Mitigating Information Externalities in Mortgage Markets: The Role of Government-Sponsored Enterprises

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Abstract

Financial theory, supported by recent empirical evidence, suggests that property transactions in a particular market area generate information that makes similar future transactions in that area less risky for prospective lenders. Specifically, information from home sales helps appraisers develop more precise value estimates, which reduce the uncertainty (risk) faced by lenders and, in turn, may increase acceptance rates and the flow of funds to the given market area. Interestingly, Federal housing policy efforts have been noticeably absent in the assessment and correction of these potential mortgage market imperfections known as information externalities.

Using a sample of government-sponsored enterprise (GSE) purchasing activities across 12 Florida counties, we find both Fannie Mae and Freddie Mac are more active in neighborhoods with historically low transaction volume than they are in other neighborhoods. In addition, the results of our investigation are generally consistent with the previous literature suggesting Fannie Mae outperformed Freddie Mac in historically underserved market segments in 1993–95. Finally, when the analysis is restricted to loans with a high imputed payment relative to borrowers' income, we again find that Fannie Mae and Freddie Mac are more active in neighborhoods with historically low transaction volume. These findings are consistent with the view that GSE activity mitigates information externalities, at least within our 12-county sample.

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Cityscape 115

Fannie Mae and Freddie Mac enjoy the benefits of implicit government guarantees supporting their issuance of mortgage-backed securities and debt securities. In exchange for their legislated borrowing advantages, these government-sponsored enterprises (GSEs) are required to help further the government's housing policy objectives, most notably by increasing the flow of credit for low-income housing and underserved mortgage markets. Currently, these objectives are implemented through percentage-of-business goals that specify the minimum acceptable level for GSE purchases of mortgage loans in categories defined in legislation and regulations.[1,2] Specifically, HUD defines targeted lending for GSE purchases along the following three dimensions:

■ Loans to low- and moderate-income borrowers.

■ Loans to low-income borrowers in low-income and very low-income areas.

■ Loans in areas with high concentrations of low-income or minority residents.

Although these goals were designed to improve the "social lending" performance of both organizations, empirical research suggests that neither Fannie Mae nor Freddie Mac occupy a dominant leadership role in expanding the availability of affordable housing at the national level.[3] One area in which Federal housing policy efforts have been noticeably quiet is in the assessment and correction of information externalities in home mortgage markets.

The Information Externality Hypothesis

William Lang and Leonard Nakamura's (1990, 1993) seminal work provides the foundation for investigating the existence and significance of information externalities in home mortgage lending. They argue that individual home sale transactions generate information that makes future transactions less risky to lenders. Specifically, their analysis begins with the observation that lenders' decisions to accept or reject applications for mortgage financing are based—at least in part—on the point or range estimates of values provided by independent appraisers. Appraisal estimates, in turn, are based on the recent selling prices of comparable units within a given market area. In areas with few recent transactions, appraisers will have a relatively difficult time providing precise estimates of market value, accept/reject decisions on the part of lenders will be plagued by more uncertainty and, therefore, rejection rates will be higher. If historically low-volume areas tend to be areas with relatively high populations of minorities or low-income families, then analyses of lending patterns that omit information variables such as historic sales levels and lower price appreciation rates may lead to the mischaracterization of lending patterns. For example, the results from an economically rational decisionmaking process on the part of lenders may be misinterpreted as the presence of irrational redlining or discriminatory behavior on the part of lenders.

To date, only three major empirical investigations have explicitly addressed information externalities in home mortgage markets. First, using a nationwide data set of major metropolitan areas, Paul Calem (1996) finds information externalities at work across primarily White census tract groupings. Interestingly, no such externalities can be detected across minority tracts. David Ling and Susan Wachter (1998), on the other hand, using data for Dade County (Miami), Florida, find strong evidence of information externalities exerting an economically significant influence across all tract groupings. Specifically, they find that an increase of one standard deviation in historic appreciation rates and sales levels between neighborhoods increases the probability of acceptance on home mortgage applications by 3 to 4 percentage points, with applications in minority neighborhoods being more sensitive to such information effects. Both studies employ data

exclusively from 1990, a period of economic recession (particularly in real estate markets), during which Lang and Nakamura (1990, 1993) hypothesize that information effects should be most pronounced. Harrison (1999) overcomes the deficiencies inherent in these single-period analyses and provides the first multiperiod evidence of the existence, persistence, and economic significance of information externalities in home mortgage lending. Specifically, he examines the Pinellas County (St. Petersburg), Florida mortgage market from January 1993 through December 1995. His results suggest that controlling for differential operating characteristics across lending institutions (lender heterogeneity) reduces the significance of variables that suggest redlining or disparate outcomes across racial or income classifications but enhances the explanatory power and economic significance of information effects in underwriting decisions.

From a public policy perspective, these externalities may be viewed as a market imperfection in which prospective borrowers may be able to obtain financing in high-volume areas but are unable to borrow funds for an equivalent housing unit in a lower activity neighborhood. This outcome runs counter to U.S. housing policy objectives as it implies that credit decisions may be based on factors other than the borrower's underlying willingness and ability to pay. Furthermore, the existence of such externalities may provide justification for narrowly tailored government intervention in U.S. housing markets. For example, if GSEs such as Fannie Mae and Freddie Mac are prepared to increase their purchases of mortgages from low-activity neighborhoods, lenders would be more willing to extend credit in these areas. Increased lending would, in turn, mitigate future information effects, breaking the cyclical pattern of information-based neighborhood disinvestment.[4] Narrowly tailored government intervention in the mortgage market, specifically designed to mitigate the effects of information externalities in home mortgage markets, may enhance the efficiency of underwriting decisions for lenders, stimulate the flow of credit to economically disadvantaged neighborhoods, and further government housing policy objectives by increasing homeownership rates.

The purpose of the current investigation is to examine the purchasing activities of Fannie Mae and Freddie Mac across census tracts in a sample of 12 Florida counties to identify the role and relative importance of each institution in combating information problems in the mortgage market. Our results indicate that both Fannie Mae's and Freddie Mac's lending activities help mitigate information externalities in the mortgage market. Specifically, the number and dollar volume of loan purchases made by each GSE relative to current transaction volume within a census tract are both inversely related to historic transaction volume (as a percentage of the housing stock). Furthermore, using a subset of loans with high imputed payments relative to borrowers' income, for which appraisal values should be most critical for lenders, we again find an inverse relationship between historic transaction volume and the percentage of purchases by both GSEs. Finally, our results are generally consistent with the previous literature suggesting that Fannie Mae outperformed Freddie Mac in historically underserved market segments in 1993–95.

Data

Four primary data sources were combined to analyze the role of Fannie Mae and Freddie Mac in mitigating information externalities in home mortgage markets. First, the Census Tract File from the GSE Public Use Database (PUDB) was used to obtain information on the number and principal balance of single-family mortgages purchased by each GSE. Over the 1993–95 interval, Fannie Mae purchased 94,754 single-family mortgages valued at $6.88 billion while Freddie Mac purchased 60,182 loans valued at $4.51 billion in the 12 counties in this study.[5] A complete breakdown of GSE activity by year, entity, number of purchases, and dollar value of purchases for these counties is available in an online

file, "GSE Mortgage Purchasing Activities: 12 Florida Counties, 1993–1995."[6] PUDB records were also used to identify each borrower's annual income and race. Second, census data were used to create expanded neighborhood profiles at the census tract level. These neighborhood profiles include population and housing stock characteristics. Third, Home Mortgage Disclosure Act (HMDA) data were collected and summed to measure the size of the conventional, conforming mortgage market by census tract. Finally, Florida Department of Revenue (DOR) property tax records were geo-coded to provide information regarding historic transaction volumes and house price appreciation rates at the census tract level for the counties included in the investigation.[7]

Each set of data was collected for a sample of 12 Florida counties: 3 densely populated (Broward, Hillsborough, and Orange), 3 moderately populated (Alachua, Leon, and Marion), and 6 rural (DeSoto, Gilchrist, Holmes, Lafayette, Putnam, and Washington).[8] These counties contain a total of 601 census tracts.[9] The sample, which is geographically and demographically diverse, was selected to provide a broad cross-section of Florida's housing markets.[10]

Descriptive statistics for each of these data categories are provided in exhibit 1. A close examination of the data in each section of the exhibit provides unique insight into Florida's housing markets. The first two variables report information on historic home sales transaction rates and sales price trends based on the DOR data.[11] The transaction rate variable represents the total number of units sold in the tract in the previous 3 years (that is, 1990–92 for 1993, 1991–93 for 1994, and 1992–94 for 1995) divided by the number of single-family detached units in the tract in 1990 (from the decennial census). Approximately 10 percent of all single-family homes transacted during the 3-year period. Similarly, the historic house price appreciation rate for each tract represents the geometric average annual appreciation rate for 1990–92, 1991–93, and 1992–94 as shown by DOR data. Exhibit 1 shows that the average over all tracts in the 12-county area is 3 percent.

