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June 2014

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Abstract

This study provides an empirical examination of the pattern of appraisal bias during the housing crisis in the Third Federal Reserve District. After the nation experienced the worst housing crisis since the Great Depression, home valuation became more widely underestimated. In 9.2 percent of the cases, the appraisals in the Third District were below the contract prices from 2007 to 2011, and the share of low appraisals peaked during the mid-2009 to mid-2010 period. Factors that help explain the incidence of low appraisals include measures of market inefficiency such as the concentration of foreclosures and a lack of prior mortgage-financed purchases, contract prices, property types, appraiser types, and tightened regulations. Low appraisals are also found to create challenges for many borrowers in troubled neighborhoods and make mortgages more difficult to obtain.

Keywords: Property Valuation, Mortgage, Regulation, Appraisal
JEL Classification Code: G21, G28, R38

The author thanks Leonard Nakamura, Robert Hunt, and Theresa Singleton for their comments and suggestions and Keith Wardrip for his kind assistance in generating maps for this study. The author acknowledges Shih-Hsien Yang and Thomas Hylands for their dedicated research assistance. Special thanks to Barbara Brynko for her careful editing of early drafts of this paper. The views expressed in this paper are those of the author and do not necessarily reflect those of the Federal Reserve Bank of Philadelphia or the Federal Reserve System. This paper is available free of charge at https://www.philadelphiafed.org/community-development/publications/discussion-papers/.

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1. Introduction

The pattern of more home valuations coming in under their contract prices in recent years has drawn attention from practitioners, the press, and policymakers.[1] Because of the increased incidence of low appraisals, there has been a tension between efforts to achieve unbiased appraisals and the desire to close deals and to protect the access to credit in the hardest-hit markets. However, little is known about the pattern and determinants of appraisal bias during the housing crisis. This study provides an empirical examination of the appraisals in the Third Federal Reserve District (the Third District), which includes eastern Pennsylvania, southern New Jersey, and Delaware,[2] compared with the national trend, using a unique transaction-level appraisal data set. In this study, *appraisal bias* is defined as appraised value less contract price as a percent of contract price, while *low appraisal* as one in which appraised value falls below the contract price.[3]

An appraisal, which provides an estimate of the market value of a property based on market research and analysis at a point in time, is the most commonly used valuation method for residential mortgage applications.[4] The appraised value and the difference between the appraised value and the contract price (or sales price) are important factors in underwriting residential mortgages, which help predict the mortgage performance and influence the options for the mortgage lender if the borrower defaults.[5] In theory, an appraisal should provide an objective valuation of the true market value of the property; however, the fallout from the housing bubble

[1] See the Reuters article: http://www.reuters.com/article/2011/08/24/us-usa-economy-appraisals-idUSTRE77N2PM20110824; and the *New York Times* articles: http://www.nytimes.com/2012/10/13/business/scrutiny-for-home-appraisers-as-the-market-struggles.html; and http://www.nytimes.com/2013/09/15/realestate/when-appraisals-come-in-low.html.

[2] For a map of the Third District, see http://www.philadelphiafed.org/about-the-fed/third-district-map/.

[3] Similarly, *significantly low appraisal* is defined as one in which appraisal is at least 5 percent below the contract price. *Share of low appraisals* represents the share of appraisals with appraisal values below the contract price. It needs to be noted that an appraisal only provides an opinion of value so a deviation between appraised value and contract price does not necessarily mean the appraisal is wrong or biased. See similar measures of appraisal bias in Cho and Megbolugbe (1996), Chinloy, Cho, and Megbolugbe (1997) (1997), and LaCour-Little and Green (1998).

[4] Methods other than appraisals, such as broker price opinions, automated valuation models, or other mixed methods, are usually quicker and less expensive but are often less reliable (U.S. Government Accountability Office (GAO), 2012). Appraisers are required to consider all relevant transactions that have occurred in the market area (usually within the past six months) and determine those transactions that are the best comparable sales to the property being appraised. Usually appraisers use three to five comparable properties to estimate the value of the subject property by comparing their characteristics and condition and making adjustments for material differences between each comparable property and the subject property.

[5] The precise value of a home on the market provides crucial information to the mortgage lender because the equity stake of a mortgage at origination, usually measured by the loan-to-value (LTV) ratio, reflects the credit risk of a mortgage application. Lenders usually use the lesser of the property's sales price and appraisal value as the value of the property in calculating LTV ratios (Nakamura, 2010).

has raised questions about the accuracy of appraisals, and several empirical studies suggest that appraisals had often been biased upward and made mortgages riskier before and during the subprime boom.[6] Even during the housing crisis, according to this study, about 90.8 percent of appraisals in the Third District were above or exactly at the contract prices of a sample of purchase-mortgage appraisals completed between January 2007 and December 2011.

In the middle of the housing crisis, appraisal bias could cause home valuations to be more widely underestimated. In 9.2 percent of the cases, the appraisals in the Third District were below the contract prices during the 2007 to 2011 period, and the incidence of low appraisals had increased significantly during the period from 2007 to 2009. While inflated appraisals increase the risk for lenders and investors and could ultimately create a housing bubble, low appraisals may introduce substantial uncertainty into the homebuying process, increase the likelihood of withdrawal or denial of mortgage applications, and slow the recovery of the housing market in some of the hardest-hit areas. A set of statistical models helps identify the following factors that influence the likelihood of low appraisals, which has been a major concern related to appraisals during the most recent housing crisis.

- *Prior market activity* — Prior market activity, measured by the number of mortgage-financed purchases in the previous year, is negatively associated with the probability of having low appraisal valuation. A sufficient volume of market sales aids in price discovery, which provides more certainty about home values, allows lenders to distinguish observable risks, and leads to a decreased incidence of appraisal bias and possibly an increased supply of mortgage credit. An insufficient volume of market sales, in contrast, creates difficulty in price discovery, which introduces greater uncertainty about home values and leads to increased incidence of downward appraisal.[7]
- *Level of mortgage default* — A neighborhood's mortgage serious delinquency rate (90-plus days) is associated with a higher probability of low appraisal. While the serious delinquency

[6] A few recent empirical studies on the appraisal bias include Cho and Megbolugbe (1996), Chinloy et al. (1997), LaCour-Little and Green (1998), Leventis (2006), and Agarwal, Ben-David, and Yao (2013).

[7] There is an "information externality" theory introduced by Lang and Nakamura (1993), which explains how market activities impact lenders' lending decision: The volume of sales affects the accuracy of appraisals, and uncertainty may now be causing house appraisals to be biased too low; furthermore, low appraisals due to few recent sales affect the loan decision outcome. See a recent empirical test of the "information externality" theory of the Detroit market in Ding (2014).

rate may represent unobserved neighborhood risk, the concentration of troubled loans and foreclosures and the resulting distressed property sales can cause a downward drag on estimates of housing prices, considering they may be used as comparable properties without appropriate adjustments in appraisals.

- *Condominiums and higher-priced properties* — Condominiums and higher-priced properties are more likely to receive low appraisals. Compared with single-family properties, condominiums are about 43 to 56 percent more likely to have appraisals below the contract prices. Higher-priced properties are also more likely to be appraised below the contract prices, and the likelihood of low appraisals increases monotonically with the contract prices.
- *Tightened regulations* — The well-intentioned Home Valuation Code of Conduct (HVCC), which was a major appraisal rule adopted during the housing crisis in May 2009, has led to more low appraisals and less inflated valuations. The share of low appraisals peaked in the summer of 2009, which coincided with the enactment of HVCC. The regression results confirm that the probability of getting a low appraisal increased significantly after HVCC was enacted.
- *Increased use of appraisal management companies (AMCs)* — Since the housing crisis, lenders have been increasingly outsourcing their appraisal functions to AMCs, which act as intermediaries between lenders and appraisers. Appraisals ordered through AMCs have significantly higher incidences of low appraisals compared with those directly ordered by lenders.

The increased incidence of low appraisals could introduce greater uncertainty to the homebuying process and make the mortgage origination more difficult. The preliminary evidence confirms this contention: Low appraisals prolong the time it takes to close a transaction and increase the probability of requesting new appraisals. Neighborhood-level analysis suggests that low appraisals are positively linked to mortgage application denials, especially denials due to insufficient collateral. A 1 percentage point increase in the share of low appraisals in 2011 is associated with a 0.03 percentage point increase in collateral denial, or a 0.07 percentage point increase in the overall denial rate in the U.S.

