is a stratified choice-based sample with weights that account for choice-based sampling from strata based on differential loan losses by race and loan status. The individual loan files are observed on a monthly basis from month of origination through that of termination or maturation or, for active loans, through the end of 2000.

33. For additional information on the data set, see Deng and Gabriel (2006).

Table 7. Comparison of Means of 1992 and 1996 Vintage of FHA Loans<sup>a</sup>

<i>Loan characteristic</i>	<i>1992 pool</i>	<i>1996 pool</i>
Credit score < 620	0.13 (0.34)	0.24**** (0.42)
Credit score 620-680	0.28 (0.46)	0.33**** (0.46)
Credit score 680-740	0.35 (0.48)	0.29**** (0.45)
Credit score > 740	0.24 (0.43)	0.14**** (0.34)
Black	0.09 (0.3)	0.13**** (0.33)
Asian	0.02 (0.13)	0.02 (0.12)
Hispanic	0.08 (0.27)	0.16**** (0.36)
White	0.80 (0.41)	0.66**** (0.46)
Other race or ethnicity	0.01 (0.11)	0.03**** (0.17)
Age under 25	0.11 (0.31)	0.11 (0.31)
Age between 25 and 35	0.52 (0.5)	0.48**** (0.49)
Age between 35 and 45	0.25 (0.44)	0.26 (0.43)
Loan to value ratio	0.93 (0.06)	0.94**** (0.06)
Housing expenditure to income ratio between 20-38 percent	0.61 (0.49)	0.65**** (0.47)
Housing expenditure to income ratio over 38 percent	0.01 (0.1)	0.01** (0.11)
Debt-to-income ratio 20-41 percent	0.84 (0.37)	0.77**** (0.42)
Debt-to-income ratio 41-53 percent	0.12 (0.33)	0.20**** (0.39)
Debt-to-income ratio over 53 percent	0.01 (0.1)	0.01 (0.09)
Loan for refinance an existing property	0.07 (0.25)	0.04**** (0.2)
Indicator of buy down	0.03 (0.18)	0.03 (0.16)
Log of house value	11.13 (0.37)	11.28**** (0.36)
Short-term mortgage	0.05 (0.22)	0.03**** (0.16)
Central city borrower	0.45 (0.5)	0.42*** (0.49)

*(continued)*

Table 7. Comparison of Means of 1992 and 1996 Vintage of FHA Loans<sup>a</sup> (Continued)

Loan characteristic	1992 pool	1996 pool
Rural borrower	0.05 (0.23)	0.07**** (0.26)
First-time home buyer	0.62 (0.49)	0.72**** (0.44)
Loan for new home	0.08 (0.27)	0.06**** (0.23)
Co-borrower not married	0.09 (0.29)	0.13*** (0.33)
Single male	0.18 (0.39)	0.20*** (0.39)
Single female	0.19 (0.4)	0.21 (0.4)
Number of dependents	0.80 (1.13)	0.73*** (1.06)
Log of liquid asset	8.53 (1.56)	8.41**** (1.62)
Log of income	8.00 (0.39)	8.07**** (0.4)
Census tract percentage black	0.10 (0.19)	0.09 (0.17)
Census tract percentage Asian	0.02 (0.04)	0.02**** (0.04)
Census tract percentage Hispanic	0.07 (0.14)	0.09**** (0.15)
Census tract percentage other race or ethnicity	0.01 (0.01)	0.01 (0.02)
Census tract median family income relative to MSA median	1.02 (0.26)	1.03*** (0.26)
Census tract median rent	0.32 (0.18)	0.32 (0.17)
Month of origination (from January 1992)	8.03 (2.66)	54.46**** (2.39)
Low liquid asset	0.46 (0.5)	0.52**** (0.49)
High liquid asset	0.54 (0.5)	0.48**** (0.49)
Loan age	63.54 (27.47)	36.28**** (9.1)
Prepayment	0.61 (0.49)	0.37**** (0.47)
Default	0.05 (0.22)	0.04 (0.2)
Current	0.34 (0.48)	0.59**** (0.48)
Number of loans	3,384	4,673

Source: The FHA loan sample statistics are from Deng and Gabriel (2006). The FHA sample includes a random sample of all FHA loans originated in 1992 and 1996.

\*\*\*\* $p < 0.001$ .

\*\*\* $p < 0.01$ .

\*\* $p < 0.05$ .



Table 8. Cumulative Prepayment and Default Rates of Different FHA Pools, 1992 and 1996<sup>a</sup>

Relative income group and cumulative probability	Prepayment		Default	
	1992 pool	1996 pool	1992 pool	1996 pool
<i>≤ 80 percent</i>				
One year	0.01	0.02	0.00	0.01
Three years	0.17	0.25****	0.02	0.03
Five years	0.32	0.38***	0.04	0.04
<i>80–90 percent</i>				
One year	0.02	0.02	0.00	0.01
Three years	0.21	0.24	0.03	0.05***
Five years	0.33	0.35	0.04	0.05
<i>90–100 percent</i>				
One year	0.01	0.01	0.00	0.01
Three years	0.20	0.26****	0.03	0.04
Five years	0.34	0.37	0.04	0.05
<i>100–120 percent</i>				
One year	0.02	0.01	0.00	0.01
Three years	0.18	0.27****	0.02	0.03
Five years	0.31	0.38****	0.04	0.04
<i>&gt;120 percent</i>				
One year	0.03	0.01****	0.00	0.01****
Three years	0.20	0.26****	0.02	0.04
Five years	0.34	0.37	0.04	0.04

\*\*\*\* $p < 0.001$ .\*\*\* $p < 0.01$ .

a. Relative income is defined as tract median family income relative to MSA median. In the columns for the 1996 pool, asterisks indicate a value that is statistically different from that of the 1992 pool.

average credit quality of FHA-insured borrowers in the 1996 sample. For example, a comparison of means suggests statistically depressed credit score distributions among borrowers in 1996 relative to their counterparts in 1992. Similarly, the 1996 sample contains evidence of significant deterioration in borrower debt-to-income ratios relative to levels recorded among the 1992 sample of borrowers. The 1996 sample contains a statistically elevated share of first-time home buyers; further the 1996 sample shows significant deterioration in the distribution of borrowers' liquid assets. These findings then support the hypothesis of significant decline in the credit quality of FHA-insured borrowers over the decade of the 1990s, owing perhaps to changes in the origination of conforming versus FHA-insured loans in the wake of enactment of the GSE affordable housing loan-purchase goals.

Table 8 provides information on summary performance characteristics of the 1992 and 1996 FHA-insured loan pools. Here we tabulate cumulative default and prepayment rates at one, three, and five years after origination and report

the data across neighborhoods grouped by relative income. We observe few differences between the 1992 and 1996 pools regarding default propensities. Given the fact that 1996 loans faced higher housing price appreciation and a better overall economic environment in the years after origination, one might have expected better default performance for the 1996 portfolio of loans. One would expect any significant deterioration in credit quality among FHA-insured borrowers to be evidenced in depressed—rather than elevated—rates of prepayment.<sup>34</sup> However, in many instances, 1996 borrowers show statistically elevated rates of prepayment.