Turning to tract population characteristics as revealed by 1990 census data, we observe that the typical tract has almost 6,000 residents, of which roughly 21 percent are racial minorities. One-fourth of all tracts have a minority population in excess of 25 percent.[12] The average median income across the sample is almost $28,000, and 6 percent of households receive public assistance income. Nearly three-fourths of adults over age 25 have a high school diploma or the equivalent, and one-fourth of residents are at, or near, retirement age in the typical Florida neighborhood.

Housing stock characteristics, from the 1990 census, also provide interesting information. The typical tract has nearly 2,700 housing units, of which 64 percent are owner-occupied, whereas 12 percent stand vacant. According to census estimates, the typical unit is approximately 20 years old, with a median year built of 1971, and has an owner-estimated worth of nearly $84,000. In addition, the relative rental cost, which is calculated by dividing the tract's selected monthly rental costs by the tract's selected monthly owner costs as recorded in the 1990 U.S. census data, was only 28 percent. This is consistent with the notion that rental properties (and their residents) are concentrated in the low-moderate price (income) range, whereas wealthier individuals are more likely to own their homes.

A review of loan and borrower characteristics based on PUDB data reveals that the underlying borrowers whose loans were purchased by either GSE had a relatively modest loan-to-income ratio of 1.39. The difference in borrower income variable for each tract represents the difference between the average borrower income on loans purchased by the GSEs in the tract and the 1990 tract median income. The average value across all

Exhibit 1

Neighborhood and Borrower Characteristics in 12 Florida Counties, 1993–95

Variable	Mean	Standard Deviation
Information variables		
Historic home sales transaction rate (%)	10	77
Historic home price appreciation rate (%)	3	11
Population characteristics		
Census tract population (*n*)	5,778	4,559
Minority population (%)	21	26
Minority concentration >25% (%)	25	43
Median income ($)	27,899	11,897
On public assistance (%)	6	6
High school graduates (%)	74	15
Residents aged ≥ 55 (%)	25	14
Housing stock characteristics		
Housing units (*n*)	2,657	2,199
Median house value ($)	83,738	57,744
Relative rental cost (%)	28	7
Median year built	1971	9.81
Owner occupied (%)	64	22
Vacant (%)	12	8
Loan and borrower characteristics		
Average loan-to-income ratio	1.39	0.30
Difference in borrower income ($)	24,985	16,513
Difference in racial composition (%)	11	20

Notes: The counties studied were Alachua, Broward, DeSoto, Gilchrist, Hillsborough, Holmes, Lafayette, Leon, Marion, Orange, Putnam, and Washington. Figures are based on all 601 census tracts.

Sources: GSE PUDB, Florida DOR, 1990 U.S. census

tracts in the sample is nearly $25,000, implying an average borrower annual income of nearly $53,000. The difference in racial composition variable for each tract represents the difference between the minority percentage for loans purchased by the GSEs in the tract and the minority concentration among all residents of the tract from the 1990 census. The value shown in exhibit 1 indicates that racial minorities comprised 32 percent of borrowers in the 12 counties, or 11 percentage points more than the general population.

Finally, considerable disagreement exists regarding the appropriate methodology for estimating the size of the mortgage market. Traditional studies of GSE performance have relied on HMDA data to estimate the size of the relevant market and assess GSE penetration. Recent empirical evidence, however, calls into question the use of such methodologies. For example, Berkovec and Zorn (1996) find HMDA records appear to account for only 70 to 75 percent of total lending volume. Perhaps more troubling, they also demonstrate that coverage rates vary systematically along neighborhood racial and income

dimensions. Specifically, they find evidence of consistently higher coverage ratios for low-income tracts and argue that the exclusive use of HMDA data to estimate mortgage market volume biases policy analyses toward overstating the size of the low-income market relative to the broader market. In the current investigation, the HMDA analysis must be limited to the 572 tracts (1,716 observations) within the 6 metropolitan counties in the sample; the DOR-based analysis has the advantage that it can cover the additional 29 tracts (87 observations) in the 6 nonmetropolitan counties.[13]

To overcome these potential problems, the current investigation uses two approaches. First, we employ the traditional HMDA-derived market share approach through the main body of the text. However, rather than rely exclusively on the potentially biased HMDA-based estimates of market size, we also scale GSE purchases (and dollar value of purchases) by real estate transaction volume (and value) calculated directly from Florida DOR property tax records. These data are believed to be both more complete and more reliable than their HMDA counterparts. Unfortunately, these records indicate only home sales prices and not mortgage values. Thus, they measure real estate transaction volume, not mortgage market origination volume. They also include nonmortgaged properties and exclude refinanced properties. Furthermore, if loan-to-value ratios vary systematically across neighborhood characteristics or time, we could be biasing our results in a similar fashion to that reported above. Exhibit 2 presents descriptive statistics for each dependent variable employed throughout this investigation: regression results from using this non-traditional DOR-derived size measure of the conventional conforming mortgage market are found in appendix A.

Exhibit 2 shows that many of the market share estimates exceed one. This results from the exclusion of refinance loans from the market-size calculations for both the HMDA and DOR metrics and is, therefore, not surprising. Comparing the calculated GSE market share estimates across the alternative market-size models reveals generally larger estimates under the HMDA specifications. Interestingly, a close examination of Fannie Mae and Freddie Mac reveals that Fannie Mae purchases significantly more loans within the 12-county area than does Freddie Mac. These differential activity levels do not appear to be systematically related to neighborhood characteristics and thus may be attributable primarily to Fannie Mae's larger scale of operation relative to Freddie Mac.

Estimates of GSE market share begin with an analysis of the size of the relevant/target market. To calculate the size of the conventional conforming mortgage market, we collected data regarding the number and dollar volume of all approved, single-family home purchase mortgage applications within the given census tract from HMDA loan application registers. Jumbo loans, mortgages in excess of $203,150 for each sample year, were then explicitly removed from our calculation. In addition, loans insured by either the Federal Housing Administration or Farmers Home Administration, as well as those guaranteed by the Department of Veterans Affairs (VA), were also dropped. These restrictions allow us to focus on the activities of the GSEs as a determinant of mortgage market participation. Finally, only home purchase loans were retained. Excluding refinancings enhances the comparability of HMDA-based results relative to those derived from DOR data. Market share estimates based on both the number of purchases and unpaid principal balance can then easily be calculated by dividing GSE purchase figures obtained directly from PUDB data by these HMDA-based market-size estimates.

DOR-derived market share estimates are similarly constructed by first collecting the transactions prices of all single-family, owner-occupied, arms-length home sales within each tract. This time, market share is calculated by dividing GSE purchases, as reported in PUDB records, by DOR recorded sales volume for the tract. As mentioned above,

Exhibit 2

Descriptive Statistics for Market Share and Peer Comparison Variables

Variable	Observed	Mean	Standard Deviation
Government-sponsored enterprises			
GSE UPB/HMDA UPB	1,639	1.80	4.18
GSE UPB/DOR UPB	1,504	1.32	3.67
GSE total loans/HMDA total loans	1,639	1.64	1.87
GSE total loans/DOR total loans	1,504	1.60	3.19
GSE high-stress UPB/GSE total UPB	889	5.76%	6.19%
GSE high-stress loans/GSE total loans	889	3.77%	3.66%
Fannie Mae			
Fannie Mae UPB/HMDA UPB	1,614	1.15	3.07
Fannie Mae UPB/DOR UPB	1,481	0.83	2.44
Fannie Mae total loans/HMDA total loans	1,614	1.04	1.38
Fannie Mae total loans/DOR total loans	1,481	0.98	1.96
Fannie Mae high-stress UPB/Fannie Mae total UPB	709	7.51%	9.92%
Fannie Mae high-stress loans/Fannie Mae total loans	709	4.93%	5.50%
Freddie Mac			
Freddie Mac UPB/HMDA UPB	1,555	0.70	1.32
Freddie Mac UPB/DOR UPB	1,437	0.53	1.33
Freddie Mac total loans/HMDA total loans	1,555	0.64	0.64
Freddie Mac total loans/DOR total loans	1,437	0.66	1.35
Freddie Mac high-stress UPB/Freddie Mac total UPB	578	8.70%	9.51%
Freddie Mac high-stress loans/Freddie Mac total loans	578	5.60%	5.40%
Fannie Mae versus Freddie Mac			
Fannie Mae UPB/Freddie Mac UPB	1,530	1.86	1.43
Fannie Mae total loans/Freddie Mac total loans	1,530	1.95	2.72
Fannie Mae high-stress UPB/Freddie Mac high-stress UPB	402	1.18	1.05
Fannie Mae high-stress loans/Freddie Mac high-stress loans	402	1.29	1.36

Note: UPB = unpaid principal balance; HMDA = Home Mortgage Disclosure Act; DOR = Florida Department of Revenue.

