

THE INFLUENCE OF CONTRACT PRICES AND RELATIONSHIPS ON COLLATERAL VALUATION

Michael D. Eriksen, University of Cincinnati*

Hamilton B. Fout, Fannie Mae and Kansas State University

Mark Palim, Fannie Mae

Eric Rosenblatt, Fannie Mae

* Corresponding Author: Michael Eriksen Department of Finance and Real Estate; 2925 Campus Green Drive, Lindner College of Business; Cincinnati, OH 45221; mike.eriksen@uc.edu. The authors would like to thank Bob Barclay, Luke Wong, Jesse Staal, Ruwei Wang, and Weifeng Wu for excellent research assistance. They would also like to thank Doug Duncan, Pete Bakel, Lan Shi, Lauren Lambie-Hanson, Will Strange, and two anonymous referees for helpful discussions and comments on earlier versions of the manuscript. The authors are solely responsible for the views expressed in the paper, and these views do not represent official positions of Fannie Mae or any other employer. All errors are our own.

ABSTRACT

Prior evidence has shown appraised values of residential properties are biased, but the mechanism and motivation of appraisers to bias their estimates are unclear. We construct a database of 25.3 million comparable transactions selected and used by appraisers to estimate 6.5 million property values associated with a home purchase from 2013 until 2017. The primary source of introduced bias we identify is in the weights appraisers assign to individual comparable transactions after already adjusting for observable attributes. We find appraisers use unequal weighting to increase appraised values to match contract price for over 69% of properties if an otherwise equal weighting would have resulted in an appraised value under that amount. This unequal weighting resulted in an additional 23% of properties having an appraised value at least equal to contract price. Using appraiser-specific fixed effects, we show appraisers were most likely to apply differential weights to confirm contract price for the properties associated with financial institutions, loan officers, and real estate brokers they worked with most frequently. We discuss potential reforms to offset such biases in the conclusion.

JEL Classifications: G21, G28, K11, L85, R31

Keywords: mortgage loans, collateral, soft relationships, big data

I. INTRODUCTION

The U.S. Congressional Budget Office (2012) estimated the 2008 financial crisis cost the U.S. economy \$5.7 trillion dollars. It has been argued that a contributing factor of the financial crisis were inflated property valuations by appraisers (Shi and Zhang, 2015; Griffin and Maturana, 2016). An earlier literature has shown that appraised values are generally higher than alternative econometric or automated valuation model (AVM) estimates of a property's value, which has been labeled appraisal bias (Agarwal *et al.*, 2015; Kruger and Maturana, 2017; Demiroglu and James, *forthcoming*). The motivation and mechanism by which appraisers introduce bias into their estimates remain unclear, especially after recent reforms were enacted following the 2008 financial crisis. In this paper, we use a novel data set to illustrate how some appraisers continue to introduce bias into their estimates even after those reforms.

Home mortgage lenders are required to obtain an independent appraisal to verify the value of the property that will serve as collateral for the loan. This requirement exists because expected credit losses by the lender are directly related to the ratio of the loan's balance to collateral value (see for instance Foote *et al.*, 2008; Kelly, 2008; Mayer *et al.*, 2009; Bhutta *et al.*, 2010; Elul *et al.*, 2010; An *et al.*, 2012). The premise that appraised values of residential property are biased is not new to this study (e.g., see Ding and Nakamura (2016) for a recent review). Related literatures in economics, finance, and real estate have illustrated the presence of appraisal bias associated with residential loans in primarily two ways. The first method compares the appraised values of originated loans with the purchase price and argues that a more than expected proportion of appraised values exceed, and are especially equal to, the eventual purchase price of the properties. For example, Cho and Megbolugbe (1996) report that 65% of appraised values in 1993 were above

the purchase price, and an additional 30% were exactly equal to the purchase price.¹ A second approach to illustrate the presence of appraisal bias has been for researchers to compare their own derived estimate of a property's value (e.g., from an AVM) to the appraisers' valuation and attribute any deviation in estimates to appraiser behavior (Agarwal *et al.*, 2015; Kruger and Maturana, 2017).

A main limitation in the above analyses is that appraised values are often only available for successfully originated loans. This results in possible selection biases since an appraised value below contract price may result in a loan never being originated, or trigger a renegotiation between the buyer and seller, making the true distribution censored from the perspective of the researcher (Fout and Yao, 2016). This censoring would result in not only overstating the percentage of appraised values at least equal to contract price, but also introduce potential bias in the calibration of econometric valuation models (such as AVMs).