As in many markets across the nation, some neighborhoods in the Third District experienced a significant increase in low appraisals during the housing crisis, and low appraisals create challenges for many borrowers in troubled neighborhoods. As access to mortgage credit has been tight since the housing crisis, the more limited credit availability in certain markets that were hit hardest by the crisis may have more severe consequences in the long term.

2. Empirical Analysis of Appraisal Bias in the Third District

Prior research on appraisal bias was limited largely because of data constraint. Appraisal data that are compiled on a regular and uniform basis for free public use do not exist. This analysis is primarily based on the FNC Inc.'s collateral database (the FNC data), which provides a national sample of appraisal records, regardless of whether they result in mortgage originations or not. The FNC data have been built from data aggregated from major mortgage lenders who agreed to share with FNC their nonconfidential appraisal data.[8] This study primarily used a sample of appraisals conducted from January 1, 2007, to December 31, 2011, in the Third District, while the national data were also used as a benchmark in some cases.

The FNC data overcome some shortcomings in the data sets used in prior studies and can provide insights about the appraisal practices in the aftermath of the Great Recession. Prior studies suffer from a selection bias when they used approved loans only: Since applications with appraisal values lower than contract prices are more likely to be denied, the focus on the approved loans induces an underestimate of the incidence of low appraisals. Second, data sets with approved mortgages usually only allow for a comparison of the appraisal values with final sales prices, instead of contract prices, which are not always the same as the final transaction prices. If the seller has been forced to renegotiate the asking price when the appraised value is below the contract price, the observed sales price could actually be lower than the contract price. Of course, this data set has limitations, such as the sparse information on the borrower and loan characteristics as well as the underrepresentation in certain markets. [9]

[8] The data include information on property type, contract date, appraisal date, rounded sales price (rounded up to the next $50,000), appraisal-price percent difference, zip code, and county code of the property, and whether the appraisal ended up with a transaction within one month, within two to three months, or within four to six months. Unfortunately, the data are inconclusive on whether the appraisals that could not be matched with public records failed to generate sales or because their public records were not received or matched.

[9] Due to privacy considerations, geographical information is only available at the zip code level. Information on individual borrowers, mortgage applied, property condition, and property address is generally unavailable. Some sand states, including California, Florida, Arizona, and Nevada, were overrepresented, while the Third District and the

2.1. General Pattern of Appraisal Bias

Even during the housing crisis, the share of appraisals equal to or above contract prices was significantly higher than that of low appraisals (Table 1).[10] In the Third District, 90.8 percent of the appraisals completed from 2007 to 2011 were equal to or higher than contract prices (Figure 1). Among this group, about 29.1 percent were exactly the same as contract prices, 45.2 percent were slightly higher than contract prices (0–5 percent), and 16.5 percent of appraisals were significantly higher than contract prices (more than 5 percent higher). Nationwide, about 89 percent of the appraisals showed either a zero or a surplus in appraised value.

The pattern in which most appraisals were higher than or exactly equal to contract prices is consistent with the moral hazard explanations of the appraisers' behavior: Appraisers usually appraise properties slightly higher than (or equal to) contract prices as they face asymmetric costs from overstating versus understating. Overvaluation will benefit all stakeholders who have a vested interest in completing sales, including buyers, sellers, and real estate agents, as well as certain lenders who do not bear the risk of originated loans. In contrast, deals could be threatened by undervaluation, especially when the undervaluation leads to appraisal values being lower than contract prices. So a natural choice for appraisers is to provide an appraisal either slightly higher or equal to contract prices, especially when they are influenced by parties with a financial interest in a mortgage loan transaction.

The share of low appraisals was about 9.2 percent during the 2007 to 2011 period in the Third District, which was slightly lower than the 10.1 percent for the U.S. Figure 2 shows that low appraisals in the Third District increased sharply during the housing crisis (from 6.8 percent in third quarter of 2008 to 12.2 percent in the second quarter of 2009). The share of low appraisals had remained at a high level from mid-2009 to mid-2010 and started to decline from the third quarter of 2010 as market conditions became more stable. Nationally, the share of low appraisals increased significantly from 2007 to 2009 and started to decline after mid-2010. The share of low appraisals in the U.S. peaked in the third quarter of 2009 at about 15.2 percent, which occurred several months after housing prices bottomed out in the first quarter of 2009 and a few quarters

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Midwest were slightly underrepresented (see Table 7 for a comparison of the geographic distribution of appraisal data relative to the Home Mortgage Disclosure Act (HMDA) application data for 2008 to 2009).

[10] The measure of appraisal bias in the FNC data set is the percent difference between the appraisal value of a property and the contract price. Zero appraisal bias suggests that an appraiser assesses a property exactly at the actual contract price. The further away from zero the bias is, the more inflated (or deflated) the appraisal is.

before the mortgage serious delinquency rate peaked (in about the fourth quarter of 2009).[11] Low appraisals were more prevalent in areas that were hardest hit by the recent subprime crisis and the economic recession, including the sand states (Arizona, California, Florida, and Nevada) and the Rust Belt states (e.g., Michigan and Ohio); see Figure 3. The increase in low appraisals was more modest in 2009 and 2010 in the Third District, relative to the national trend.

Table 2 summarizes the pattern of appraisal bias during the 2008–2009 period and the 2010–2011 period for major cities in the Third District. Overall, the share of low appraisals became smaller in the latter period. Five cities (Chester, Harrisburg, Reading, and Philadelphia in Pennsylvania, and Trenton, NJ) had a higher than average share of low appraisals in both periods. In contrast, five other cities (Allentown, Altoona, Bethlehem, Lancaster, and Wilkes-Barre in Pennsylvania) had a relatively lower share of low appraisals from 2008 to 2011. Camden, NJ, had a lower than average share of low appraisals before 2010, but the share increased sharply afterward (from 5.5 percent in 2008 and 2009 to almost 21 percent in 2010 and 2011). Of course, low appraisals were not only concentrated in central cities and, as suggested by Figure 4, many suburban neighborhoods in the Third District also had higher shares of low appraisals.

2.2. Determinants of Appraisal Bias

The determinants of the incidence of low appraisals were identified primarily based on a set of logit regression models.[12] Rather than reporting simple odds ratios that are not easy to interpret, Table 5 reports the estimated marginal effects of each independent variable on the probability of low appraisals, based on results from the regression. The low appraisal probability was first estimated for a typical appraisal, and the change in low appraisal rates associated with altering individual appraisal characteristics was then calculated.[13] In the base case, the appraised property is assumed to be a moderately priced ($200,001–$400,000) single-family house in the

[11] Estimations of the bottoms of housing prices and the peaks of foreclosure rates are based on the CoreLogic Housing Price Index and the Black Knight (previously LPS) data.

[12] Table 3 provides definitions and summary statistics of variables used in the regression. Table 4 summarizes results from logistic regression models based on two different samples: the Third District and the U.S. The logit regression controls for property type, contract price, appraisal year, lender, and metro dummies, as well as neighborhood characteristics including the number of mortgage originations in the previous year (in log), housing price change, foreclosure rate as of December of the prior year, and neighborhood size measured by the number of housing units in log. Regressions were conducted for the 2008–2009 and 2010–2011 cohort separately to isolate time-varying effects by policies or changes in housing market conditions.

[13] Marginal effects are estimated by independently changing each continuous variable by the stated amount, while for dummy variables, the marginal effects are constructed by comparing low appraisal rates in the presence and absence of the characteristic.

city of Philadelphia. It is assumed that the appraisal is ordered by a major lender in the FNC data (Lender 1) directly. The property is also assumed to be located in an average neighborhood (average size; with average number of mortgage originations, mean foreclosure rate, and average housing price changes).[14]

Market Inefficiency: Foreclosures and Prior Market Activities

In the Third District, regression results confirm that the probability of low appraisals is higher in neighborhoods with a lower level of market activities. As an illustration, for an average appraisal completed in 2009 in the city of Philadelphia, its probability of low appraisal will decrease from 15.0 percent to 13.1 percent when the number of prior loan originations in the zip code increases from 300 to 500.[15] And the low appraisal probability will increase by 59 percent (from 15.0 percent to 23.8 percent) when the volume decreases from 300 loans to 50 loans. A similar but slightly more modest pattern can be found for the 2011 appraisals: The incidence of low appraisals increases from 10.6 percent to 13.3 percent when the number of prior loan originations decreases from 250 (the average in 2010) to 50. The results illustrate how an insufficient number of mortgage-financed sales impact the probability of low appraisals.