Sources: GSE PUDB, HMDA, Florida DOR

these records represent a direct measure of the size of the housing market, not the mortgage market. Thus, if loan-to-value ratios vary systematically across neighborhood characteristics, the DOR-derived market share estimates could be potentially biased. In addition, to the extent that Florida DOR records are more accurate and complete than

HMDA data, GSE market share estimates based on the DOR-derived market-size model should be smaller than their corresponding HMDA-based market share estimates. Interestingly, although the two alternative market-size calculations exhibit considerable dispersion, the qualitative results of this investigation, particularly with regard to information externalities, are surprisingly robust across the alternative metrics.

Stage 1: GSE Purchasing Activities

To address the issue of GSE participation in low-activity neighborhoods, we employed a three-tiered investigation that first examined the purchasing activities of Fannie Mae and Freddie Mac within the 12-county area. Specifically, the ratio of GSE mortgage purchase volume to total market volume within each census tract was regressed against the tract-level attributes described above to capture the economic, demographic, and information dynamics of the local mortgage market. The analysis employed a multivariate, ordinary least squares (OLS) regression of the following general form:

RATIO = f (Information Externalities, Neighborhood Characteristics, Housing Stock Characteristics, Applicant Characteristics, ε),

where RATIO is the ratio of GSE loan purchases to total transaction volume within the census tract. The ratio is calculated using both the number of transactions and the dollar value of those transactions. Information externality variables include the historic transaction volume within the census tract and historic house price appreciation rates. Transaction volume is calculated on a rolling basis as the percentage of the total housing stock that sold in the 3 years preceding the estimation interval. Appreciation rates are calculated as the 3-year, annualized, geometric change in the median house price index for the census tract.[14]

Population characteristics entering our model include the population of the census tract, the median household income within the tract, the tract's racial composition, a zero/one indicator variable identifying census tracts with a high concentration of racial minorities, the percentage of the tract's households receiving public assistance income, the percentage of the tract's residents with a high school diploma or equivalent, and the percentage of the tract's residents 55 years of age and older. A legitimate question is why each of these variables has been included in the model specification. First, consider the population variable. Many tracts within metropolitan areas are composed primarily of commercial or industrial space. Similarly, many rural counties have sparsely populated neighborhoods (Block Numbering Areas). To the extent the GSEs are disproportionately (in)active in such regions with low population growth, our results could be driven by growth-induced extreme value observations. Tract population is included in our regression specification to help mitigate this possibility.[15]

Next, we have included two variables to control for the potentially disparate treatment of ethnic minorities. The fraction of the tract's population that is non-White ranges from zero to one and measures the ethnic diversity of the tract. Consistent with the previous literature, we have also included a dichotomous zero/one indicator variable to identify tracts with more than 25-percent non-White residents.[16] A rationale for the inclusion of this variable is that discriminatory lenders may find a neighborhood unacceptable once a threshold level of diversity has been attained.

Finally, we have included four variables designed to control for differing aspects of neighborhood wealth. Median household income is included as a measure of current period cash flows. Higher income areas may well be associated with lower default risk and,

therefore, higher levels of GSE investment. Alternatively, if GSEs refrain from purchasing loans made to low- and moderate-income borrowers, we would also expect a positive relationship between income and market share. The percentage of the tract's residents receiving public assistance income measures the very low-income segment of the population and can thus serve as a proxy for Community Reinvestment Act (CRA) eligibility. Therefore, GSE market share may rationally be expected to be lower in tracts characterized by a high degree of welfare recipients because regulated depository institutions may be originating loans for CRA credit and holding them in portfolio. Similarly, the percentage of the tract's residents with a high school diploma or the equivalent is a direct measure of educational attainment and may be construed as an index of wealth in the sense of human capital. Again, higher wealth levels may rationally be expected to reduce default risk, resulting in higher levels of GSE activity. Finally, the age of the tract's residents, particularly in regions with a high percentage of retirees, such as we have in our sample, is often correlated with accumulated wealth and thus lower default risk.

Housing stock attributes include the number of housing units within the tract, median house value, relative rental cost, median year built, percentage of units occupied by the owner, and the percentage of units standing vacant. As discussed above with respect to tract population, the number of housing units within the tract is included to reduce the effect of extreme value observations.[17] Median house values, after controlling for resident income and wealth, may be construed as a measure of affordability. Other things being equal, the lower the price of housing within a given area, the greater the pool of potential buyers seeking conventional conforming financing. The relative rental cost is calculated by dividing the tract's selected monthly rental costs by the tract's selected monthly owner costs as recorded in the 1990 census data. To the extent that rental housing is easily available and affordable, the transitory costs of mortgage default (that is, default externalities) may be reduced. All else the same, lower default costs should be associated with increased default risk.

Median year built is an inverse measure of neighborhood age. Given specific prohibitions against the use of neighborhood age as an appraisal tool by both GSEs, we would expect this variable to be unrelated to GSE market share unless the GSEs face an adverse selection problem along this dimension. For example, if older neighborhoods are more stable and represent safer investments, underwriting lenders may choose to retain properties in established neighborhoods for their own portfolios while passing on properties in the higher risk new neighborhoods to secondary market purchasers. Alternatively, if investment risk increases with neighborhood age, underwriting lenders may rationally choose to pass on a disproportionate percentage of properties located in older neighborhoods. The inclusion of median year built in our model specification is designed to investigate these conflicting possibilities.

Percentage owner occupied is frequently added to mortgage and housing market models as a proxy for neighborhood amenities and/or condition. Owner occupants have stronger incentives than renters to maintain and enhance property values, as they effectively hold a call option on the market value of the house (if prices go up, owners capture the gain but renters do not). Thus neighborhoods characterized by a high degree of owner occupancy may be attractive for investment. Similarly, vacant structures may represent uninhabitable, or at least undesirable, units or locations. Thus neighborhoods exhibiting a high percentage of such structures may be differentially risky. Therefore, if GSEs face an adverse selection problem with underwriting lenders along this dimension of neighborhood risk, we would expect market share to be directly related to the percentage of units standing vacant within the tract.

Finally, to control for the importance of loan and borrower characteristics, the average loan-to-income ratio for all loans purchased within the tract, the difference between the average borrower income on loans purchased and the median income within the tract, and the difference between the racial composition of loans purchased and the racial composition of the tract are included in the regression specification.

We must stress that the focal point of this investigation is information externalities. A significant negative coefficient on either information variable would be consistent with GSE activity helping to alleviate information problems, as it would indicate that they are relatively active in informationally deficient neighborhoods. Conversely, positive coefficients would suggest that GSE purchases lag behind market competitors in low-information areas. Neighborhood and housing stock characteristics also provide unique insight into the functioning of the secondary mortgage market, but should be interpreted with caution because of the high degree of collinearity between many of the characteristics.

It is also interesting to note the degree of correlation between historic transaction volume rates, our primary measure of informational adequacy, and our population and housing stock characteristics. Exhibit 3 examines this issue. Consistent with intuitive expectations, transaction volume rates appear to be positively correlated with neighborhood measures of wealth and educational attainment. Similarly, transactions volume appears low in minority tracts, tracts with a high percentage of residents on public assistance, and in neighborhoods characterized by a large number of vacant structures. These correlations suggest that the concept of informationally deficient neighborhoods based upon historic transactions volume rates may be similar in nature to the current regulatory definitions of underserved and targeted markets.