We extend this literature by using a data set collected by Fannie Mae starting in 2013. This data is novel for two main reasons. First, it includes detailed property attributes and appraised values associated with 6.5 million loan applications between 2013 and 2017 regardless of whether the loan was eventually originated. This sample represents an estimated 65.6% of all home purchase appraisals in metropolitan areas over this time period relative to Home Mortgage Disclosure Act (HMDA) records. These data uniquely identifies the financial institutions, loan officers, and real estate brokers associated with the loan application, which enables us to explore the role of repeat interactions on resulting appraised values, especially relative to contract price.

Second, the assembled data includes information on the 25.3 million comparable transactions selected by appraisers as the basis for their opinion of value. Virtually all appraisers

¹ Horne and Rosenblatt (1996) were also among the first to report a similar pattern.

of residential property use a matching estimator, called the sales-comparison approach, to generate an appraised value. This estimator has been shown to have desirable attributes in small samples and first entails that the appraiser matches the subject of the appraisal to recent property transactions, or “comparable sales” (Vandell, 1991). The goal through matching the properties is to difference away similar attributes, which may otherwise be difficult to measure or quantify. For example, a matched property may have in common access to a local public amenity, or a desirable property attribute such as a view. The subject property may have also been recently renovated in a way undetectable by permit or other data records, but observed by the appraiser due to his/her site visit. Such heterogeneity if otherwise unobserved can result in omitted variable and other specification biases based on other valuation approaches, such as hedonic or AVM approaches. Using data on an individual appraisers selection of comparable transactions, and his/her subsequent adjustments for unmatched differences enables our analysis to directly test why deviations between AVM and appraised values occur in a manner previously not possible.

Our results indicate that appraised values and practices were not only influenced by the contract price, but also by appraisers’ past interactions with loan officers and real estate brokers. These counterparties potentially benefit most from an upwardly biased appraised value confirming contract price, which we discuss underlying motivations and possible incentives faced by appraisers in Section II. We feel our strongest evidence of such influence is from our analysis of the final step of the appraisal process that requires appraisers to use their own discretion in applying weights to each individual comparable transaction to reach a final appraised value. We argue that an average of selected comparable transactions after adjusting for observable differences is the least biased value estimate of the subject property, but demonstrate that appraisers systematically deviate from this average when it is below contract price. We estimate appraisers were 467% more

likely to increase an appraised value through unequal weighting when the average adjusted comp was below contract price. This unequal weighting resulted in an additional 23% of properties (over 1.1 million) having an appraised value at least equal to contract price that would have otherwise been below. This result is robust to seasonality, rounding, individual appraiser fixed effects, and adjusting for whether the most proximal or otherwise similar comp was itself above the average adjusted comp. Last, we show a role of intermediaries, called Appraisal Management Companies (AMCs), to partially mitigate these biases.

The implication of the research is that further reform is needed to improve the accuracy and independence of appraisals. This is important because regulators depend on appraisals to determine acceptable social exposures of credit risk in an effort to prevent future financial crises. Better understanding how and incentives for why appraisers introduce bias into their estimates and circumstances when these biases are most likely to occur is important when designing future policies. We discuss these potential reforms in the conclusion.

II. BACKGROUND

The Real Estate Appraisal Reform Act of 1987 requires an appraisal conducted by an independent and qualified appraiser for all federally-related mortgage loans. The purpose of the appraisal is to provide an independent opinion of market value for the property that a borrower pledges to the mortgage lender in exchange for receiving a home loan. Earlier research has documented the likelihood a borrower defaults on a loan and potential credit losses for the lender are directly related to the loan balance divided by collateral value (i.e., loan-to-value). The independence of the appraisal from buyers and sellers is important because each has incentives to collude to inflate the appraised value to increase leverage, or equivalently decrease borrowing costs of the buyer (Ben-

David, 2011). Furthermore, the independence of the appraisal process from lender influence is important due to potential agency issues between the lender, its employees, and eventual secondary market investors of a loan.