High mortgage default rates are also linked to a higher likelihood of low appraisals. When the serious delinquency rate increases from 0.5 percent to 4 percent, the probability of low appraisals will almost double (from 12.0 percent to 20.1 percent) for an average 2009 appraisal and will increase by more than one-third (from 7.9 percent to 10.6 percent) for a typical 2011 appraisal.

The Home Valuation Code of Conduct and Appraisal Management Companies

HVCC was the result of a joint agreement between Fannie Mae and Freddie Mac (government-sponsored enterprises, or GSEs), the Federal Housing Finance Agency (FHFA), and the New York State Attorney General. HVCC was adopted to enhance the independence and accuracy of the appraisal process and to reduce the incidence of inflated appraisals and appraisal scams that were prevalent during the subprime boom in some markets. While HVCC is not a federal regulation and covered GSE loans only when it was introduced, it had marketwide effects

[14] All remaining continuous application variables are set at their means, while the remaining dichotomous application characteristics are set to zero.

[15] The average number of purchase loan originations in a zip code was about 300 loans in 2008 in the Third District.

as a result of the oligopoly power of the GSEs in the absence of a robust alternative secondary market for mortgages.

As expected, there was a sharp increase in the share of low appraisals after HVCC was enacted in May 2009 (Figure 2). Nationally, the share of low appraisals almost doubled from the end of 2008 to the third quarter of 2009 (an increase from 8.3 percent to 15.2 percent), while the Third District had a slightly more modest increase (an increase from 8.3 percent to 12.1 percent). Because not all appraisals are subject to HVCC, we were able to use a statistical model to track the change in the share of low appraisals before and after HVCC for the likely conforming loan appraisals, compared with those appraisals that are less likely to be subject to HVCC.[16] The results suggest that nationally the odds of low appraisals increase about 48.5 percent in the six months after the enactment of HVCC.[17]

Due to the increased regulation, especially after the enactment of HVCC and the Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act), AMCs, which act as intermediaries between lenders and appraisers and manage appraisals for lenders, have taken a greater market share.[18] Predictions based on regression results demonstrate that the incidence of low appraisals for those directly ordered by lenders is much lower compared with that of AMC appraisals: The probability of low appraisals by major lenders is about 40 to 60 percent lower than that of AMC appraisals in 2009 and about 8 to 46 percent lower in 2011. Of course, as more appraisals were conducted by AMCs, the gap between AMCs and other lenders became narrower in terms of the share of low appraisals by different lender types. While the incidence of low appraisals does not necessarily represent the quality of appraisals, the results provide some evidence of the significant heterogeneity in the appraisal approaches or in the enforcement of existing regulations by different appraisers.

[16] HVCC applied to lenders selling one- to four-unit single-family loans to Fannie Mae or Freddie Mac, but it had no applicability to nonconforming mortgage appraisals. The logit regression used a national sample of appraisals conducted before and after the enactment of the HVCC. Details of the model are not included in this paper but are available upon request.

[17] The odds of getting a low appraisal is the ratio of the probability of low appraisal to the probability of zero or positive appraisal gaps (appraisal value above or equal to contract price).

[18] The FNC data suggest that the share of appraisals conducted by appraisers through AMCs increased from about 5.3 percent in the second quarter of 2009 to more than 55 percent in the third quarter of 2012 in the Third District. However, the actual market share of AMCs could be underestimated: Nationally, the share of appraisals that were ordered through AMCs increased from less than one-half to between 60 and 80 percent after the HVCC, according to some appraisal industry participants (GAO, 2011).

Other Factors: Contract Price and Property Types

Another dimension in which appraisal bias may vary is the contract price or loan amount. There is a positive correlation between the incidence of low appraisals and the contract price. Properties with higher contract prices have a higher probability of receiving a low appraisal.[19] For a typical appraisal in 2011, the probability of low appraisal for a higher-priced property (a contract price greater than $400,000) is estimated to be 16.9 percent, higher than the 7.4 percent for a relatively lower-priced property (between $100,001 and $200,000), and much higher than the 4.1 percent for the lower-priced property (at or below $100,000).[20] Appraisers may have greater difficulty finding comparables for higher-priced properties, and they may be more conservative for the appraisal of higher-priced properties given the potentially greater loss for the lenders and investors.

Compared with single-family properties, condominiums are more likely to have low appraisals. In 2011, the probability of low appraisal for a typical condominium property is estimated to be 16.5 percent, significantly higher than the 10.6 percent for single-family properties (the probabilities of low appraisals are 21.4 percent and 15.0 percent for typical condominium and single-family properties, respectively, in 2009). The condominium market was hit harder during the housing crisis, and loans backed by condominium properties usually have a higher underwriting standard (Agarwal, et al., 2014). So, the likelihood of low appraisals is expected to be higher as condominium sales used as comparables during the crisis are more likely to be distressed sales with low prices.

2.3. Appraisal Bias and Outcome of Mortgage Applications

Low Appraisals and the Time It Takes to Close

The FNC data allow for a rough estimation of the number of months it took to close a transaction for those that can be matched with public records. The descriptive statistics suggest that contracts with low appraisals were more likely to require multiple appraisals: More than 21

[19] The FNC data do not allow for a test of whether the valuation bias varies with loan size explicitly because the loan characteristics are not available in the data set.

[20] It needs to be noted that the appraisal bias for lower-priced properties (at or below $100,000) had larger variation than that of higher-priced properties (appraised values were more likely to be significantly different from contract prices).

percent of contracts with first appraisals below contract prices had additional appraisals, while only 11 percent of those with zero or positive appraisal gaps had requested new appraisals. In other words, contracts that had requested additional appraisals were more likely to have low first appraisals (Figure 5): Among the contracts that had requested three or more appraisals, 20.7 percent had low appraisals, while for contracts with one appraisal, only the share of low appraisals was 7.8 percent. Why do contracts with low appraisals take longer to close? There could be a variety of potential explanations: Buyers may request more time to renegotiate with sellers, order new appraisals, secure enough cash for a larger down payment, or deal with other issues induced by low appraisals.

Interestingly, the analysis suggests that the values of new appraisals were much closer to the contract prices: More new appraisals had exactly the same amount as the contract prices, and fewer new appraisals had values that significantly deviate from the contract prices. For properties that requested three or more appraisals, 17.5 percent of their first appraisals were equal to the contract prices, while the share increased to 29.5 percent for the second appraisals and an astonishing 51.6 percent for the third (Figure 6). Appraisers may be able to obtain more information of property conditions or better price information from recent comparable properties. They may also be under greater pressure from sellers, buyers, lenders, or other stakeholders to arrive at an appraisal value that is equal to or slightly higher than the contract price.

Appraisal and Outcome of Mortgage Applications

We further examined whether low appraisals are linked to an increased likelihood of mortgage denials. As the information on the outcome of a contract is not readily available in the FNC data, we used a simple OLS model at the aggregate level to test the relationship between the share of low appraisals and the denial rates in the same zip code (Table 6).[21]

[21] Based on HMDA data, the mortgage denial rate was calculated as the share of denied applications by the sum of applications that were approved and originated, denied applications, and approved applications that were not accepted. T he share of denials due to insufficient collateral out of all applications is used as the measure of collateral denials, which is an imperfect measure because not all denials report the denial reasons. Since the smallest geographic unit available in HMDA is the census tract, the data at the zip code level were aggregated using all census tracts within the zip code with USPS zip code crosswalk files available at http://www.huduser.org/portal/datasets/usps_crosswalk.html.

The results suggest that low appraisals are associated with purchase mortgage denial rates.[22] Specifically, the incidence of low appraisals is significantly associated with the collateral denial rates at the zip code level for the U.S. and the Third District (with the exception of one out of eight regressions). Low appraisals are also significantly associated with the overall denial rate in the nation for all the years and in the Third District for 2008 and 2011.[23] For example, for the nation, a 1 percentage point increase in the share of low appraisals leads to a 0.03 percentage point increase in the collateral denial rate, or about a 0.07 percentage point increase in the overall denial rate in 2011. The effect is slightly less in the Third District: A 1 percentage point increase in the neighborhood low appraisal rate is associated with about a 0.02 percentage point increase in collateral denial rates, or a 0.03 percentage point increase in the overall denial rate.