In order to disentangle the possible impacts of the GSE affordable housing goals on the FHA-insured market, we adopt an option-based empirical hazard model. In estimation of that model, we seek to analyze prepayment and default behaviors among FHA borrowers in periods prior and subsequent to implementation of the GSE affordable housing goals. The empirical hazard model allows us to control for more than forty contemporaneous and time-invariant covariates, including well-specified contemporaneous proxies for the intrinsic values of the mortgage put and call option exercise, borrower creditworthiness (credit scores), and a large number of common underwriting variables measuring borrower, loan, and locational risks. Further, the model includes a regime shift indicator (to distinguish prepayment or default behavior before and after January 1996) as well as a GSE-targeted tract indicator.<sup>35</sup> The indicators are also interacted with one another and with the contemporaneous values of the put (default) and call (prepayment) option variables. We hypothesize that FHA-insured borrowers in GSE-targeted tracts will have elevated prepayment propensities, given their enhanced access to conventional conforming loans. However, following Deng and Gabriel, we further hypothesize that loans originated among less creditworthy FHA-insured borrowers will have substantially depressed rates of prepayment.<sup>36</sup> Our sample includes loans originated during the 1992–96 period, in contrast to our previous analysis of credit characteristics, which only compares loans originating in 1992 and 1996.

Table 9 displays results of the Cox partial likelihood estimates of the prepayment and default equations. Overall, results of the analysis strongly

34. Deng and Gabriel (2006).

35. We also experimented with an origination year dummy to distinguish loans of different vintages. The estimated coefficient associated with that control was not significant in explaining prepayment and default behaviors, which is not surprising given the fact that we had already controlled many underwriting-related factors.

36. Deng and Gabriel (2006).

Table 9. Cox Partial Likelihood Estimates of the Prepayment and Default Models<sup>a</sup>

<i>Explanatory variable</i>	<i>Prepayment model</i>	<i>Default model</i>
Calendar time dummy (loan outstanding after January 1996)	-2.68**** (0.05)	-2.73**** (0.14)
Loan in GSE-targeted tract	-0.11 (0.08)	0.39** (0.2)
Call	7.74**** (0.36)	2.27*** (0.77)
Put	-0.09 (0.26)	1.71**** (0.43)
Calendar time dummy * loan in GSE-targeted tract	0.20** (0.08)	-0.10 (0.2)
Call * calendar time dummy	-1.05** (0.42)	4.12**** (0.94)
Put * calendar time dummy	-2.91**** (0.32)	-1.33** (0.57)
Call * loan in GSE-targeted tract	1.02 (0.54)	-3.41*** (1.28)
Put * loan in GSE-targeted tract	-1.25*** (0.39)	-0.12 (0.6)
Call * calendar time dummy * loan in GSE-targeted tract	-2.33**** (0.6)	2.30 (1.51)
Put * calendar time dummy * loan in GSE-targeted tract	1.17** (0.49)	1.56** (0.79)
Unemployment rate	-0.15**** (0.01)	-0.01 (0.01)
Herfindahl index	0.05** (0.02)	-0.35**** (0.08)
Black * Herfindahl index	0.49**** (0.07)	-0.18 (0.15)
Hispanic * Herfindahl index	0.18** (0.08)	0.61**** (0.17)
Credit score < 620	0.05 (0.03)	1.19**** (0.11)
Credit score 620-680	-0.05 (0.03)	0.93**** (0.1)
Credit score 680-740	0.08**** (0.02)	0.46**** (0.11)
Loan-to-value ratio	0.73**** (0.17)	1.39** (0.59)
Black	-3.05**** (0.39)	1.72** (0.82)
Asian	0.31**** (0.07)	0.69*** (0.22)
Hispanic	-1.15*** (0.42)	-3.05*** (0.95)

(continued)

**Table 9. Cox Partial Likelihood Estimates of the Prepayment and Default Models<sup>a</sup> (Continued)**

<i>Explanatory variable</i>	<i>Prepayment model</i>	<i>Default model</i>
Other	-0.35**** (0.07)	-0.81*** (0.29)
Housing expenditure to income less than 20–38 percent	0.02 (0.03)	0.10 (0.09)
Housing expenditure to income over 38 percent	-0.14 (0.1)	-0.90** (0.44)
Debt-to-income ratio 20–41 percent	-0.10 (0.05)	-0.75**** (0.14)
Debt-to-income ratio 41–53 percent	0.08 (0.06)	-0.58**** (0.15)
Debt-to-income ratio over 53 percent	0.30** (0.12)	-0.85 (0.45)
Loan for refinance	0.36**** (0.05)	-0.15 (0.18)
Indicator of buy down	0.00 (0.05)	-0.04 (0.18)
Log of appraisal home value	0.72**** (0.05)	0.28 (0.15)
Short-term loan indicator	0.01 (0.05)	-3.70**** (1.00)
Loan in central city	0.02 (0.02)	-0.13** (0.06)
Loan in rural area	0.22**** (0.03)	-0.52**** (0.13)
First-time home buyer	-0.04** (0.02)	0.15** (0.07)
New house	-0.13**** (0.03)	-0.16 (0.12)
Co-borrower unmarried	0.06** (0.03)	-0.30*** (0.1)
Single male borrower	0.07*** (0.03)	0.21*** (0.07)
Single female borrower	0.02 (0.03)	-0.39**** (0.09)
Number of dependents	-0.07**** (0.01)	0.10**** (0.02)
Log of liquid assets	0.04**** (0.01)	-0.14**** (0.02)
Borrower age under 25	0.28**** (0.04)	-0.12 (0.11)
Borrower age 25–35	0.19**** (0.03)	-0.45**** (0.08)
Borrower age 35–45	0.05 (0.03)	-0.27*** (0.09)

**Table 9. Cox Partial Likelihood Estimates of the Prepayment and Default Models<sup>a</sup> (Continued)**

<i>Explanatory variable</i>	<i>Prepayment model</i>	<i>Default model</i>
Log of income	0.11** (0.05)	-0.37** (0.15)
Census tract percentage black	0.28**** (0.05)	0.14 (0.17)
Census tract percentage Asian	-0.62** (0.27)	1.27 (0.71)
Census tract percentage Hispanic	0.15** (0.07)	0.18 (0.2)
Census tract percentage other	-18.43 (9.92)	76.22**** (13.1)
Census tract relative income (tract median to MSA median)	-0.57 (0.31)	4.65**** (0.95)
Census tract median rent	0.06 (0.06)	0.20 (0.19)
Woodhead measure	-0.01**** (0.00)	-0.02**** (0.00)
Number of loans	12,021	12,021
-2 Log L	238,782	26,229