Exhibit 4 presents results from this first stage of the analysis. RATIO is defined in terms of the dollar volume of loans purchased relative to the total dollar volume of all transactions within the census tract. The first column exclusively employs purchases made by Fannie Mae, the second column uses only Freddie Mac's purchases, and the third column combines Fannie Mae's and Freddie Mac's activities to arrive at a figure for total GSE purchases. Borrower characteristics are similarly defined over the purchaser subsets, whereas information, neighborhood, and housing stock attributes remain constant over the three columns.

The results from exhibit 4 provide evidence that is consistent with the GSEs playing a role in mitigating information externalities in home mortgage markets. The coefficients on historic transaction volume in all three columns are strongly negative, indicating that both Fannie Mae and Freddie Mac purchase a relatively larger dollar volume of loans in low-activity neighborhoods than they do in high-activity areas. One explanation for these findings is that GSEs face an adverse selection problem.[18] Fannie Mae and Freddie Mac both have standing arrangements with qualified lenders to purchase any loan that conforms to a prespecified set of underwriting criteria. Sophisticated lenders will recognize appraisal uncertainty as a legitimate risk factor and thus may be inclined to sell a higher proportion of loans in low-activity neighborhoods than in high-volume areas. From a societal perspective, this arrangement may well be optimal because in the absence of a strong secondary market, many of these loans in informationally deficient markets would never be originated or would be originated at terms less favorable to borrowers. GSEs may be the most appropriate risk bearers, because, to the extent that idiosyncratic neighborhood default risk can be geographically diversified away, large nationwide secondary market purchasers may facilitate efficient diversification of this information-based risk.

Exhibit 3

Correlation Coefficients Between Historic Home Sales Transaction Rates and Explanatory Variables

Variable	Correlation Coefficient
Information variables	
Historic home price appreciation rate	0.0014
Population characteristics	
Census tract population	0.0857
Minority population	–0.1729
Minority concentration >25%	–0.2002
Median income	0.4388
On public assistance	–0.2430
High school graduates	0.3198
Residents aged ≥ 55	–0.2258
Housing stock characteristics	
Number of housing units	–0.0071
Median house value	0.1178
Relative rental cost	–0.1789
Median year built	0.2725
Owner occupied	0.2827
Vacant	–0.2321
Loan and borrower characteristics	
Average loan-to-income ratio	0.2233
Difference in borrower income	–0.1298
Difference in racial composition	0.0670

Sources: GSE PUDB, Florida DOR, 1990 U.S. census

These findings are also consistent with the previous work of Freddie Mac (1996), which concludes that GSEs provide liquidity to the mortgage market during periods of economic recession when traditional lenders withdraw. Specifically, internal Freddie Mac research documents an increasing market share in California, Texas, and New York during periods of economic recession. To the extent that census tracts exhibiting low historic transaction volume are economically depressed or face high economic uncertainty, the current investigation provides further evidence of increased GSE activity in tough economic times.

Continuing our examination of exhibit 4, we find that GSEs are somewhat more active in highly populated regions, in low-value tracts, and in areas characterized by relatively few housing units. Again, these factors are consistent with Fannie Mae and Freddie Mac facing an adverse selection problem. Interestingly, examining the DOR-derived results in appendix A, we find that both Fannie Mae and Freddie Mac also appear to be relatively more active in more recently developed neighborhoods. We find this result quite surprising, because both agencies explicitly forbid the use of neighborhood age as a decision tool. For example, according to Fannie Mae:

Exhibit 4

Ordinary Least Squares Regressions Using HMDA-Derived Market Share Metric Explaining Investment by GSEs in Six Florida Counties, 1993–95

Variable	Fannie Mae	Freddie Mac	Total GSE
Constant	3.65 (0.37)	0.32 (0.07)	7.12 (0.55)
Information variables			
Historic home sales transaction rate	–2.02 (–2.36)**	–0.78 (–2.39)**	–2.59 (–2.46)**
Historic home price appreciation rate	–1.39 (–2.06)**	–0.33 (–0.86)	–1.48 (–1.54)
Population characteristics			
Census tract population	0.15 (1.89)*	0.05 (1.73)*	0.20 (1.93)*
Minority population percentage	0.65 (0.71)	–0.02 (–0.08)	0.31 (0.30)
Minority concentration >25%	–0.72 (–1.60)	–0.20 (–1.00)	–0.93 (–1.43)
Median income	–0.005 (–0.37)	0.001 (0.19)	–0.003 (–0.14)
On public assistance	4.13 (1.52)	2.32 (2.12)**	5.53 (1.62)
High school graduates	1.52 (1.46)	1.13 (2.54)**	2.25 (1.49)
Residents aged $\geq$ 55	–0.73 (–0.90)	–0.015 (–0.04)	–0.78 (–0.68)
Housing stock characteristics			
Number of housing units	–0.30 (–1.80)*	–0.12 (–1.72)*	–0.40 (–1.82)*
Median house value	–0.004 (–2.41)**	–0.002 (–2.44)**	–0.004 (–2.59)***
Relative rental cost	–0.84 (–0.43)	–0.19 (–0.23)	–1.08 (–0.41)
Median year built	–0.002 (–0.39)	–0.0005 (–0.21)	–0.004 (–0.52)
Owner occupied	1.43 (2.15)**	0.49 (1.59)	1.77 (2.04)**
Vacant	3.45 (1.72)*	1.12 (1.24)	3.89 (1.48)
Loan and borrower characteristics			
Average loan-to-income ratio	–0.07 (–0.27)	0.11 (0.65)	–0.27 (–0.99)
Difference in borrower income	0.01 (1.59)	0.004 (2.40)**	0.01 (1.03)
Difference in racial composition	–1.05 (–1.35)	–0.14 (–0.55)	–1.82 (–1.39)
Number of observations	1,369	1,327	1,383
F (18, n–19)	1.72**	1.05	1.55*
R^2	0.0224	0.0142	0.0200

*Significant at the 90-percent level.
**Significant at the 95-percent level.
***Significant at the 99-percent level.

Sources: GSE PUDB, HMDA, Florida DOR, 1990 U.S. census

> A neighborhood analysis should consider the influence of social, economic, government, and environmental forces on property values in the subject neighborhood. However, neither the racial composition nor the age of a neighborhood is an appraisal factor. A property located in an older neighborhood can be as sound an investment as a property located in a new neighborhood (Federal National Mortgage Association, 1995).

> In addition, the appraisal must not improperly take into consideration the property modifications made to accommodate handicapped persons, or the age or location of a dwelling, or the age of the neighborhood or census tract where the dwelling is located (Federal Home Loan Mortgage Corporation, 1996).

Finally, Fannie Mae and Freddie Mac both appear to be (marginally) more active in neighborhoods where borrower incomes exceed median tract incomes.

Exhibit 5 alters the dependent variable to examine the number of housing units associated with the GSEs' loan purchases as a fraction of the total number of home sales rather than in terms of dollar volumes. Once again, we find evidence consistent with GSEs playing a relatively large role in low-activity market segments. Using this specification, Fannie Mae and Freddie Mac appear to be active in heavily populated regions and tracts exhibiting relatively high fractions of residents receiving public assistance. Low-value districts again appear to be GSE strongholds, as are tracts with relatively few housing units. Under this alternative specification, applicant characteristics do not appear to be related to the purchasing activities of either Fannie Mae or Freddie Mac.

To further characterize the performance of Fannie Mae and Freddie Mac relative to the broader market, we have broken out the number and dollar value of purchases in low-volume tracts by county. Specifically, appendix B contains three exhibits. Exhibit B–1 shows the number of tracts that are classified as low-volume in 1 or more of the 3 years of the study and the total number of tracts in each county. Exhibit B–2 shows the number of GSE purchases occurring in tracts with low historic transaction volume, as a percentage of total GSE purchases in the county. Exhibit B–3 shows the dollar volume of GSE purchases occurring in tracts with low historic transaction volume as a percentage of the total dollar value of all GSE purchases within the county. Exhibits B–2 and B–3 also include a Total Volume column that delineates the percentage of all HMDA reported transactions (and the dollar volume of transactions) occurring in low-transaction volume tracts. These low-volume areas are defined as any tract in which less than 1 percent of the housing stock transacted within the past 3 years.[19, 20] Consistent with the previously reported empirical results, these exhibits suggest the GSEs' percentage of purchases lead the marketwide (HMDA) totals in the most stagnant counties (Alachua and Washington) and trail the totals in many of the counties with more rapid turnover.