3. Concluding Remarks

Appraisers are expected to provide unbiased opinions about the value of assets. However, the appraisal could be biased and appraisal values could be significantly different from a home's true market value. There had been an increase in the incidence of low appraisals in the Third District during the housing crisis, especially because there were concentrations of low appraisals in certain neighborhoods with a higher rate of foreclosures and less market activity.

The increase in the incidence of low appraisals was partly due to the introduction of some well-intended new rules as well. In particular, the HVCC rule issued at the worst of the housing crisis seemed to have contributed to the increased incidence of low appraisals, while reducing inflated valuations that were prevalent during the subprime boom. The results also demonstrate that appraisals ordered through AMCs have a higher incidence of low appraisals than those ordered by lenders directly. The preliminary evidence provides some support for the need to further improve or standardize the quality of appraisals ordered by different types of appraisers.

The prevalence of low appraisals in certain markets could make mortgage origination more difficult and potentially lower the demand for housing. Low appraisals increase the time it takes to close a transaction and increase the chance of requiring additional appraisals. At the aggregate

[22] The finding is consistent with the LaCour-Little and Green (1998) study, which confirmed that low appraised value significantly increases the probability of mortgage loan application rejection. They found that a low appraisal raises the likelihood of denial by 1.8 percentage points.

[23] The less significant results for the Third District are likely due to the relatively small sample size (a total of 323 zip codes).

level, low appraisals are significantly associated with mortgage denial rates, especially denials due to insufficient collateral.

Results from this study have important policy implications because the flow of credit to the residential market has become a critical issue in the recovery of the housing markets in many neighborhoods. The purchase mortgages have become more difficult to obtain, partly due to the sharp increase of low appraisals during the crisis. More limited credit availability may have more severe consequences in the long term for certain populations and neighborhoods, especially those that were hardest hit by the housing crisis.

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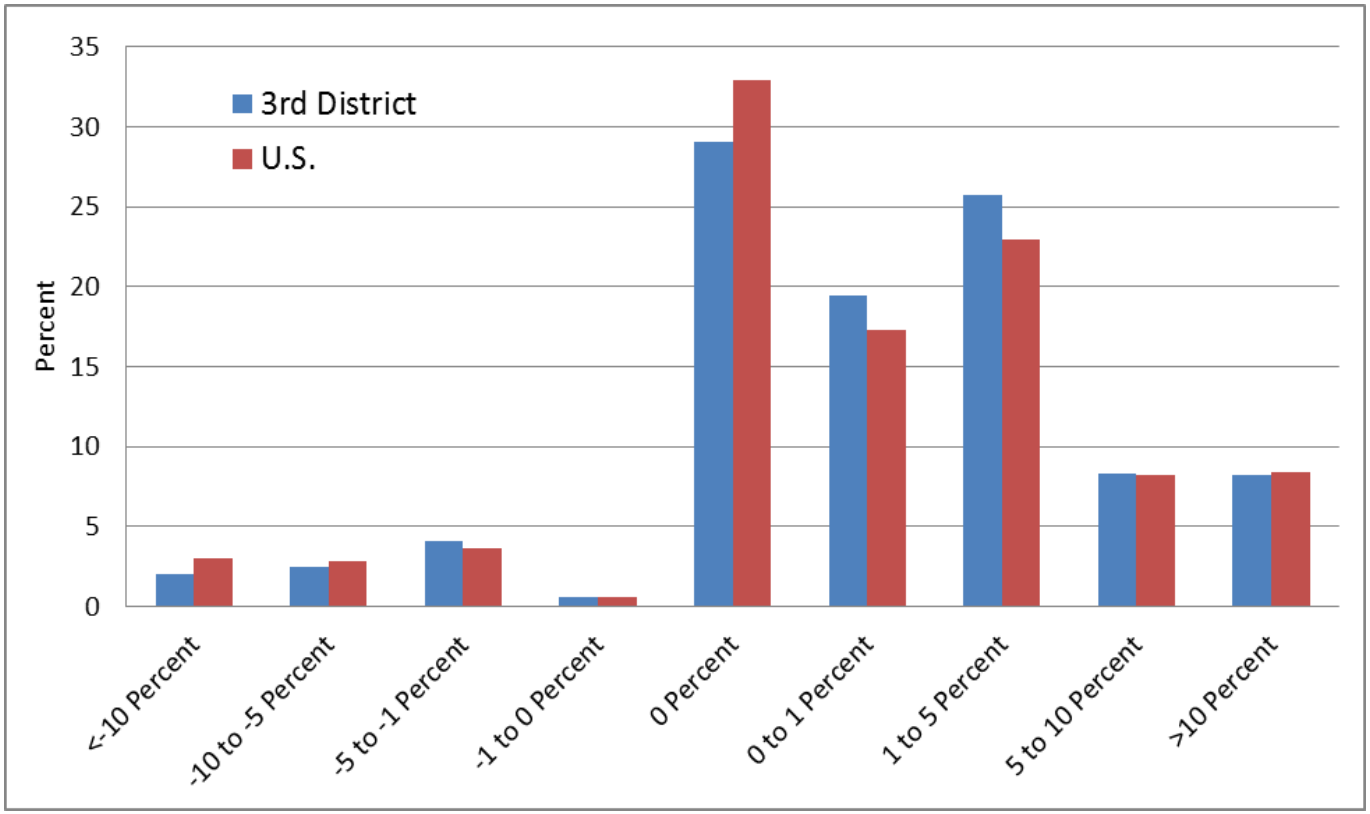
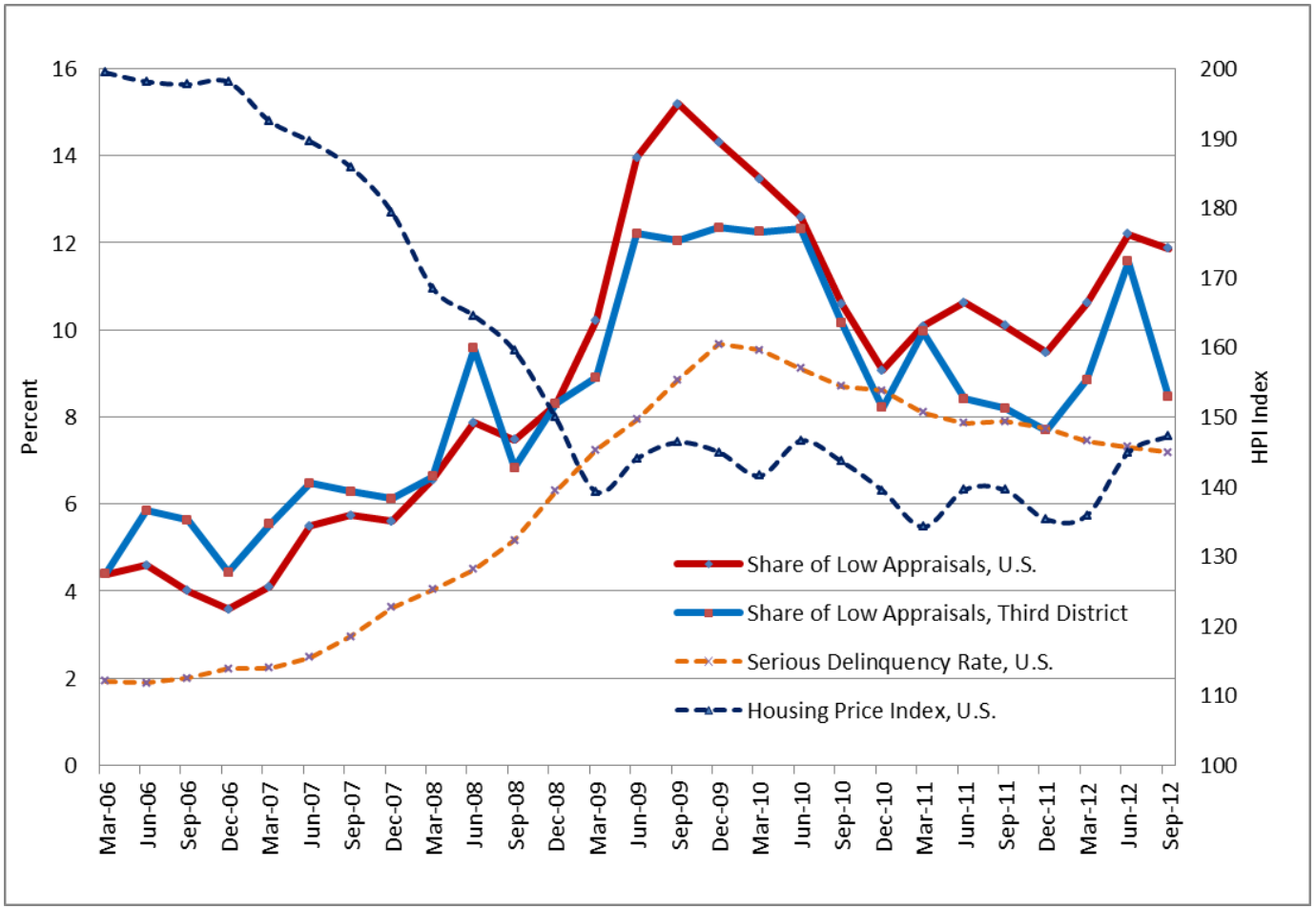
Appendix: Figures and Tables