\*\*\*\* $p < 0.001$ .\*\*\* $p < 0.01$ .\*\* $p < 0.05$ .

a. Estimation is based on a random sample of FHA loans originated during 1992 and 1996 and within census tracts with relative income of 80–100 percent.

support the predictions of option theory in explaining the exercise of default and prepayment options among FHA-insured borrowers. The estimates confirm that the intrinsic values of the call and put option variables are positive and highly significant in the exercise of the prepayment and default options, respectively. Note, however, that the coefficients associated with the value of the call option among loans outstanding after January 1996 as well as the value of the call option among loans outstanding after January 1996 in GSE-targeted tracts are negative and significant.<sup>37</sup> Those results suggest that after 1996, FHA borrowers, especially those in GSE-targeted tracts, were less ruthless in the exercise of prepayment opportunities. Those findings are consistent with declines in the credit quality of FHA-insured borrowers in the post-January 1996 sample (table 9) and could be associated with increasing selection of better-qualified FHA-insured borrowers into

37. This can be seen by comparing the estimated coefficients for the call option before 1996 (7.74) with the coefficient after 1996 ( $7.74 - 1.05 = 6.69$ ) in rows 3 and 6 of column 1.

the conventional, conforming market in the wake of the 1992 enactment of the GSE affordable housing loan-purchase goals. Indeed, as Deng and Gabriel show, lower-credit-quality borrowers are less responsive to the “in the money” call option exercise.<sup>38</sup> Estimation findings also show a significant positive coefficient associated with FHA-insured loans outstanding after January 1996 in GSE-targeted tracts (row 5, column 1). This result is consistent with our hypothesis of enhanced ease of refinance of FHA-insured loans in GSE-targeted areas, owing perhaps to the improved access to conventional mortgage finance. Overall, FHA-insured mortgages in GSE-targeted tracts show damped responsiveness to call-option-driven prepayment after the 1996 regime shift. This can be seen by comparing the estimated coefficient after 1996 (that is,  $7.74 + 1.02 - 2.33 = 6.43$ ) with that prior to 1996 (that is,  $7.74 + 1.02 = 8.76$ ). Other results generally conform to expectations. For example, higher credit scores are associated with higher rates of prepayment, all other things equal; further research findings indicate damped prepayment propensities among minority households. In sum, findings from the estimation of the Cox proportional hazard model provide support for the notion that, all things equal, rates of prepayment in GSE-targeted tracts increase, while at the same time FHA-insured mortgage borrowers are less responsive to “in the money” prepayment, as consistent with deterioration in the credit quality of FHA-insured loans outstanding in GSE-targeted tracts after 1996.

## Conclusions

This paper has assessed the effects of the GSE loan-purchase goals on local housing outcomes and on the characteristics and performance of FHA-insured loans. In so doing, the study seeks to infer whether GSE mortgage-purchase activity among targeted tracts is associated with improvements in homeownership, housing conditions, and credit access. The test framework exploits differences in the regulatory definition of lower-income neighborhoods under the 1992 GSE act, which establishes regulation for the GSEs, and the 1977 Community Reinvestment Act, which lays out regulation for federally insured depository institutions. In defining lower-income neighborhoods,

38. Deng and Gabriel (2006).

the GSE act establishes a neighborhood median family income threshold at 90 percent of area median family income, whereas the CRA establishes a neighborhood regulatory threshold at 80 percent of the area median family income. These definitions leave census tracts with median incomes between 80 and 90 percent of the area median family income as the clear GSE treatment group. In this context, we also test for robustness of results across local housing market stratification. We use changes in measures of housing market outcomes, including home prices, vacancy rates, and homeownership, among GSE-targeted communities compared to a control group of census tracts to indicate the impact of GSE activities.

Initial research findings suggest limited direct effects of the GSE affordable housing goals on local housing outcomes. While GSE-targeted tracts tended to lag nontargeted tracts in terms of initial housing market conditions, suggesting the appropriateness of a policy focusing on these neighborhoods, the results do not indicate much efficacy of the GSE affordable housing loan-purchase targets in improving the housing market conditions in designated tracts. For the most part, after controlling for changes in tract and metropolitan area characteristics, tracts targeted under the GSE affordable goals were little different from nontargeted tracts with respect to housing market outcomes during the 1990s.

After accounting for the endogeneity of GSE loan-purchase activity via the use of a two-stage least squares framework, however, we find that the GSEs appear to have increased their purchase intensity significantly in neighborhoods targeted by the GSE affordable goals and that there have been significant GSE-related effects on local housing outcomes. Increases in GSE purchase intensity are associated with declines in neighborhood vacancy rates and increases in median house values, both of which might be interpreted as neighborhood improvements. As expected, GSE purchase intensities are sensitive to local economic conditions; also GSE purchase intensity varies positively with the scale of the conforming loan market.

One key issue is associated with the first test: the true observable margin by which GSE activity influences household consumption might not be in housing consumption. By this argument, households may now be choosing to make sacrifices to consume an optimal bundle of housing. If so, then household monetary benefits resulting from GSE activity relieve these constraints and allow for consumption of goods other than housing. Our current methodology cannot address this potentiality, which is a shortcoming.

Finally, the analysis investigates whether the credit quality and performance of FHA-insured home mortgages declined subsequent to enactment of the affordable housing goals. As An and Bostic observe, such deterioration in the composition and performance of the FHA pool could have resulted from enhanced outreach by conforming loan originators to underserved, lower-income, and minority borrowers in the wake of the GSE act.<sup>39</sup> Summary information on credit characteristics and unadjusted prepayment and default performances from a large random sample of FHA-insured home-purchase loans suggests significant deterioration in the average credit quality of FHA-insured borrowers after 1996. Further, Cox partial likelihood estimates of a proportional hazard model indicate elevated prepayment speeds among FHA-insured loans in GSE-targeted tracts. This finding is consistent with the notion that FHA borrowers in targeted tracts had improved access to less expensive conventional, conforming loans, perhaps owing to enhanced outreach on the part of conventional lenders.

For the second test, there is also an important outstanding issue. In 1995 the FHA redefined long-term debt and effective income and increased flexibility of lenders in evaluating borrowers' credit history. Both of these actions eased underwriting standards and could be responsible for the observed declines in the quality of borrower credit.<sup>40</sup> Because the changes occurred in 1995, however, the effects of this easing may not have been most pronounced in the 1996 FHA loan portfolio. By this argument, GSE activity would still be a significant driving factor. Future research might focus on disentangling these two effects.

Taken together, research findings suggest that the GSE affordable goals have affected the housing market in significant ways. At the same time, results serve to emphasize the importance of ongoing efforts to facilitate the flow of mortgage credit to targeted underserved communities. The findings here argue for further investigation as to whether expanding the scope of GSE purchase activity might enhance the efficacy of the affordable housing goals.

39. An and Bostic (forthcoming).

40. We thank Bill Shear from the Government Accounting Office for pointing this out. For more information, see GAO (2002).