Finally, unreported nonparametric tests consistently reaffirm our findings of increased GSE market share in historically low-transaction volume census tracts.[21]

Stage 2: Relative Performance of Fannie Mae and Freddie Mac

Previous empirical research, such as that of Harold Bunce and Randall Scheessele (1996), suggests that Fannie Mae outperforms Freddie Mac in most aspects of socially beneficial lending. Stage 2 of this investigation examines what factors, if any, explain differences in the purchasing activities of Fannie Mae and Freddie Mac across our 12-county DOR sample. The answer to this question may have significant public policy

Exhibit 5

Ordinary Least Squares Regressions Using HMDA-Derived Market Share Metric Explaining Number of Loan Purchases by GSEs in Six Florida Counties, 1993–95

Variable	Fannie Mae	Freddie Mac	Total GSE
Constant	11.23 (1.80)*	5.97 (1.86)*	18.13 (2.08)**
Information variables			
Historic home sales transaction rate	–0.99 (–2.26)**	–0.14 (–0.80)	–0.97 (–1.73)*
Historic home price appreciation rate	–0.93 (–2.49)**	–0.32 (–1.79)*	–1.17 (–2.33)**
Population characteristics			
Census tract population	0.07 (2.09)**	0.03 (1.70)*	0.10 (2.15)**
Minority population	–0.10 (–0.19)	–0.11 (–0.60)	–0.43 (–0.70)
Minority concentration >25%	–0.14 (–0.71)	0.01 (0.06)	–0.12 (–0.45)
Median income	0.004 (0.55)	0.006 (1.69)*	0.012 (1.14)
On public assistance	3.92 (2.54)**	1.75 (2.44)**	4.94 (2.56)***
High school graduates	1.31 (2.50)**	0.95 (4.11)	2.12 (3.13)***
Residents aged ≥ 55	–0.48 (–1.02)	0.14 (0.68)	–0.34 (–0.54)
Housing stock characteristics			
Number of housing units	–0.14 (–2.04)**	–0.06 (–1.78)*	–0.20 (–2.07)**
Median house value	–0.002 (–2.49)**	–0.008 (–1.95)*	–0.003 (–2.71)***
Relative rental cost	0.55 (0.67)	0.26 (0.71)	0.76 (0.69)
Median year built	–0.006 (–1.86)*	–0.003 (–2.00)**	–0.009 (–2.14)
Owner occupied	0.61 (1.56)	0.09 (0.57)	0.69 (1.40)
Vacant	1.11 (1.41)	0.007 (0.02)	0.72 (0.72)
Loan and borrower characteristics			
Average loan-to-income ratio	–0.30 (–2.16)**	–0.05 (–0.73)	–0.46 (–2.36)**
Difference in borrower income	0.005 (1.52)	0.002 (1.58)	0.007 (1.58)
Difference in racial composition	–0.19 (–0.67)	0.12 (1.36)	–0.33 (–0.76)
Observations (*n*)	1,369	1,327	1,383
***F* (18, *n*–19)**	2.69***	2.92***	2.93***
R^2	0.0347	0.0386	0.0373

*Significant at the 90-percent level.
**Significant at the 95-percent level.
***Significant at the 99-percent level.

Sources: GSE PUDB, HMDA, Florida DOR, 1990 U.S. census

implications pertaining to the efficient and consistent implementation of U.S. housing policy objectives. For example, evidence showing that relative purchasing activity varies by transaction volume levels would suggest that divergent roles are being played by Fannie Mae and Freddie Mac in mitigating information externalities in mortgage lending. Thus, by regressing the ratio of loan purchases by Fannie Mae to loan purchases by Freddie Mac against our tract-level measures of information effects, neighborhood and housing stock characteristics, and borrower attributes, we may gain insight into the implementation of U.S. housing policy objectives.

As for the first tier of analysis, a multivariate OLS framework of the following general form is used to analyze the relative lending patterns of the two GSEs:

RATIO = f (Information Externalities, Neighborhood Characteristics, Housing Stock Characteristics, Applicant Characteristics, ε),

where RATIO is now defined as the ratio of the number of units (and dollar volume) for single-family mortgages purchased by Fannie Mae to the number of units (and dollar volume) for single-family mortgages purchased by Freddie Mac within the same census tract. Information effects, neighborhood population characteristics, and housing stock attributes are all defined as in Stage 1. The three applicant characteristics are calculated as the ratio of the Fannie Mae value to the Freddie Mac observation. Again, particular emphasis should be given to the results for the information variables because significantly negative (positive) coefficients would suggest Fannie Mae (Freddie Mac) outperforms Freddie Mac (Fannie Mae) in low-activity markets.

Exhibit 6 presents the results of this analysis and shows little difference between the activities of Fannie Mae and Freddie Mac in combating information problems. Although Fannie Mae seems to outperform Freddie Mac in terms of the sheer number (percentage) of loans purchased from low-activity tracts, no significant difference is observable in terms of the value (dollar volume) of loans purchased in these areas. Our results, though not surprising given the similar purchasing behavior of these entities documented in stage 1, provide little support for the notion that Fannie Mae's purchases are mitigating information externalities any more or less than Freddie Mac's. On the other hand, an examination of the neighborhood and housing stock characteristics indicates that Fannie Mae is more active in neighborhoods with high vacancy rates and in lower priced neighborhoods, whereas Freddie Mac is more active in areas with high concentrations of older (wealthy) residents. These results are generally consistent with the previous literature suggesting that Fannie Mae outperformed Freddie Mac in historically (traditionally defined) underserved market segments in 1993–95.

Stage 3: High Payment-Stress Loans

Stage 3 of the analysis focuses the investigation on the subset of loan purchases most likely to be influenced by information externalities—high payment-stress loans. As previously discussed, appraisal uncertainty is most important in the event of default and foreclosure. If a borrower pays the loan in full, the lender is clearly made whole. Similarly, if a borrower defaults on the loan, but proceeds from the sale of the property exceed the remaining principal balance (plus all foreclosure costs), the lender is again made whole. Only if sale proceeds fail to meet the remaining principal balance is the lender financially impaired. Clearly, the risk of impairment is greatest when appraisal uncertainty is combined with a high probability of default. As a simple approximation of high default-probability loans, we identify a subset of the GSE purchases in which the borrowers' imputed monthly payments exceed 28 percent of their monthly income. PUDB records provide the necessary information regarding the loan size and annual income for each

Exhibit 6

Ordinary Least Squares Regressions Explaining the Relative Activity of Fannie Mae and Freddie Mac in 12 Florida Counties, 1993–95

Variable	Number of Loans Purchased	Total Investment ($)
Constant	12.09 (1.64)*	7.67 (0.94)
Information variables		
Historic homes sales transaction rate	–0.57 (–2.06)**	–0.35 (–0.87)
Historic home price appreciation rate	–0.22 (0.45)	–0.74 (–1.50)
Population characteristics		
Census tract population	0.01 (0.03)	0.01 (0.33)
Minority population	0.91 (1.36)	0.34 (0.35)
Minority concentration >25%	0.04 (0.18)	0.31 (0.85)
Median income	–0.01 (–0.11)	0.02 (0.25)
On public assistance	3.46 (1.23)	5.46 (1.16)
High school graduates	–0.19 (–0.28)	–0.19 (–0.24)
Residents aged $\geq$ 55	–0.74 (–1.91)*	–0.86 (–1.86)*
Housing stock characteristics		
Number of housing units	0.01 (0.19)	–0.05 (–0.08)
Median house value	–0.03 (–3.25)***	–0.03 (–2.76)***
Relative rental cost	0.41 (0.57)	0.84 (0.94)
Median year built	–0.01 (–1.43)	–0.00 (–0.79)
Owner occupied	0.48 (1.38)	0.32 (0.71)
Vacant	1.36 (1.77)*	1.92 (1.67)*
Loan and borrower characteristics		
Average loan-to-income ratio	–0.12 (–1.08)	0.08 (0.45)
Difference in borrower income	0.01 (0.83)	0.02 (1.07)
Difference in racial composition	–0.00 (–1.21)	–0.00 (–1.17)
Observations (*n*)	1,348	1,348
F (18, *n*–19)	8.48***	6.00***
Adjusted R^2	0.1030	0.0626

*Significant at the 90-percent level.
**Significant at the 95-percent level.
***Significant at the 99-percent level.

Sources: GSE PUDB, Florida DOR, 1990 U.S. census

GSE purchase, and the interest rate used to impute each borrower's monthly payment is Freddie Mac's *Primary Mortgage Market Survey* annual 30-year, fixed-rate average for the year in which the loan was purchased by the GSE.[22] Under this definition, Fannie Mae purchased 2,018 high payment-stress loans valued at $271 million, whereas Freddie Mac purchased 1,392 high payment-stress loans valued at $206 million. Combined, these figures represent 2.2 percent of all GSE loan purchases and account for 10.6 percent of the dollar value of those purchases.