Figure 1: Patterns of Appraisal Bias (Percent Difference from Contract Prices) (Third Federal Reserve District and U.S.), 2007–2011



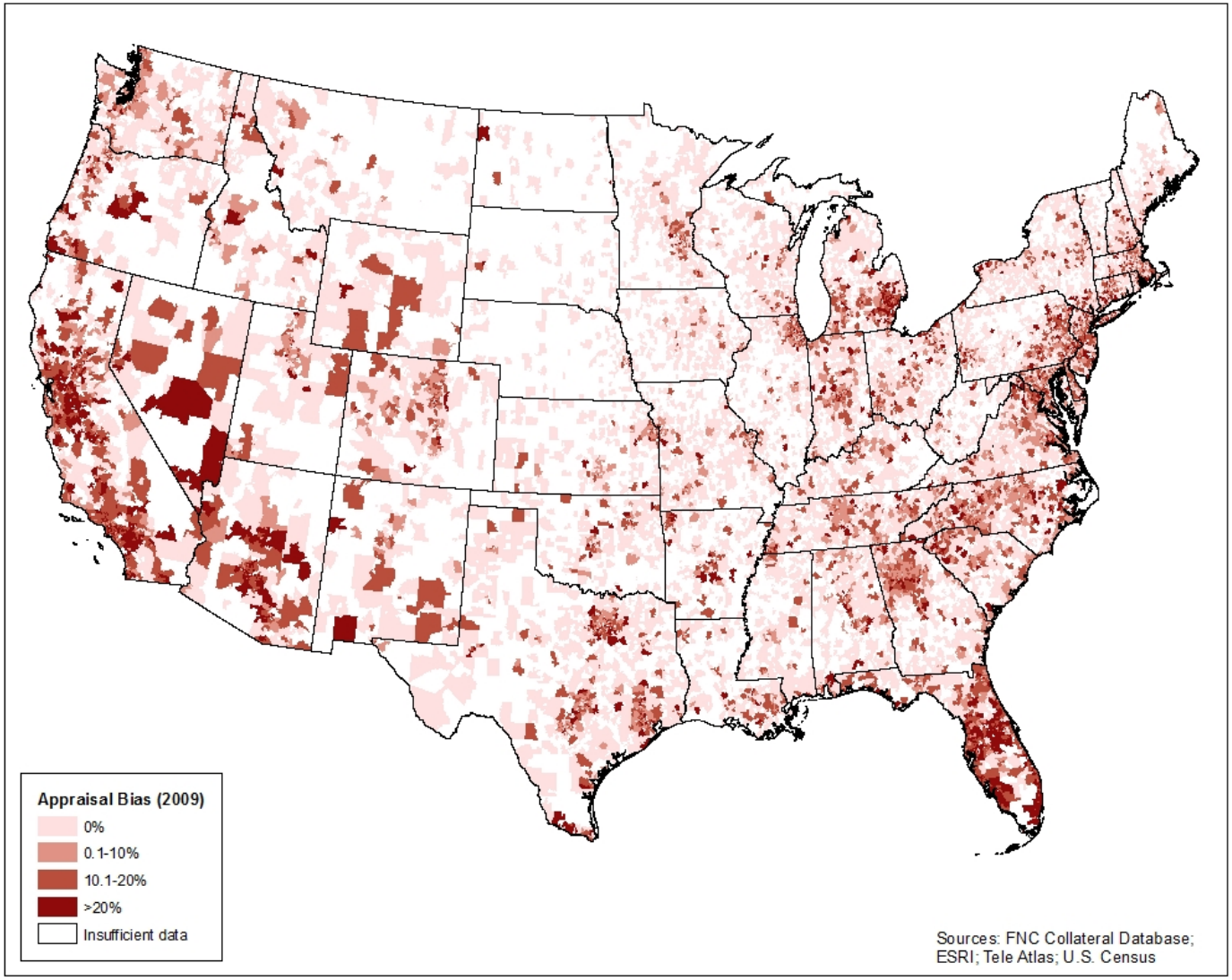
Note: Based on 2007–2011 appraisals in FNC data

Figure 2: Change in the Share of Low Appraisals over Time: Third District versus U.S.



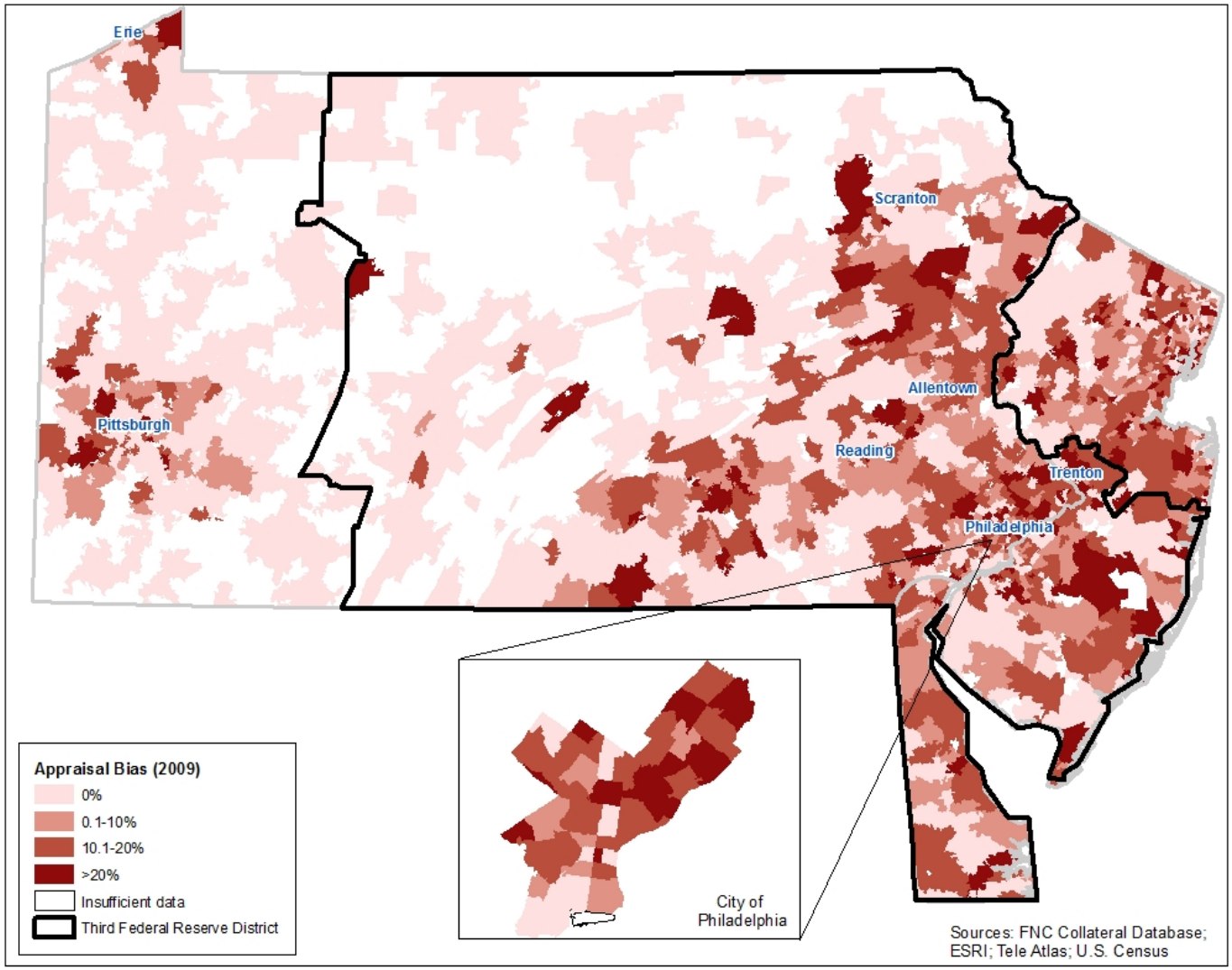
Note: Quarterly aggregated data based on FNC data, CoreLogic Single-Family Housing Price Index, and the Black Knight (previously LPS) data