## APPENDIX

Table A-1. List of Variables for GSE-Housing Outcome Test

<i>Variables</i>	<i>Definition</i>
Central city	Central city tract indicator (char)
Change in GSE intensity (^)	The fitted value of percent change of GSE intensity from the GSE intensity model; GSE purchase intensity = (number of conforming loans purchased by the two GSEs) / (total number of conforming loans originated in the census tract)
Change in GSE intensity (^) * change in number of units	Interaction of the fitted value of change in GSE intensity and percent change of total housing units
GEOG	GSE geographic loan-purchase goal indicator; according to HUD's affordable housing goals, tracts with median family income under 90 percent of area (MSA) median or tracts characterized by more than 30 percent minority population with median family incomes under 120 percent of area median qualify under the geographic goal
GSE intensity (^)	The fitted value of GSE intensity from the GSE intensity model; GSE purchase intensity = (number of conforming loans purchased by the two GSEs) / (total number of conforming loans originated in the census tract)
GSE intensity (^) * change in number of units	Interaction of fitted GSE intensity and percent change of total housing units
Household size	Number of persons per household
Homeownership rate	(Owner-occupied one- to four-unit housing units in tract) / (total housing units in tract)
Hot market	Principal metropolitan statistical area (PMSA) / MSA in the upper half of a ranking of metro areas based on average Office of Federal Housing Enterprise Oversight (OFHEO) housing price index (HPI) growth <sup>a</sup>
HPI	Geometric weighted repeat-sales HPI estimated by OFHEO for each MSA <sup>a</sup>
LOW-MOD	Indicator of whether the tract is ranked among the top 25 percent of tracts in the metro area by share of families qualifying for the low-moderate-income GSE affordable housing goal
Median family income	Census tract median family income
Median home value	Census tract median value for all owner-occupied housing units
Median rent	Census tract median gross rent
MSA annual home price growth rate, 1995-2000	The average annual growth rate of house prices in the MSA during 1995 and 2000 <sup>b</sup>
Median home value	Median home value for all owner-occupied housing units
Number of units	Total number of housing units in the census tract

(continued)

Table A-1. List of Variables for GSE-Housing Outcome Test (Continued)

<i>Variables</i>	<i>Definition</i>
Owner-occupied units	Owner-occupied one- to four-unit housing units (used to derive the aggregate homeownership measure for groups of tracts, contrasting with the average homeownership measure for groups of tracts)
Per capita income in PMSA	MSA per capita income <sup>c</sup>
Per capita wages in PMSA	MSA per capita wage <sup>c</sup>
Percentage age 17 or younger	(Number of people age 17 or younger in tract) / (total tract population)
Percentage age 65 or older	(Number of people age 65 or older in tract) / (total tract population)
Percentage single-family homes	Percentage of single-family homes; (number of one-unit detached) / (all one- to four-unit housing units)
Percentage minority	Percentage of minority population, based on census definition: total population minus non-Hispanic white-alone population
Percentage Asian	Percentage of Asian population (non-Hispanic)
Poverty rate	Poverty-level percentage as defined in census
Price to income	Price-to-income ratio; (census tract median home value) / (tract median family income)
Price to rent	Price-to-rent ratio; (tract median rent) / (tract median home value)
Supply-constraint index	MSA-level (core-based statistical area, based on Office of Management and Budget definition) supply-constraint index <sup>d</sup>
SPEC	Special affordable goal incentive indicator; 1 if the tract is in the top quartile in the rank of all tracts based on special goal incentive (share of families under goal)
Total number of conforming loans	Total number of loans originated in the census tract falling below the conforming loan limit in one specific year
Unemployment rate	Tract unemployment rate; (number of unemployed people) / (number of people in labor force)
Urban tract indicator	Urban tract indicator; 1 if population is more than 50 percent urban
Vacancy rate	Tract vacancy rate; (number of vacant units) / (total housing units)
Weak market	PMSA / MSA in the lower half of the ranking based on average OFHEO HPI growth <sup>a</sup>

Source: Census of Population and Housing, 1990, 2000, unless otherwise indicated. Percent change values are (value in 2000 - value in 1990) / value in 1990, when it applies.

a. For more information, see OFHEO housing price index website ([www.ofheo.gov/HPI.asp](http://www.ofheo.gov/HPI.asp)).

b. OFHEO housing price index (HPI).

c. U.S. Bureau of Statistics.

d. As estimated by Malpezzi, Chun, and Green (1998).

Table A-2. Selected Sample Averages for MSA Census Tracts in the United States

<i>Indicator</i>	<i>Selected sample (1)</i>	<i>Top 25 percent of low-moderate-income goal (2)</i>	<i>Top 25 percent of special affordable goal (3)</i>
<i>Housing market indicators</i>			
Homeownership rate, 1990	60.47	57.28****	54.52****
Vacancy rate, 1990	7.62	8.13***	8.92****
Median home value, 1990 (thousands)	84.40	75.21****	79.26****
Homeownership rate, 2000	60.88	57.46****	54.72****
Vacancy rate, 2000	7.07	7.60***	8.43****
Median home value, 2000 (thousands)	113.27	100.92****	107.62****
Percentage single-family homes, 1990	68.82	65.03****	64.99****
Number of units, 1990	1,777	1,755	1,972
Number of owner-occupied units, 1990	1,065	997****	1,094**
Change in homeownership rate, 1990s	1.35	0.90	1.02
Change in vacancy rate, 1990s	7.34	8.27	8.03
Change in median home value, 1990s	45.31	45.56	46.92
Change in percentage of single-family homes, 1990s	4.56	6.16**	5.03
Change in number of units, 1990s	11.01	9.52**	9.33****
Change in owner-occupied units, 1990s	13.16	11.24**	11.26***
<i>Demographic characteristics</i>			
Percentage age 17 or younger, 1990	23.62	23.61	23.57
Percentage age 65 or older, 1990	14.84	15.22	14.35****
Percentage minority, 1990	8.93	9.64****	18.79****
Percentage Asian, 1990	1.47	1.45	2.65****
Household size, 1990	2.59	2.55****	2.48****
Central city, 1990	0.37	0.42****	0.45****
Urban tract, 1990	0.80	0.83**	0.80
Change in percentage age 17 or younger, 1990s	2.70	4.34**	1.84**
Change in percentage age 65 or older, 1990s	1.06	-4.12****	-4.17****
Change in percentage minority, 1990s	148.83	157.26	130.40****
Change in percentage Asian, 1990s	122.29	135.15	100.92****
Change in household size, 1990s	-1.91	-1.00****	-1.36****
<i>Economic characteristics</i>			
Median family income, 1990 (thousands)	34.08	32.35****	43.61****
Unemployment rate, 1990	4.10	4.26****	4.08
Poverty rate, 1990	10.66	10.98**	13.53****
House price to income, 1990	2.39	2.24****	2.45
House price to rent, 1990	181.47	165.30****	190.00****
Change in median family income, 1990s	42.02	40.00****	40.81***
Change in unemployment rate, 1990s	1.03	2.46	-3.25**
Change in poverty rate, 1990s	15.34	14.18	2.05****
Change in house price to income, 1990s	-0.05	-0.05	-0.03**
Change in house price to rent, 1990s	7.69	8.04	8.22