To investigate the activities of Fannie Mae and Freddie Mac within this unique sector of the mortgage market, we replicate both Stage 1 and Stage 2 of the analysis using information from this subset of loan purchases. Exhibit 7 presents the results from regressing the ratio of the dollar value of high payment-stress loan purchases by each entity to the dollar value of all loan purchases by each entity within a given census tract against our now familiar set of information variables, neighborhood population characteristics, housing stock attributes, and borrower information.[23] Once again, we find evidence consistent with enhanced GSE activity in informationally deficient market areas, because the percentage of high payment-stress loan purchases is inversely related to the historic transaction volume within the tract. No neighborhood or housing stock characteristics exhibit consistently significant explanatory power across all three model specifications. However, an examination of applicant characteristics suggests that high payment-stress loans are more prevalent among high-income borrowers.

Exhibit 8 presents the results from regressing the ratio of high payment-stress loan purchases by each entity to total loan purchases by each entity within a given census tract against our continuing set of information and control variables. Once again, the results are strikingly similar to those previously reported. GSEs purchase a higher fraction of loans in low-activity neighborhoods, and high payment-stress loan purchases are concentrated among higher income borrowers. Under this specification, the percentage of housing units in the tract that are occupied by the owner also appears to be inversely related to the percentage of loan purchases classified as high payment-stress. To the extent that neighborhoods with a high percentage of owner-occupied housing units are considered more stable (desirable) by underwriting lenders, this result is consistent with GSEs facing an adverse selection problem in their purchasing activities.

Exhibit 9 compares the relative high payment-stress loan purchasing activities of Fannie Mae and Freddie Mac on both a numeric and dollar basis. The first column employs an independent variable defined as the number of high payment-stress loans purchased by Fannie Mae divided by the number of high payment-stress loans purchased by Freddie Mac. The latter column alters the ratio to use the dollar value of high payment-stress loans in both the numerator and denominator. We again regress these ratios against our repeated set of information characteristics and control variables. As with the full set of loan purchases, very few differences in the purchasing activities of the two entities can be documented. In particular, no differential performance is reported in either column with respect to historic transaction volume. A close examination of the remainder of the table reveals weak evidence that Freddie Mac is more active in neighborhoods characterized by a high percentage of households receiving public assistance income, whereas Fannie Mae is more active in low-rent neighborhoods. Finally, as expected, the relative creditworthiness of borrowers is directly related to the relative high payment-stress loan purchasing activities of each GSE.

Conclusion

Fannie Mae and Freddie Mac provide important services to the residential mortgage market through their loan purchasing activities. Not only do these activities pump billions of dollars into the loan market, they may also help overcome information-based underwriting problems. Specifically, the results of this investigation indicate that historic transaction volume (as a percentage of the housing stock within a given census tract) is inversely related to both the number and dollar volume of loan purchases made by Fannie Mae and Freddie Mac. In addition, when examining a subset of high payment-stress loans, historic transaction volume is again found to be inversely related to both the number and dollar volume of loan purchases made by both Fannie Mae and Freddie Mac. These

Exhibit 7

Ordinary Least Squares Regressions Explaining Purchases ($) of High Payment-Stress Loans by GSEs in 12 Florida Counties, 1993–95

Variable	Fannie Mae	Freddie Mac	Both
Constant	0.41 (0.57)	1.58 (1.59)	1.29 (2.24)**
Information variables			
Historic home sales transaction rate	–0.06 (–3.10)***	–0.44 (–4.21)***	–0.05 (–3.15)***
Historic house price appreciation rate	0.09 (1.35)	0.04 (0.63)	0.07 (1.52)
Population characteristics			
Census tract population	0.02 (0.83)	0.01 (2.45)**	0.02 (1.22)
Minority population	0.04 (1.14)	0.15 (1.96)**	0.03 (1.03)
Minority concentration >25%	–0.03 (–2.40)**	–0.02 (–0.61)	–0.01 (–0.47)
Median income	–0.00 (–0.44)	0.00 (0.95)	0.00 (0.50)
On public assistance	0.18 (0.96)	–0.32 (–1.06)	0.01 (0.06)
High school graduates	–0.02 (–0.37)	–0.01 (–0.10)	–0.02 (–0.38)
Residents aged ≥ 55	0.03 (0.68)	0.13 (2.31)**	0.01 (0.26)
Housing stock characteristics			
Number of housing units	–0.01 (–1.80)*	–0.03 (–3.02)***	–0.01 (–1.89)*
Median house value	0.00 (1.63)	–0.00 (–2.18)**	0.00 (1.16)
Relative rental cost	–0.01 (–0.18)	–0.14 (–1.25)	–0.04 (–0.65)
Median year built	–0.00 (–0.63)	–0.00 (–1.62)	–0.00 (–2.33)**
Owner occupied	–0.06 (–1.59)	–0.10 (–1.99)**	–0.04 (–2.13)**
Vacant	0.06 (0.98)	0.26 (1.69)*	0.15 (1.36)
Loan and borrower characteristics			
Average loan-to-income ratio	0.09 (3.68)***	0.11 (4.41)***	0.09 (4.68)***
Difference in borrower income	0.01 (2.75)***	0.02 (4.36)***	0.01 (3.67)***
Difference in racial composition	0.03 (0.96)	–0.02 (–0.56)	0.01 (0.61)
Observations (*n*)	635	514	785
$F_{(18, n-19)}$	8.46***	9.04***	13.41***
Adjusted R^2	0.1748	0.2199	0.2218

*Significant at the 90-percent level.
**Significant at the 95-percent level.
***Significant at the 99-percent level.

Sources: GSE PUDB, Florida DOR, 1990 U.S. census

results are also consistent with the findings of both internal GSE investigations and external policy analyses, which find that GSE market share rises during periods of economic recession. These findings are also consistent with the view that GSE purchasing activities have the effect of mitigating information externalities—at least within the 12 counties examined in the current investigation.

Exhibit 8

Ordinary Least Squares Regressions Explaining the Number of High Payment-Stress Loans Purchased by GSEs in 12 Florida Counties, 1993–95

Variable	Fannie Mae	Freddie Mac	Total GSE
Constant	0.15 (0.33)	1.45 (2.46)**	0.78 (2.27)**
Information variables			
Historic home sales transaction rate	–0.03 (–3.07)***	–0.07 (–5.47)***	–0.02 (–2.88)***
Historic home price appreciation rate	0.02 (0.66)	0.03 (0.98)	0.03 (1.31)
Population characteristics			
Census tract population	–0.00 (–0.17)	0.07 (2.63)***	0.01 (0.63)
Minority population	0.02 (0.84)	0.09 (2.24)**	0.02 (1.19)
Minority concentration >25%	–0.02 (–2.41)**	–0.02 (–1.22)	–0.01 (–1.10)
Median income	0.00 (0.24)	0.01 (1.46)	0.01 (1.84)*
On public assistance	0.16 (1.20)	–0.25 (–1.44)	0.02 (0.28)
High school graduates	–0.07 (–1.63)	–0.08 (–1.46)	–0.05 (–1.98)**
Residents aged ≥ 55	0.00 (0.14)	0.08 (2.32)**	–0.00 (–0.01)
Housing stock characteristics			
Number of housing units	–0.03 (–0.96)	–0.02 (–3.31)***	–0.04 (–1.44)
Median house value	0.00 (1.34)	–0.00 (–3.24)***	0.00 (0.39)
Relative rental cost	–0.01 (–0.16)	–0.07 (–1.47)	–0.01 (–0.47)
Median year built	–0.00 (–0.26)	–0.00 (–2.45)**	–0.00 (–2.25)**
Owner occupied	–0.05 (–2.37)**	–0.06 (–2.68)***	–0.04 (–3.32)***
Vacant	0.02 (0.60)	0.22 (2.42)**	0.10 (1.40)
Loan and borrower characteristics			
Average loan-to-income ratio	0.06 (4.21)***	0.08 (6.07)***	0.05 (5.16)***
Difference in borrower income	0.00 (1.69)*	0.01 (3.50)***	0.00 (2.15)**
Difference in racial composition	0.01 (0.56)	–0.00 (–0.11)	0.02 (1.23)
Observations (*n*)	635	514	789
***F* (18, *n*–19)**	8.40***	15.23***	12.28***
Adjusted R^2	0.1735	0.3331	0.2049

*Significant at the 90-percent level.
**Significant at the 95-percent level.
***Significant at the 99-percent level.