Figure 3: Share of Low Appraisals by U.S. Zip Code in 2009



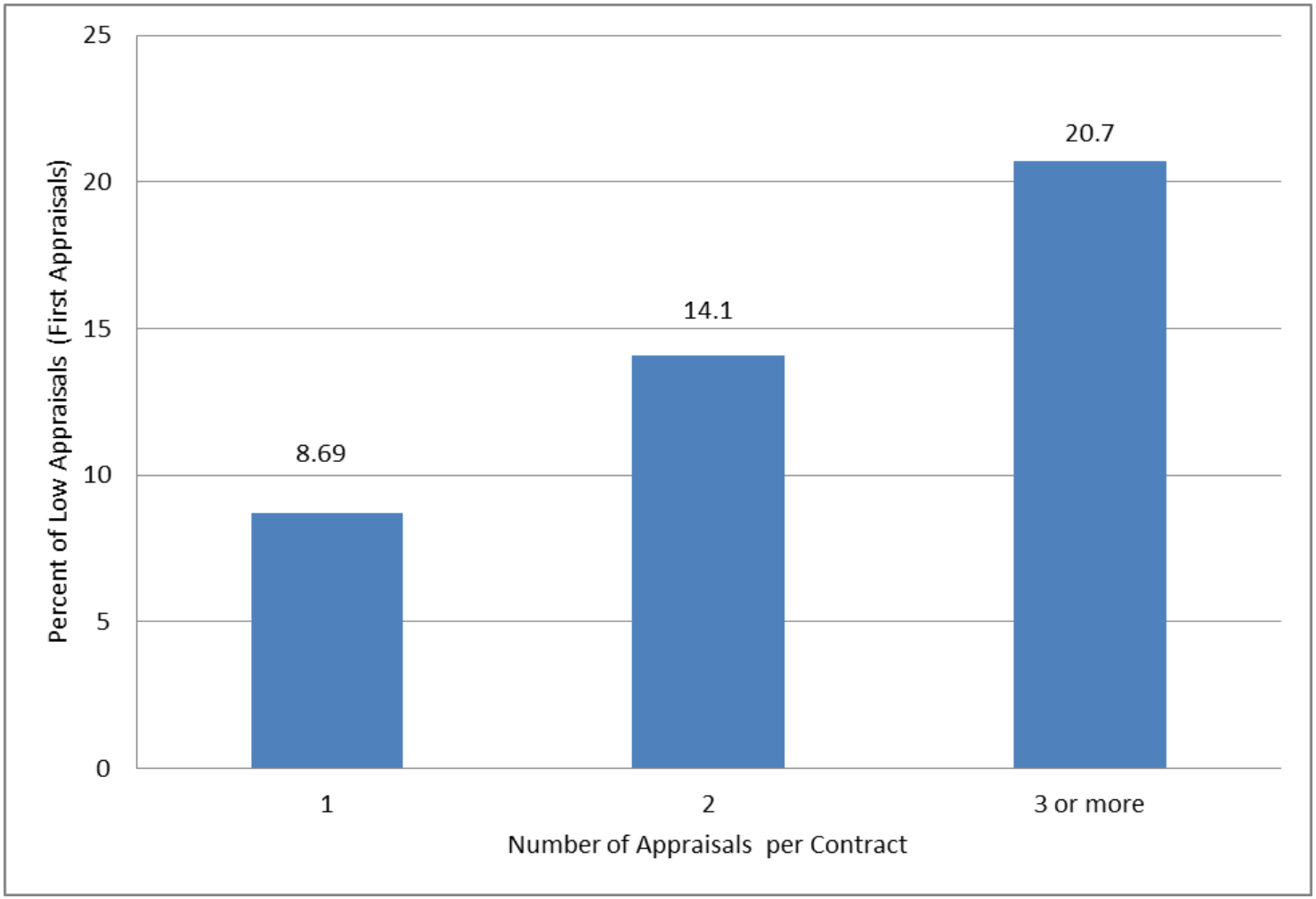
Note: Based on the appraisals conducted in 2009 in FNC data

Figure 4: Share of Low Appraisals in the Third Federal Reserve District by Zip Code in 2009



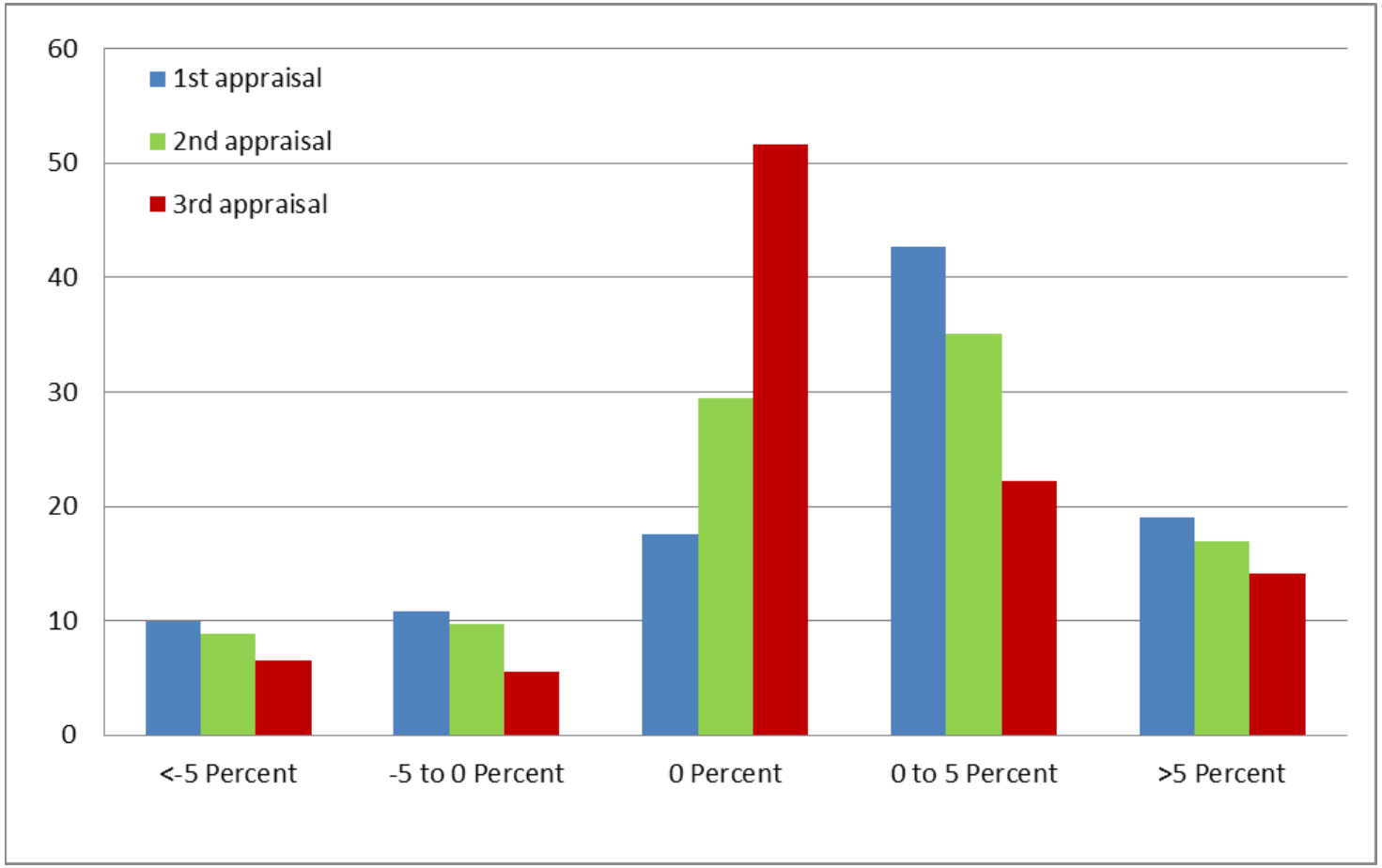
Note: Based on the appraisals conducted in 2009 in FNC data

Figure 5: Share of Low Appraisals for Contracts with Different Number of Appraisals, Third Federal Reserve District



Note: Based on 2007–2011 appraisals in FNC data

Figure 6: Pattern of Appraisal Bias (Percent Difference from Contract Prices) for the First, Second, and Third Appraisals, Third Federal Reserve District



Note: X-axis shows the appraisal bias categories (percent difference between appraisal value and contract price), and Y-axis shows the percent of appraisals in each category; based on 645 contracts with three or more appraisals in the Third District in FNC data.