(continued)

**Table A-2. Selected Sample Averages for MSA Census Tracts in the United States (Continued)**

<i>Indicator</i>	<i>Selected sample (1)</i>	<i>Top 25 percent of low-moderate-income goal (2)</i>	<i>Top 25 percent of special affordable goal (3)</i>
Per capita income in primary metropolitan statistical area (PMSA), 1990 (thousands)	28.65	29.08****	27.94****
Per capita wages in PMSA, 1990 (thousands)	32.42	32.62	31.78****
Change in PMSA per capita income, 1990s	52.02	52.30	51.92
Change in PMSA per capita wage, 1990s	46.88	47.35**	45.91****
MSA annual house price growth rate, 1995-2000	-0.77	0.87**	0.70
Supply-constraint index	20.52	20.34****	20.68**
Number of tracts	7,602	1,805	2,007

Source: Census of Population and Housing, 1990 and 2000. Column 2 is defined as the top 25 percent of tracts in the metropolitan area ranked by share of families qualifying for the low-moderate-income affordable housing goal; column 3 is the top 25 percent of tracts in the metropolitan area ranked by share of families qualifying for the special affordable housing goal. In columns 2 and 3, asterisks indicate a value that is statistically different from the selected sample (column 1).

\*\*\*\* $p < 0.001$ .

\*\*\* $p < 0.01$ .

\*\* $p < 0.05$ .

## Comments

**Richard K. Green:** The United States has idiosyncratic institutions whose purpose is to provide capital to mortgage markets while not originating loans. Two of these institutions, Fannie Mae and Freddie Mac, are among the largest financial intermediaries in the world, with assets of about \$800 billion each.<sup>1</sup> Each company guarantees well over \$1 trillion of off-balance-sheet mortgages.<sup>2</sup>

Beyond being large, both of these companies are highly profitable, with typical book returns on equity of 25 percent.<sup>3</sup> Critics of the firms argue that, on a risk-adjusted basis, they are *too* profitable.<sup>4</sup> Specifically, they argue that shareholders whose debts are implicitly guaranteed by the U.S. government should not earn such large returns.

The size and profitability of the companies are likely the reason that they are required to meet affordable housing goals. The original charters of the companies were silent on the issue of affordability. Rather, they emphasized stability, liquidity, and ubiquity.<sup>5</sup> It was not until 1992, with passage of the Federal Housing Enterprises Financial Safety and Soundness Act, that Fannie Mae

1. Neither Fannie Mae nor Freddie Mac has issued current financial statements. According to their most recent restated financial statements, each of the companies has more than \$800 billion in assets on its balance sheet. For Freddie Mac's consolidated financial statement for 2006, see ([freddiemac.com/investors/ar/](http://freddiemac.com/investors/ar/) [March 2007]). For Fannie Mae's 2003 consolidated financial statement, see ([www.fanniemae.com/ir/annualreport/index.jhtml?s=Annual+Reports+%26+Proxy+Statements](http://www.fanniemae.com/ir/annualreport/index.jhtml?s=Annual+Reports+%26+Proxy+Statements) [March 2007]).

2. For Freddie Mac, see ([freddiemac.com/investors/volsum/pdf/0107mvs.pdf](http://freddiemac.com/investors/volsum/pdf/0107mvs.pdf) [March 2008]). For Fannie Mae, see ([www.fanniemae.com/ir/pdf/monthly/2007/013107.pdf](http://www.fanniemae.com/ir/pdf/monthly/2007/013107.pdf) [March 2007]).

3. The current five-year average return on equity is 24.1 percent for Freddie Mac and 28.9 percent for Fannie Mae. For Freddie Mac, see ([finapps.forbes.com/finapps/jsp/finance/compinfo/Ratios.jsp?tkr=FRE](http://finapps.forbes.com/finapps/jsp/finance/compinfo/Ratios.jsp?tkr=FRE) [March 2007]). For Fannie Mae, see ([finapps.forbes.com/finapps/jsp/finance/compinfo/Ratios.jsp?tkr=FNM](http://finapps.forbes.com/finapps/jsp/finance/compinfo/Ratios.jsp?tkr=FNM) [March 2007]).

4. See, for example, Frame and White (2005).

5. For the text of Freddie Mac's original 1970 charter, see ([www.freddiemac.com/governance/pdf/charter.pdf](http://www.freddiemac.com/governance/pdf/charter.pdf) [March 2007]). For the text of Fannie Mae's original charter, see ([www.fanniemae.com/global/pdf/aboutfm/understanding/charter.pdf](http://www.fanniemae.com/global/pdf/aboutfm/understanding/charter.pdf) [March 2007]).

**Table 10. GSE Performance on the Low- and Moderate-Income Housing Goals, 1996–2003**  
Percent

<i>Performance level</i>	1996	1997	1998	1999	2000	2001	2002	2003
Goal	40	42	42	42	42	50	50	50
Fannie Mae								
Official	45.6	45.7	44.1	45.9	49.5	51.5	51.8	52.3
Baseline <sup>a</sup>	46.8	47.5	45.1	46.8	51.3	49.2	49.0	48.7
Freddie Mac								
Official	41.1	42.6	42.9	46.1	49.9	53.2	50.5	51.2
Baseline <sup>a</sup>	41.2	42.7	43.2	46.6	50.6	47.7	46.1	45.0

Source: *Federal Register* (2004).

a. Official performance reflects how Fannie Mae and Freddie Mac were actually scored between 1996 and 2003. The baseline represents performance under scoring rules in place after the 2004 rulemaking, including the exclusion of multifamily housing bonus points and the TAF for Freddie Mac.

and Freddie Mac faced a regulatory requirement to target mortgage funding to “low- and moderate-income” borrowers, to “underserved” census tracts, and to “very low-income” borrowers or low-income borrowers in “low-income” areas. It is not a stretch to think that Congress felt that, in light of the companies’ special status and profitability, they had a special obligation to help those at the margins of the housing market. These targets became known as the “affordable housing goals.”

The paper by An, Bostic, Deng, and Gabriel asks a very simple question: Did the regulatory requirements put in place in 1992 work? More specifically, did the goals actually increase the flow of mortgage credit available to low- to moderate-income borrowers and underserved neighborhoods? The paper is typical of the authors in that it is thorough, is careful, and reveals an impressive mastery of data. Yet my interpretation of their findings is different from theirs.