Sources: GSE PUDB, Florida DOR, 1990 U.S. census

Exhibit 9

Ordinary Least Squares Regressions Explaining the Relative Purchases of
High Payment-Stress Loans by Fannie Mae and Freddie Mac in 12 Florida
Counties, 1993–95

Variable	Number of Loans Purchased	Total Investment ($)
Constant	–2.63 (–0.24)	–11.39 (–0.93)
Information variables		
Historic home sales transaction rate	1.08 (1.27)	0.47 (0.63)
Historic home price appreciation rate	0.40 (0.39)	0.78 (0.77)
Population characteristics		
Census tract population	–0.03 (–0.76)	0.04 (0.07)
Minority population	–0.46 (–0.59)	–0.99 (–0.95)
Minority concentration >25%	–0.02 (–0.07)	0.03 (0.09)
Median income	0.02 (0.10)	–0.07 (–0.37)
On public assistance	–5.24 (–1.77)*	–6.65 (–1.71)*
High school graduates	–0.97 (–0.87)	–0.18 (–0.13)
Residents aged $\geq$ 55	0.93 (1.06)	1.03 (0.83)
Housing stock characteristics		
Number of housing units	0.07 (0.71)	–0.02 (–0.15)
Median house value	0.02 (0.81)	0.00 (0.10)
Relative rental cost	–3.61 (–1.96)*	–3.79 (–1.94)*
Median year built	0.00 (0.43)	0.01 (1.09)
Owner occupied	–0.22 (–0.34)	0.20 (0.24)
Vacant	–1.52 (–1.81)*	–0.60 (–0.56)
Loan and borrower characteristics		
Average loan-to-income ratio	0.71 (3.08)***	0.56 (2.12)**
Difference in borrower income	0.02 (0.34)	0.07 (1.28)
Difference in racial composition	0.00 (0.45)	0.00 (2.01)**
Observations (*n*)	364	364
F (18, *n*–19)	2.65***	1.36
Adjusted R^2	0.0754	0.0175

*Significant at the 90-percent level.
**Significant at the 95-percent level.
***Significant at the 99-percent level.

Sources: GSE PUDB, Florida DOR, 1990 U.S. census

Finally, an examination of neighborhood and housing stock characteristics indicates that
Fannie Mae is more active in neighborhoods with high vacancy rates and in lower priced
neighborhoods, whereas Freddie Mac is more active in areas with high concentrations of
older (wealthy) residents. These results are generally consistent with the previous litera-
ture suggesting Fannie Mae outperformed Freddie Mac in historically (traditionally
defined) underserved market segments in 1993–95.

Appendix A

Market Share Analysis Using Market Size Measure Based on Florida Department of Revenue Data

Exhibit A–1

Ordinary Least Squares Regressions Using DOR-Derived Market Share Metric Explaining Investment ($) by GSEs in 12 Florida Counties, 1993–95

Variable	Fannie Mae	Freddie Mac	Total GSE
Constant	–9.75 (–1.40)	–7.91 (–1.96)**	–15.78 (–1.50)
Information variables			
Historic home sales transaction rate	–2.13 (–4.09)***	–1.36 (–4.04)***	–3.49 (–4.11)***
Historic home price appreciation rate	–0.54 (–0.60)	–0.05 (–0.08)	–0.47 (–0.35)
Population characteristics			
Census tract population	–0.09 (–2.74)***	–0.06 (–2.62)***	–0.14 (–2.75)***
Minority population	–0.16 (–0.32)	–0.40 (–1.16)	–0.63 (–0.80)
Minority concentration >25%	0.39 (1.36)	0.33 (1.71)*	0.66 (1.46)
Median income	0.03 (2.90)***	0.01 (1.49)	0.04 (2.98)***
On public assistance	–2.84 (–2.21)**	–0.89 (–1.63)	–4.00 (–2.47)**
High school graduates	–2.37 (–3.09)***	–0.85 (–2.63)***	–3.17 (–3.14)***
Residents aged ≥ 55	–0.08 (–0.20)	–0.13 (–0.54)	0.03 (0.05)
Housing stock characteristics			
Number of housing units	0.21 (2.91)***	0.13 (2.59)***	0.34 (2.91)***
Median house value	0.00 (0.24)	0.02 (1.88)*	0.02 (0.71)
Relative rental cost	–1.42 (–1.66)*	–1.03 (–1.93)*	–2.34 (–1.81)*
Median year built	0.01 (1.68)*	0.01 (2.20)**	0.01 (1.77)*
Owner occupied	–0.74 (–1.93)*	–0.21 (–1.26)	–1.01 (–1.96)**
Vacant	–1.18 (–2.08)**	–0.68 (–1.59)	–2.10 (–2.32)**
Loan and borrower characteristics			
Average loan-to-income ratio	0.13 (1.20)	0.13 (1.90)*	0.36 (1.75)*
Difference in borrower income	0.01 (3.05)***	0.02 (1.72)*	0.01 (2.28)**
Difference in racial composition	–0.36 (–1.78)*	–0.11 (–1.07)	–0.82 (–2.56)**
Observations (n)	1,412	1,369	1,433
F (18, n–19)	7.06***	7.70***	7.48***
Adjusted R^2	0.0717	0.0810	0.0753

*Significant at the 90-percent level.
**Significant at the 95-percent level.
***Significant at the 99-percent level.

Sources: GSE PUDB, Florida DOR, 1990 U.S. census

Exhibit A–2

Ordinary Least Squares Regressions Using DOR-Derived Market Share Metric Explaining Number of Loans Purchased by GSEs in 12 Florida Counties, 1993–95

Variable	Fannie Mae	Freddie Mac	Total GSE
Constant	–6.88 (–0.86)	–6.12 (–1.24)	–11.90 (–0.96)
Information variables			
Historic home sales transaction rate	–6.88 (–3.92)***	–1.74 (–3.90)***	–4.42 (–3.95)***
Historic home price appreciation rate	–0.01 (–0.01)	0.26 (0.48)	0.27 (0.22)
Population characteristics			
Census tract population	–0.12 (–3.04)***	–0.09 (–2.89)***	–0.21 (–3.08)***
Minority population	–0.04 (–0.09)	–0.27 (–0.83)	–0.41 (–0.54)
Minority concentration >25%	0.37 (1.38)	0.35 (1.95)*	0.66 (1.56)
Median income	0.05 (4.15)***	0.02 (2.63)***	0.07 (4.39)***
On public assistance	–2.96 (–2.19)**	–1.23 (–1.88)*	–4.28 (–2.43)**
High school graduates	–2.55 (–3.17)***	–0.97 (–2.50)***	–3.45 (–3.13)***
Residents aged $\geq$ 55	0.43 (0.91)	0.28 (0.89)	1.01 (1.31)
Housing stock characteristics			
Number of housing units	0.30 (3.22)***	0.20 (2.91)***	0.50 (3.28)***
Median house value	0.01 (0.86)	0.04 (2.50)**	0.03 (1.16)
Relative rental cost	–1.62 (–1.93)*	–1.53 (–2.59)***	–2.94 (–2.29)**
Median year built	0.01 (1.19)	0.00 (1.53)	0.01 (1.26)
Owner occupied	–1.20 (–2.95)***	–0.56 (–2.61)***	–1.79 (–3.14)***
Vacant	–0.86 (–1.13)	–0.57 (–1.07)	–1.73 (–1.49)
Loan and borrower characteristics			
Average loan-to-income ratio	–0.14 (–1.12)	–0.01 (–0.09)	0.04 (0.20)
Difference in borrower income	0.05 (1.55)	–0.01 (–0.08)	0.07 (1.30)
Difference in racial composition	–0.25 (–1.26)	–0.02 (–0.22)	–0.64 (–1.98)**
Observations (*n*)	1,412	1,369	1,433
F (18, *n*–19)	10.74***	14.79***	13.00***
Adjusted R^2	0.1105	0.1536	0.1311

*Significant at the 90-percent level.
**Significant at the 95-percent level.
***Significant at the 99-percent level.