Table 1: Distribution of Appraisal Bias by Year, Location, Lender, and Contract Price (Row Percent)

	Negative Appraisal Bias			Positive Appraisal Bias	
	<-5 Percent	-5 to -0.1 Percent	0 Percent	0.1-5 Percent	>5 Percent
U.S.					
2007	2.64	2.53	32.12	45.41	17.30
2008	4.80	2.79	30.02	41.07	21.31
2009	8.72	5.14	31.81	37.97	16.36
2010	6.70	5.12	32.85	39.72	15.63
2011	5.56	4.57	34.88	39.41	15.58
All	5.90	4.19	32.46	40.52	16.93
Third District					
2007	3.11	3.02	29.93	48.41	15.53
2008	3.86	4.07	27.58	46.43	18.04
2009	5.63	6.02	27.75	44.93	15.67
2010	5.13	5.94	28.08	43.94	16.90
2011	4.37	4.16	31.71	42.35	17.41
All	4.48	4.71	29.07	45.20	16.54
By State					
Delaware	2.70	4.25	25.18	49.47	18.4
New Jersey	4.93	4.70	32.11	41.98	16.28
Pennsylvania	4.68	4.81	28.79	45.47	16.25
By Lender					
AMCs*	5.8	5.41	30.51	39.85	18.42
Others	4.32	4.63	28.91	45.82	16.32
By Contract Price					
$0-$100K	4.63	0.93	28.87	23.31	42.26
$101K-$200K	4.46	3.29	28.27	39.25	24.73
$201K-$400K	4.08	5.32	28.79	48.60	13.21
$401K-$2M	5.70	5.82	31.33	48.07	9.07

* AMCs represent appraisal management companies. The states of New Jersey and Pennsylvania only include the southern part of New Jersey and the eastern part of Pennsylvania, which are within the Third District.
Note: Based on appraisals conducted during 2007–2011 in FNC data

Table 2: Appraisal Bias in Major Cities in the Third Federal Reserve District

City	2008–2009			2010–2011		
	Low Appraisal (Below 0 percent)	Sig. Low Appraisal (Below -5 Percent)	Sig. High Appraisal (Above 5 Percent)	Low Appraisal (Below 0 percent)	Sig. Low Appraisal (Below -5 Percent)	Sig. High Appraisal (Above 5 Percent)
Allentown, PA	10.26	7.00	19.85	7.17	3.68	24.72
Altoona, PA	2.56	1.28	17.16	4.79	2.05	14.23
Bethlehem, PA	9.34	3.35	17.72	7.87	3.33	23.05
Camden, NJ	5.53	5.27	32.80	20.53	17.96	12.28
Chester, PA	18.07	15.34	15.39	*	*	*
Harrisburg, PA	18.22	10.54	15.40	13.76	5.55	14.89
Lancaster, PA	5.63	2.33	18.74	5.45	3.04	24.62
Reading, PA	17.70	13.01	15.31	10.99	3.69	16.48
Scranton, PA	5.61	3.57	30.84	11.99	1.50	17.33
Trenton, NJ	20.61	15.71	23.95	11.69	4.20	17.42
Wilkes-Barre, PA	3.00	3.00	37.50	4.98	4.98	12.86
Wilmington, DE	15.36	7.51	17.67	7.25	4.84	26.56
York, PA	13.36	10.12	9.55	7.01	2.63	18.19
Philadelphia, PA	13.16	6.41	14.67	12.26	6.52	16.75
Third District	10.35	4.98	16.50	9.92	4.74	17.13
U.S.	11.74	7.36	17.71	11.38	6.32	14.56

* Statistics are unavailable as the sample size is too small.
Note: Based on FNC data

Table 3: Variable Definition and Summary Statistics

Variable	Definition	Mean or Percent	
		Third District	U.S.
low appraisal	"1" if appraisal is lower than contract price	10.2%	11.5%
significantly low appraisal	"1" if appraisal is at least 5% below contract price	4.6%	6.8%
prior_log_orig (in log)	number of purchase originations in the zip code in the previous year (HMDA)	5.68	5.92
prior_fc_rate	% of loans in default in at the end of the previous year (from Black Knight) (previously	2.62	4.21
hpi_12mon_chg	zip code housing price change in the previous 12 months (from CoreLogic)	-4.37	-7.46
price_0_100k	contract price $0-$100k	9.5%	12.3%
price_101k_200k	contract price $101-$200k	36.1%	34.1%
price_201k_400k	contract price $201-$400k	40.6%	33.7%
price_400k_plus	contract price >$400k	13.8%	20.0%
Condo	an indicator as to whether the property is a condo (vs. single-family home)	11.6%	12.6%
appraisal_year_2008	appraisals conducted in 2008	15.4%	18.4%
appraisal_year_2009	appraisals conducted in 2009	30.2%	28.9%
appraisal_year_2010	appraisals conducted in 2010	30.2%	29.2%
appraisal_year_2011	appraisals conducted in 2011	24.3%	23.6%
log_units	number of owner-occupied housing units in the zip code (2000 number, in log)	9.27	9.20
lender 1	appraisals by lender 1	53.3%	46.6%
lender 2	appraisals by lender 2	8.2%	13.2%
lender 3	appraisals by lender 3	13.7%	6.5%
lender 4	appraisals by lender 4	7.8%	11.6%
small lenders	appraisals by other small non-AMC lenders	6.6%	11.4%
AMC	appraisals conducted by appraisers through appraisal management companies	10.6%	11.6%
Geographic distribution			
California		-	24.0%
Florida		-	11.4%
Texas		-	6.1%
Georgia		-	5.7%
Virginia		-	5.1%
Delaware		12.4%	0.3%
New Jersey		28.9%	2.1%
Pennsylvania		58.7%	1.8%
Number of observations		27,091	1,067,749

Note: Based on FNC data

Table 4: Results from the Logit Models of Low Appraisal (Odds Ratios)

Parameter	2008–2009 appraisals				2010–2011 appraisals			
	low appraisal		significantly low appraisal		low appraisal		significantly low appraisal	
Intercept	3rd District	U.S.	3rd District	U.S.	3rd District	U.S.	3rd District	U.S.
prior_log_orig	0.772***	0.892***	0.649***	0.827***	0.865	0.893***	0.690***	0.798***
prior_fc_rate	1.160***	1.109***	1.279***	1.126***	1.087***	1.076***	1.105***	1.089***
hpi_12mon_chg	1.001	1.010***	1.000	1.005***	1.004	1.005***	0.980**	1.006***
price_101k_200k	1.281**	1.525***	0.907	1.284***	1.807***	1.322***	1.411**	1.055***
price_201k_400k	1.666***	2.056***	1.106	1.700***	2.574***	1.634***	1.884***	1.173***
price_400k_plus	2.512***	2.649***	2.096***	2.239***	4.123***	2.008***	3.903***	1.467***
condo (vs. single-fam)	1.433***	1.376***	1.540***	1.430***	1.565***	1.356***	1.639***	1.384***
appraisal_year_2008 (or appraisal_year_2011)	0.738***	0.667***	0.904	0.742***	0.663***	0.844***	0.681***	0.833***
log_units	1.341***	1.135***	1.433**	1.196***	1.214**	1.123***	1.742***	1.222***
lender 1 (vs. AMC)	0.504***	0.728***	0.490***	0.771***	0.915	1.027**	0.939	1.134***
lender 2 (vs. AMC)	0.572***	0.735***	0.553***	0.864***	0.539**	1.132***	0.714	1.304***
lender 3 (vs. AMC)	0.514***	0.502***	0.383***	0.482***	0.742***	0.858***	0.653***	0.775***
lender 4 (vs. AMC)	0.415***	0.496***	0.414***	0.451***	0.725**	0.812***	0.541**	0.747***
small lenders (vs. AMC)	0.441***	0.442***	0.429***	0.409***	1.277	0.827***	1.169	0.816***
metro dummies	yes	yes	yes	yes	yes	yes	yes	yes
Model fit								
Pct Concordant	62.0	69.2	64.5	72.8	61.8	66.5	64.5	70.7
Pct Discordant	36.6	30.0	33.0	26.2	36.7	32.5	33.0	28.0
Number of observations	12,353	504,758	12,353	504,758	14,738	562,991	14,738	562,991

*** significant at 0.01 level; ** significant at 0.05 level; * significant at 0.1 level

Note: *Low appraisal* is defined as one in which the appraised value falls below the contract price, and *significantly low appraisal* is defined as one in which the appraisal is at least 5 percent below the contract price; based on FNC data.