Before getting into the authors’ methods and results, however, data from the 2004 rulemaking for the affordable housing goals shows that they did seem to have a powerful effect on the companies’ behavior.<sup>6</sup> Table 10 presents the performance of Fannie Mae and Freddie Mac for the low- and moderate-income housing goal between 1996 and 2003.<sup>7</sup> A unit counted toward meeting the low- to moderate-income goal if its household had income at or below the median family income for the tract in which it lived. “Official” performance

6. See *Federal Register* (2004).

7. To save space, I focus on only one of the three goals—the low- to moderate-income goal—but the trajectory of the performance of the companies with respect to the other two goals is qualitatively similar.

is the measure of whether the companies complied or not with the goal. Official performance was *not* a straightforward count of units that complied with the goal. I discuss this further below. In any event, one cannot help but notice that the official performance of both companies, and especially of Freddie Mac, changed dramatically between 1996 and 2001, the first year in which the companies were required to meet the 50 percent threshold for the low- to moderate-income goal. Freddie increased its performance by 12 percentage points, or 29 percent, between 1996 and 2001, a remarkable change consistent with the hypothesis that the goal influenced its behavior.

The story gets even more interesting when we consider the difference between the “official” and the “baseline” performance of Freddie Mac. Before 2004, Fannie Mae and Freddie Mac received extra credit for the affordable housing goals when they made loans to small rental properties.<sup>8</sup> Freddie Mac also received a temporary adjustment factor (TAF) that further rewarded it for making multifamily loans.<sup>9</sup> These bonuses explain the difference between the companies’ baseline performance and their official performance. Sure enough, between 1996 and 2001, Freddie Mac’s purchases of multifamily loans exploded, increasing from a little over \$2 billion in 1996 to more than \$9.5 billion by 2001, the first year the low- to moderate-income goal level rose to 50 percent.<sup>10</sup> Perhaps this was coincidence, although the increase is striking.

The other striking thing about the goals is that the incentives given to the companies to conform to them are rather amorphous. If they fail to meet the goals, they are required to explain to the Secretary of Housing and Urban Development why they failed to meet them or to file an “affordable housing plan” that details how they will avoid future failure.

The fact that Fannie and Freddie responded to such a soft incentive suggests that both companies feared the “headline risk” they would face in the event of a failure to meet the goals. To some extent, the companies are also playing a Nash game; if one meets the goals and the other fails to do so, the company that fails looks particularly bad. Both companies have paid premiums for goal-rich loan portfolios at year-end to make sure that they have met their goal requirements.<sup>11</sup>

8. Two- to four-unit owner-occupied properties and five- to fifty-unit rental properties qualified for a double-counting bonus.

9. The TAF allowed Freddie Mac to multiply the number of multifamily units in properties with more than fifty units by 1.35 for goal-counting purposes.

10. See OFHEO (2005).

11. See Berenson (2004b).

While it is likely that the affordable housing goals have influenced the behavior of Fannie and Freddie, they may still fail to produce the specific outcomes of sending more credit toward low- to moderate-income borrowers and underserved census tracts. If Fannie and Freddie are crowding out other lenders from these markets, or just compensating originators for making loans they would have made anyway, the goals are not accomplishing very much.

This is the issue that An and coauthors take on directly. They do so using three techniques: an ordinary least squares (OLS) technique exploiting similarities in census tracts immediately adjacent to goal thresholds, a two-stage technique that seeks to use "GSE intensity" as an explanatory variable, and an investigation of Federal Housing Administration (FHA) performance that seeks to determine whether the GSEs are "cream-skimming" the market.

First, they do OLS regressions explaining census-tract-level changes in ownership rates, housing prices, and vacancy rates, where proxies for the goal richness of census tracts are used as explanatory variables along with other appropriate controls. They limit themselves to tracts whose characteristics are just above and just below the thresholds to qualify for a goal.

This empirical strategy is clever. By focusing on tracts that are near qualification thresholds, and by explaining changes in rates, they control for many unobserved characteristics of the tract. Because they have more than 7,000 observations, the power of their hypothesis tests is likely to be more than acceptable. To me, these regressions produce their most convincing result: the goals just do not matter. They use smaller bands to take into account the possibility that they are confounding their results by having bands around the thresholds that are too big (10 percentage points on either side of their thresholds), but they still do not get any explanatory power from the proxies for goals. At this point, the authors would do well to stop; Richard Freeman's three laws of econometrics are that "it" had better be there in the ordinary least squares regression; it had better still be there in the econometrically sophisticated high-tech instrument procedures; and it had better still be there for small technical tweaks to the econometrically sophisticated procedures. "It" is not there in the OLS regressions.<sup>12</sup>

As for the two-stage regressions, the authors in the first stage use the goal characteristics of a census tract to predict "GSE intensity" and then

12. There is a reference to this succinct regression philosophy on Brad DeLong's website. E-mail correspondence with Professor Freeman confirmed that these are, in fact, his "laws."



use GSE intensity in the second stage to predict outcomes. The authors define GSE intensity as the percentage of mortgages in a tract that are purchased by a GSE.

The two-stage regressions become particularly problematic when we consider the first-stage results: the presence of the low- to moderate-income and underserved goals predicts lower levels of what the authors call GSE intensity, while GSE intensity predicts a higher rate of ownership. This suggests that the presence of these goals actually depresses the rate of ownership. The authors themselves note that their first-stage results are problematic.

The authors' final exercise is altogether different: they examine whether the goals have led the GSEs to "cream-skim" high-quality mortgages from FHA. Their technique is to examine whether the credit characteristics of FHA borrowers worsened after the goals were put into place. Their first point is that the credit quality of FHA mortgage pools that originated in 1996 (that is, after the goals were in place) was similar to the credit quality of pools that originated in 1992 (that is, before the goals were in place). Rising housing prices caused mortgage defaults to decline generally over the 1990s. The authors argue that the fact that FHA credit quality did not improve between the 1992 and 1996 pools indicates that the relative quality of FHA mortgages declined with respect to the market. Their second point is that FHA borrowers from the 1996 pool were much less ruthless in refinancing in the face of declining interest rates than FHA borrowers in the 1992 pool. Deng and Gabriel find that borrowers with the highest-quality credit prepay more rapidly than borrowers with lower-quality credit.<sup>13</sup> An and coauthors consequently infer that the decline in ruthlessness reflects a deterioration in the credit quality of FHA borrowers over the 1990s. While it is certainly possible that other changes, such as more flexible underwriting, created the changes in FHA borrower characteristics, the authors' findings are consistent with the hypothesis that the affordable housing goals induced the GSEs to take market share away from FHA.