Sources: GSE PUDB, Florida DOR, 1990 U.S. census

Appendix B

GSE Purchasing Activities in Low-Volume Tracts: 12 Florida Counties, 1993–95

Exhibit B–1

Percentage of Low-Volume Tracts in 12 Florida Counties, 1993–95

County	Tracts	Low-Volume Tracts*	Low Volume (%)**
Alachua	28	64	76.19
Broward	164	135	27.44
DeSoto	4	0	0.00
Gilchrist	2	2	33.33
Hillsborough	168	111	22.02
Holmes	4	0	0.00
Lafayette	2	1	16.67
Leon	42	33	26.19
Marion	46	22	15.94
Orange	124	59	15.86
Putnam	14	4	9.52
Washington	3	5	55.56
Total	**601**	**436**	**24.18**

*Tracts classified as *low-volume* in more than 1 year are weighted by the number of years in which the low-volume classification applies. Some tracts do not retain the same low-volume status across all 3 sample years.
**Low volume (%) equals the weighted number of low-volume tracts divided by three times the total number of tracts in the county.

Sources: GSE PUDB, Florida DOR

Exhibit B–2

Percentage of Mortgage Activity in Low-Volume Tracts in 12 Florida
Counties, 1993–95, By Number of Loans

County	Fannie Mae	Freddie Mac	Combined GSE	Total Volume
Alachua	74.17	75.88	74.91	66.93
Broward	10.29	10.26	10.28	10.68
DeSoto*	N/A	N/A	N/A	N/A
Gilchrist*	17.39	27.27	22.22	N/A
Hillsborough	4.75	4.45	4.64	6.47
Holmes*	N/A	N/A	N/A	N/A
Lafayette*	N/A	N/A	N/A	N/A
Leon	2.04	1.46	1.81	2.27
Marion	2.85	2.53	2.72	3.76
Orange	3.70	3.25	3.50	3.71
Putnam*	4.23	7.27	5.14	N/A
Washington*	53.66	61.54	57.50	50.00

Notes: N/A = not available. DeSoto, Holmes, and Lafayette counties do not exhibit any
purchases in tracts that are identified as low-volume by the 1-percent rule. Although
HMDA figures are not typically available for nonmetropolitan areas, Washington County
exhibits a sufficient number of reported transactions to construct a total volume indicator.
To the extent lenders systematically decide which loans to voluntarily report in Washington
County, the 50-percent figure reported in the exhibit may be biased and should be inter-
preted with caution.

*Rural county.

Sources: GSE PUDB, HMDA, Florida DOR

Exhibit B–3

Percentage of Mortgage Activity in Low-Volume Tracts in 12 Florida
Counties, 1993–95, By Dollar Value

County	Fannie Mae	Freddie Mac	Combined GSE	Total Volume
Alachua	73.42	76.27	74.68	67.89
Broward	8.94	8.66	8.84	9.00
DeSoto*	N/A	N/A	N/A	N/A
Gilchrist*	20.90	24.30	22.73	N/A
Hillsborough	4.26	4.10	4.20	4.92
Holmes*	N/A	N/A	N/A	N/A
Lafayette*	N/A	N/A	N/A	N/A
Leon	1.22	0.78	1.05	1.25
Marion	2.74	2.38	2.59	3.04
Orange	3.40	3.09	3.26	3.32
Putnam*	4.75	8.45	5.98	N/A
Washington*	52.21	56.66	54.17	61.11

Notes: N/A = not available. DeSoto, Holmes, and Lafayette counties do not exhibit any
purchases in tracts that are identified as low-volume by the 1-percent rule. Although
HMDA figures are not typically available for nonmetropolitan areas, Washington County
exhibits a sufficient number of reported transactions to construct a total volume indicator.
To the extent lenders systematically decide which loans to voluntarily report in Washington
County, the 50-percent figure reported in the exhibit may be biased and should be inter-
preted with caution.

*Rural county.

Sources: GSE PUDB, HMDA, Florida DOR

Notes

1. For a more complete description of HUD's GSE Housing Goals, see Segal and
   Szymanoski (1998) or visit the HUD Web site at www.hud.gov.

2. Although early research such as Bradbury, Case, and Dunham (1989), Munnell,
   Browne, McEneaney, and Tootell (1992), and Canner and Smith (1991, 1992) all
   document vast disparities in the amount of credit extended across borrower racial
   and income classifications, more recent studies such as Holmes and Horvitz (1994),
   Schill and Wachter (1994), and Yezer, Phillips, and Trost (1994) suggest that more
   sophisticated estimation techniques and the inclusion of more appropriate neighbor-
   hood risk measures reduce or eliminate many of the disparate outcomes identified
   by previous researchers.

3. See Bunce and Scheessele (1996) and Segal and Szymanoski (1998).

4. See Calomiris, Kahn, and Longhofer (1994) for a detailed discussion of appropriately
   targeted intervention strategies for a wide array of mortgage market imperfections.
   Specifically, with regard to the present investigation, they argue that information prob-
   lems may be mitigated by narrowly tailored government interventions designed to
   remove barriers to information collection or dissemination.

5. Although GSE data are available for 1996, property tax records necessary to calculate information effects are not available. Therefore, the current investigation is limited to GSE purchases over the 1993–95 interval.

6. See www.huduser.org/datasets/gse.html.

7. DOR data are compiled each year under a statutory provision requiring the auditing of records from the property tax master files of each of Florida's 67 counties. The complete set of records is maintained as a multitape database and includes information such as recent selling prices, transaction dates, lot sizes, and location for every parcel (for example, single-family detached, condominium, mobile home, apartments, or industrial) in the State of Florida.

8. The major cities in each of the urban counties are as follows: Alachua—Gainesville, Broward—Fort Lauderdale, Hillsborough—Tampa, Leon—Tallahassee, Marion—Ocala, Orange—Orlando.

9. Unfortunately, complete data regarding each independent variable are not available for all census tracts. Therefore, the empirical work that follows must rely on the subset of tracts for which information is available. In each case, the number of tracts used to compute the results has been included for the reader's information.

10. Block Numbering Areas were used in place of census tracts for the six rural counties.

11. We believe that historic home sales transaction rates are a better measure of informational adequacy than historic home price appreciation rates. However, to be consistent with the previous literature, such as Ling and Wachter (1998), both variables have been included in all model specifications throughout this analysis. The empirical results are clearly consistent with our a priori expectations and confirm that historical transaction rates are a more robust indicator (that is, provide stronger evidence of) information externalities.

12. Alternative cutoffs for minority concentrations provided qualitatively identical results in the regressions that follow. Fourteen percent of the tracts exhibited populations with more than 50 percent racial minorities. Six percent of the tracts exhibited populations with more than 90 percent racial minorities.

13. Again, note that only the subset of tracts with complete information enter the empirical results.

14. Lack of sufficient numbers of repeat sales or sufficient property characteristics to fully specify an appropriate hedonic house price model preclude the use of constant quality house price appreciation rates at the individual tract level.

15. Census tract boundaries are initially drawn to be relatively consistent in population size. To the extent that population growth rates differ, this will result in differential tract populations. Therefore, tract population may be used as a proxy for the population growth rate. The inclusion or exclusion of tract population does not substantially alter the regression results of our market share models.

16. See, for example, Ling and Wachter (1998).

17. As with tract population, our regression results are robust to the inclusion/exclusion of this variable.

18. See Cutts, Van Order, and Zorn (1999) for a discussion of how the development of the secondary mortgage market can be explained as a tradeoff between the lower costs of secondary market participants and the informational advantage of primary market underwriters.

19. One hundred fifty eight tracts are classified as low-volume areas for 1993, whereas 156 and 122 meet this criterion for 1994 and 1995, respectively. In addition, a number of these low-volume areas are highly industrialized (nonresidential). If we examine only those tracts in which either Fannie Mae or Freddie Mac made at least one purchase, the number of low-volume tracts falls to 131, 131, and 100 for 1993, 1994, and 1995, respectively.

20. Considerable, but not complete, overlap exists between HUD-targeted market areas and historically low-volume tracts. Specifically, using a 1 percent per annum historic transaction volume level as the cutoff for low-volume regions generates a statistically significant correlation coefficient of 0.3231 between the alternative target markets.

21. *T*-tests of market share means across tracts with more versus less than a 1 percent per annum historic transaction volume indicate higher GSE involvement in low-volume areas. Similarly, Wilcoxon rank-sum medians tests also indicate higher GSE involvement in low-income areas.

22. Interest rates used for these calculations were as follows: 1993, 7.31 percent; 1994, 8.38 percent; and 1995, 7.93 percent.

23. Many tracts did not contain any high-stress observations, significantly reducing the sample size for this stage of the analysis.

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