Table 5: Estimated Marginal Effect of Selected Independent Variables on the Probability of Low Appraisals (Percentage Points)

	A Typical 2009 Appraisal			A Typical 2011 Appraisal	
Characteristics	Estimated Prob. (low appraisal) (%)	Change in Prob. (low appraisal) (%)	Characteristics	Estimated Prob. (low appraisal) (%)	Change in Prob. (low appraisal) (%)
# of Prior Mortgage Origs			*# of Prior Mortgage Origs*		
50	23.76	8.80	50	13.34	2.77
100	19.86	4.90	100	12.07	1.50
300	**14.96**	**0**	**250**	**10.57**	**0**
500	13.11	-1.85	500	9.55	-1.02
Prior Serious Delinq. Rate			*Prior Serious Delinq. Rate*		
0.5	11.97	-2.99	0.5	7.88	-2.69
1	12.89	-2.07	1	8.22	-2.35
2	**14.96**	**0**	2	8.94	-1.63
4	20.14	5.18	**4**	**10.57**	**0**
8	36.51	21.55	8	14.78	4.21
Contract Price			*Contract Price*		
0-$100,000	8.98	-5.98	0-$100,000	4.11	-6.46
$100,001-$200,000	11.50	-3.46	$100,001-$200,000	7.42	-3.15
$200,001-$400,000	**14.96**	**0**	**$200,001-$400,000**	**10.57**	**0**
$400,001-$1,000,000	22.56	7.60	$400,001-$1,000,000	16.93	6.36
Property Type			*Property Type*		
Condo	21.44	6.48	Condo	16.54	5.97
1-4 Unit Single-Family	**14.96**	**0**	**1-4 Unit Single-Family**	**10.57**	**0**
Lender			*Lender*		
Lender 1	**14.96**	**0**	**Lender 1**	**10.57**	**0**
Lender 2	16.97	2.01	Lender 2	6.23	-4.34
Lender 3	15.25	0.29	Lender 3	8.57	-2.00
Lender 4	12.30	-2.66	Lender 4	8.37	-2.20
AMCs*	29.67	14.71	AMCs*	11.55	0.98

Note: Based on regression results for the Third District. Rows in bold represent the baseline, where a property appraised is assumed to be a moderately priced ($200,001–$400,000) single-family property in the city of Philadelphia. The appraisal is assumed to be directly ordered by Lender 1. All remaining continuous application variables are set at their means, while all remaining dichotomous application characteristics are set to zero. AMCs represent appraisal management companies.

Table 6: Effect of Zip Code Low Appraisal Rate on Mortgage Application Denial Rates (Coefficients Based on OLS Regressions)

	Third District		U.S.	
Year	Denial Rate	Collateral Denial Rate	Denial Rate	Collateral Denial Rate
2008	0.035**	0.011	0.084***	0.037***
2009	0.011	0.015**	0.076***	0.035***
2010	0.003	0.014*	0.062***	0.033***
2011	0.029*	0.015**	0.068***	0.032***
Number of observations	323		6,907	

R^2 ranges from 0.16 to 0.59. *** significant at 0.01 level; ** significant at 0.05 level; * significant at 0.1 level

Note: Unit of the low appraisal rate is percentage points. Other controls include number of mortgage originations in the previous year (in log), housing price change, foreclosure rate, and the number of housing units in the neighborhood (in log). It needs to be noted that not all denials report the denial reasons, and the share of denials due to insufficient collateral out of all applications is used as the measure of collateral denials.

Table 7: Geographic Representativeness of the FNC Data, Relative to HMDA Data

2008 FNC Data, Compared with HMDA							2009 FNC Data, Compared with HMDA						
State	Number of Appraisals	% of Total (Appraisal)	% of Total (Application)	% of Total (Origination)	Appraisal/ Application	Appraisal/ Origination	State	Number of Appraisals	% of Total (Appraisal)	% of Total (Application)	% of Total (Origination)	Appraisal/ Application	Appraisal/ Origination
CA	50,821	21.34	11.82	10.29	1.81	2.07	CA	85,963	23.33	13.34	12.32	1.75	1.89
TX	20,983	8.81	8.96	9.17	0.98	0.96	TX	23,357	6.34	8.39	8.46	0.76	0.75
FL	23,072	9.69	6.71	5.71	1.44	1.70	FL	39,445	10.71	6.22	5.53	1.72	1.94
NY	5,215	2.19	4.50	4.14	0.49	0.53	NY	8,349	2.27	4.14	3.93	0.55	0.58
IL	5,126	2.15	3.76	3.83	0.57	0.56	IL	9,291	2.52	3.53	3.59	0.71	0.70
PA	4,859	2.04	3.57	3.92	0.57	0.52	PA	8,521	2.31	3.59	3.86	0.64	0.60
NC	9,858	4.14	3.53	3.81	1.17	1.09	NC	12,571	3.41	3.16	3.28	1.08	1.04
GA	15,176	6.37	3.38	3.40	1.88	1.87	GA	18,352	4.98	3.04	2.98	1.64	1.67
OH	2,099	0.88	3.13	3.35	0.28	0.26	OH	5,669	1.54	3.11	3.30	0.50	0.47
VA	12,546	5.27	2.88	3.15	1.83	1.67	VA	18,132	4.92	3.00	3.28	1.64	1.50
AZ	6,043	2.54	2.74	2.70	0.93	0.94	AZ	10,847	2.94	2.99	3.02	0.98	0.97
NJ	4,579	1.92	2.65	2.51	0.72	0.76	NJ	8,060	2.19	2.60	2.48	0.84	0.88
MI	5,318	2.23	2.57	2.46	0.87	0.91	MI	9,396	2.55	2.46	2.36	1.04	1.08
CO	2,487	1.04	2.38	2.55	0.44	0.41	CO	6,208	1.69	2.29	2.46	0.74	0.69
WA	7,599	3.19	2.37	2.42	1.35	1.32	WA	9,601	2.61	2.44	2.46	1.07	1.06
TN	6,355	2.67	2.16	2.31	1.23	1.15	TN	8,567	2.33	2.11	2.20	1.10	1.06
IN	3,038	1.28	2.05	2.18	0.63	0.59	IN	6,161	1.67	2.03	2.11	0.83	0.79
MO	3,484	1.46	2.03	2.21	0.72	0.66	MO	4,044	1.10	2.01	2.16	0.55	0.51
MA	3,258	1.37	1.91	1.98	0.72	0.69	MA	6,509	1.77	2.08	2.13	0.85	0.83
DE	742	0.31	0.31	0.34	1.00	0.91	DE	1,482	0.4	0.31	0.32	1.29	1.25
3rd District	6,313	2.65	3.96	4.24	0.67	0.62	3rd District	11,557	3.14	3.93	4.13	0.80	0.76
U.S.	238,168		4,580,486	2,975,425	5.20	8.00	U.S.	368,401		3,877,144	2,694,333	9.50	13.67

Note: Based on FNC data and the HMDA data; *Appraisal/Application* represents the ratio between a state's share of appraisal (out of national total) to its share of applications. If it is greater than one, then the appraisal is overrepresented in this state, relative to the share of HMDA loan applications in this state. If the ratio is less than one, then it is underrepresented. *Appraisal/Origination* represents the ratio between a state's share of appraisal (out of national total) to its share of purchase loan originations.