In any event, the authors' results taken as a whole imply that the affordable housing goals have accomplished little in terms of directing mortgage capital to the "underserved." One could look at the goals as a classic outcome predicted by the public choice literature, which argues that government attempts to cure distortions that it created itself with other distortions.<sup>14</sup> In this particular case, regulators are trying to "cure" a distortion that arises

13. Deng and Gabriel (2006).

14. See Tullock (1965) for the classic argument.

from the existence of Fannie Mae and Freddie Mac: an unnaturally high return on equity to the shareholders of these two companies. This distortion arises from the perceived backing that the two companies receive from the federal government.<sup>15</sup>

The purpose of the goals is to tax the companies and send shareholder benefits to underserved borrowers and neighborhoods. Structured as they are, however, the goals may simply shift profits from Fannie and Freddie shareholders to mortgage originators. An unusually explicit example of this happened in 2003, when Freddie Mac paid Washington Mutual \$6 billion to “borrow” mortgages for goal-counting purposes.<sup>16</sup> This transaction did nothing to add liquidity to the mortgage market anywhere and yet was a perfectly rational reaction by both parties to the goals.

The problem with the goals is that they do not tackle the distortion created by the existence of Fannie Mae and Freddie Mac in a head-on manner. The companies earn large profits because they are allowed to borrow at low risk-adjusted interest rates. Moody’s, for example, notes that it gives Freddie Mac an Aaa rating in part because of “dependence between Freddie Mac and the U.S. government.”<sup>17</sup> In fact, Moody’s states that the default risk of Freddie Mac’s portfolio is at the level of an Aa1-rated financial institution. This is an excellent credit rating and reflects well on the management of the company, but it is still lower than Aaa: the company thus borrows at a lower rate than its credit characteristics warrant.

Congress could tackle this problem directly in one of two ways. It could raise the capital requirements for both companies, or it could follow the suggestion of Glaeser and Jaffee or Jaffee and Quigley and tax Fannie Mae’s and Freddie Mac’s issuance of new debt.<sup>18</sup> The second solution is particularly appealing, because it preserves the ability of Fannie and Freddie to guarantee mortgages—something that has been good for mortgage consumers in the United States—while reducing, if not completely eliminating, the ability of the companies to arbitrage their favorable borrowing position. The money raised via a debt tax could, in turn, be funneled into the Section 8 rental voucher program and, as such, could directly assist those facing the greatest housing needs.

15. I have argued that, on balance, this backing has been a good thing, because it creates liquidity in the market for conventional conforming mortgages. See Green (2005).

16. See Berenson (2004a).

17. Moody’s Investor Services (2006).

18. Glaeser and Jaffee (2006) and the paper by Jaffe and Quigley in this volume.

To make this concrete, consider the impact of a 20-basis-point fee on the issuance of new debt. If the companies have at any one time \$1.5 trillion in debt outstanding and turn debt over every three years, such a fee would produce \$1 billion in revenue each year. This would allow for a \$2,000 housing subsidy for 500,000 low-income renter families. Compared to what is currently in place, this is surely a more effective and efficient policy.

**Joseph Tracy:** The government-sponsored enterprises (GSEs) operate with a number of advantages that generate a sizable flow of subsidies and rents. Jaffee and Quigley, in their paper in this volume, report an estimate from the Congressional Budget Office that puts these rents for 2003 at \$25 billion. An important policy question is how these rents should be allocated. There are three possible recipients: homeowners through lower mortgage rates, targeted communities through government constraints on GSE loan purchases, and the managers and shareholders of the GSEs. The paper by An, Bostic, Deng, and Gabriel examines the evidence on whether government mandates on GSE loan purchases provide any tangible benefits in the targeted neighborhoods. This constitutes the first step in a fuller cost-benefit analysis of the government's decision to allocate some of the GSE rents to these targeted neighborhoods.

As discussed by the authors, the GSE act of 1992 raised the level of loan purchases that the GSEs are required to provide to low-income and minority communities. Without answering the question of what fraction of the rents are allocated through this legislative mandate, the authors address the empirical question of whether this mandate leads to better outcomes in the targeted communities.<sup>1</sup> They look at three specific outcomes: homeownership, vacancy rates, and median home values.

While the paper is largely empirical, the authors offer three hypotheses as to why increasing the level of GSE loan purchases in a community could lead to improvement in the outcomes listed above. The first hypothesis is that low-income and minority communities may have low volumes of mortgages, which creates a problem of informationally "thin markets." Lack of information more generally on borrowers in a community may lead to a higher probability that any given mortgage will be rejected, all else the same. Increasing GSE mortgage purchase activity in a community may induce more mortgage lending overall, thereby creating a positive information externality and higher

1. The estimated magnitude of the rents allocated toward these targeted communities is what the GSEs would be willing to pay to remove this legislative mandate.

acceptance rates. Second, increasing the degree of GSE mortgage purchase activity in a community may increase overall liquidity in the local mortgage market. Finally, GSEs may raise the competitive pressure in a local market, resulting in lower mortgage interest rates, which increases the demand for mortgages.

As a way to organize my discussion of the authors' empirical work, let me start with the following regression specification.

$$(1) \quad Y_{ict} = \mathbf{X}_{ict}\beta + \theta GSE_{ict} + \delta_i + \alpha_{ct} + \gamma_t + \varepsilon_{ict},$$

where  $Y_{ict}$  is an outcome of interest (that is, homeownership, vacancy rates, or median home prices) for city  $i$ , community  $c$ , and time period  $t$ .<sup>2</sup> Factors that may affect these outcomes are captured by the set of explanatory variables in  $\mathbf{X}$ . The variable  $GSE$  measures the share of conventional mortgages purchased by the GSEs. The coefficient of interest is  $\theta$ , which captures the extent to which government-induced increases in GSE mortgage purchases lead to improved community outcomes. The outcomes may involve a rich structure of error components, where  $\delta$  captures city-specific factors not controlled for in  $\mathbf{X}$  that affect the outcome measures,  $\alpha$  captures community-level factors not measured by variables in  $\mathbf{X}$  that affect the outcome measures over time,  $\gamma$  captures aggregate factors such as the business cycle that affect the outcome measures, and  $\varepsilon$  captures all other random influences on the outcome measures.

The principal empirical challenge discussed by the authors is the possibility of endogeneity of the policy variable,  $GSE$ . That is, loan purchase decisions by the GSEs (numerator) or the flow of conventional mortgages (denominator) may be affected by the outcome measures themselves. This would be reflected in the correlation between  $GSE$  and one or more of the error components. As a consequence, estimating equation 1 using ordinary least squares (OLS) would lead to a biased estimate for  $\theta$ .

A first step toward addressing the potential issue of endogeneity of the GSE intensity measure is to difference equation 1 over time. This assumes that the researcher has repeated cross sections of data.

$$(2) \quad \Delta Y_{ict} = \Delta \mathbf{X}_{ict}\beta + \theta \Delta GSE_{ict} + \Delta \alpha_{ct} + \Delta \gamma_t + \Delta \varepsilon_{ict}.$$

2. So long as none of the outcome variables takes a value of 0, the outcome variables can be entered into specification 1 in levels or logs. Alternatively, a logistic transformation can be used for the homeownership rate and the vacancy rate to take into account the fact that these outcome variables are bounded between 0 and 1.

To the extent that the GSE intensity measure is correlated with the city error component or with factors contributing to the community error component that do not vary over time, these sources of correlation will be eliminated in the first-difference specification. However, the change in the GSE intensity measure may still be correlated with the change in the community-specific error component, and so we need to consider finding instruments for  $\Delta GSE$ .

The authors propose a set of instruments that are based on the design of the 1992 GSE act and leverage the geographic detail available in their data. They construct three indicator variables to capture census tracts that are targeted by the 1992 GSE act for special emphasis by the GSEs. The details are provided in the paper. Three other instruments are included in their first-stage regression: an indicator for urban census tracts, the total number of conforming loans in 1995, and the change in the number of conforming loans from 1995 to 2000.

Instruments must satisfy two criteria. They must be correlated with the endogenous variable but uncorrelated with the error components. The authors motivate the construction of the three indicators that identify targeted census tracts, and it seems plausible that they would not be correlated with the change in the community-specific error components. However, the authors do not motivate the remaining three instruments. Assuming that the GSE intensity measure is endogenous, the question is whether the correlation with the community-specific error components arises from a correlation between the magnitude of the GSE loan purchases or the magnitude of the conforming loans in the census tract. This raises some doubt about the validity of including the number of and the change in the number of conforming loans as instruments.<sup>3</sup>

The first-stage regressions are presented in table 5. I focus on the regression for the  $\Delta GSE$ , since this is relevant for estimating equation 2. Two of the three 1992 GSE act indicators are individually significant, but only the *GEOG* indicator has the correct sign.<sup>4</sup> This suggests that, controlling for other factors that affect the GSE purchase intensity in a census tract, the evidence is limited that the 1992 act induced more GSE loan purchases in targeted communities than would have occurred otherwise. As the authors note, the first-stage regression explains only around 2 percent of the observed variation in the

3. An additional possible instrument based on political economy considerations would be an indicator for census tracts located in congressional districts represented on the House Financial Services Committee.

4. This indicator takes a value of 1 for census tracts either with median incomes between 80 and 90 percent of the metropolitan area median income or with more than 30 percent minority and median incomes below 120 percent of the metropolitan area median income.

changes in GSE purchase intensities, so the instruments are very weak (even if one is the wrong sign).<sup>5</sup>

The instrumental variable results are presented in table 6.<sup>6</sup> The authors indicate that the outcome variables and the control variables are entered as percent change. This would correspond to using a log transformation in specification 1. However, there is one difference between the estimated specifications and specification 2. The authors also add control variables in levels (these level effects are not present in specification 2). There is no discussion in the paper of why the level effects are added. The mixing of level and change effects makes interpretation of the findings difficult in that it is not possible to recover the estimate for  $\theta$  directly. Evaluating the effectiveness of the government purchase constraints on the GSEs requires assessing the economic significance of the estimated effects as well as the statistical significance that depends on the magnitude of  $\theta$ .

Given the difficulties in finding strong instruments, an alternative estimation strategy might be worth considering. One approach would be to build further on the geographic detail available in the data. As discussed earlier, in the differenced data any remaining endogeneity problem is caused by local shocks that affect both the GSE measure and the outcome of interest. Suppose that these local shocks spill over to adjacent census tracts, then a difference-in-difference estimator may correct for the endogeneity. That is, for each census tract, one would take the first-difference data from equation 2 and then take a second difference with a contiguous census tract (or the average across all of the contiguous census tracts). This process would difference out the common local shocks that are the likely source of the endogeneity. A downside of this approach is that the two rounds of differencing could exacerbate measurement errors in the data.<sup>7</sup>

The final section of the paper investigates an ancillary question of whether there is any evidence that expanded GSE loan purchases in targeted communities affected the credit quality of the portfolio of FHA-insured mortgages

5. The 2 percent is an upper bound on the joint explanatory power of the instruments on the change in the GSE measure since the first-stage regression reported in table 5 contains seven additional variables, three of which are individually statistically significant.

6. It would be helpful if the authors had provided readers with the corresponding OLS results that could be compared to the instrumental variable results. The authors were able to increase the size of the estimation sample significantly by using observations with missing values for one or more control variables. Missing values were imputed using variable means. The authors need to adjust the standard errors accordingly.

7. This depends on the specific properties of the measurement error in the data.

in these communities. The hypothesis to be tested is that if GSE loan purchases increase the availability of conventional mortgages in targeted communities, then this might induce at the margin better-credit households to switch from FHA to lower-priced conventional mortgages.

Descriptive statistics on characteristics of FHA mortgages are provided in table 7. FHA mortgages originated in 1992 are taken as a control sample and then compared to FHA mortgages originated in 1996. A cleaner control or treatment sample would be to restrict the FHA data to mortgages originated in the census tracts used in the earlier analysis (that is, those between 80 and 100 percent of the median income) and to interact the three indicators for targeted communities with the 1992 and 1996 samples. That is, the 1992 and 1996 samples from nontargeted communities would be the control sample, while the 1992 and 1996 samples from the targeted communities would be the treatment sample. This would permit a difference-in-difference approach to checking to see if there are indications of deterioration in credit quality.

Tables 8 and 9 examine prepayment and default behavior, which is meant to capture consequences of any composition shift in the quality of the underlying mortgages. Table 9 provides estimates from a Cox hazard model of prepayment and default rates using vintages of FHA mortgages from 1992 to 1996. There are two possible implications of composition shifts induced by the GSE act. First, if FHA loans originated following implementation of the GSE goals are of poorer credit quality, the authors hypothesize that these loans should dampen responses to the interest incentive to prepay. Second, for FHA loans originated prior to implementation of the GSE goals, any composition shift should show up as higher prepayment rates following the implementation date (again reflecting greater access to cheaper conventional mortgages following implementation).

The authors estimate a Cox proportional hazard model that allows for both prepayments and defaults. The FHA data permit a very rich set of controls to identify the baseline prepayment and default behaviors. Indicators are included that take a value of 1 following implementation of the GSE affordable goals, indicators for the targeted census tracts (same definitions as used in the earlier analysis), and interactions between these indicators as well as interactions with the incentive variables for refinance and default. To identify the two distinct implications of the composition shifts, however, we would need to refine the indicators to control for the pre- and post-implementation vintages of FHA mortgages. That is, the pre-implementation vintage of FHA mortgages that were originated in targeted communities should have a heightened rate of prepayment only after 1995 as well as a heightened response to

the prepayment incentive (again relative to similar FHA mortgages in non-targeted communities). This is the manner in which the composition effect works for this set of loans. In contrast, the post-implementation FHA mortgages in targeted communities should have a decreased prepayment rate and response to the prepayment incentive. This reflects the fact that any composition effect for these loans takes place at origination.

In summary, this paper addresses the important policy question of whether legislative restrictions on the GSE loan purchases provide any positive externalities to the targeted communities. This is an important first step in a fuller cost-benefit analysis of whether this is a worthwhile way to allocate some of the GSE rents. The authors provide a good first pass at this issue and bring interesting data to bear on the question.



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