The focus of the current study is on appraisals initiated by a financial institution after the buyer and seller agree to a future purchase price (i.e., the contract price) and the buyer subsequently applies for a mortgage loan. For these purchase appraisals, the appraiser is always provided with the contract, which includes the terms and price agreed to for the proposed transaction. When the appraised value is equal to or above the previously negotiated contract price and other attributes of the loan application are verified, the contract price becomes the purchase price and the loan is originated. Recent research suggests a variety of outcomes could occur if the appraised value is below contract price and the purchase agreement has an appraisal contingency (Fout and Yao, 2016). These outcomes include termination of the purchase agreement, the buyer and seller renegotiating a lower purchase price, or the buyer increasing the size of his/her down payment to avoid otherwise increased borrowing costs.² There is also evidence that some appraisers revise their initial estimates after being provided additional data from loan officers and real estate brokers (Nakamura, 2010).³

The incentives for appraisers to purposely introduce bias into their estimate is not well explored in the literature. Most states require a combination of coursework and apprenticeships for an appraiser to be licensed, and appraisers must follow the Universal Standards of Professional Appraisal Practice (USPAP) in reaching an estimated value. Although it is unclear how often

² For example, a borrower would have to pay a much higher effective interest rate if he/she contributed less than 20% of the pledged collateral amount as a down payment due to the requirement to purchase additional private mortgage insurance in order for the loan to meet usual eligibility requirements to be sold to Fannie Mae or Freddie Mac.

³ For example, a loan officer or real estate broker may ask the appraiser to use a comparable transaction not used in the appraiser's initial analysis.

regulatory actions actually occur, purposely introducing bias or otherwise engaging in unethical behavior could result in an appraiser's license being suspended or permanently revoked.⁴

Prior to 2009, lenders could directly select qualified appraisers and there was evidence that appraisers would lose their preferred status with some lenders, and therefore future business, for reporting appraised values below the contract price (Ding and Nakamura, 2016). In response to evidence of appraisal bias and alleged collusion in appraisal values, then New York Attorney General Andrew Cuomo sued eAppraiseIT, an appraisal management company working with mortgage lender Washington Mutual, for pushing its appraisers to provide appraisal values in support of inflated contract prices. To help eliminate these types of appraisal practices, the Government Sponsored Enterprises (GSEs) and the Federal Housing Finance Agency agreed to adopt the Home Valuation Code of Conduct (HVCC), which became effective in May 2009 and was formally codified into law by Dodd-Frank a year later.⁵ The reforms implemented with the adoption of the HVCC were designed to enhance the independence and accuracy of appraisal values. For example, it prohibited lenders and other third parties from influencing the appraisal reporting process, required separation of an originator's lending and appraising functions, and mandated that lenders share the appraisal report with borrowers in a timely fashion.

Several recent studies have illustrated that the HVCC and related Dodd-Frank reforms have had a marginal effect on reducing the number of appraisals equal to or above contract price (Agarwal *et al.*, 2015; Shi and Zhang, 2015; Calem *et al.*, 2015; Ding and Nakamura, 2016). For example, Calem *et al.* (2015) showed that appraisals affected by the HVCC rule were

⁴ For example, Regulation 6 of the Appraisal Institute specifies how violations of USPAP are handled for members of their organization

⁵ For more details on the Dodd-Frank rule as it relates to appraisals, see <http://www.federalreserve.gov/newsevents/press/bcreg/20101018a.htm>.

significantly less likely to be equal to the contract price immediately after the rule was implemented.

Given that recent reforms abolished direct financial incentives, the motivations for appraisers to continue to introduce bias beyond these direct channels are unclear. Under the assumption that direct financial relationships no longer exist, it is still possible that informal or “soft” relationships still exist between appraisers and those who benefit from successful loan applications. Evidence of similar relationships have been shown to exist in other contexts, and could occur through past professional and social interactions of appraisers with individual loan officers and real estate brokers (Petersen and Rajan, 2002; Agarwal *et al.*, 2011). These interactions could inform the appraiser of desirable property attributes or recent comparable transactions they may otherwise be unaware of, or signal which market participants would appeal an appraised value if below contract price.⁶ These appeals or challenges could create uncompensated effort that an appraiser may wish to avoid.

The actual mechanism by which appraisers introduce bias into their estimates is poorly understood. The comparable sales method of valuation is the near universally adopted approach used by appraisers to value residential property.⁷ Vandell (1991) provides an overview of this valuation approach, which is composed of the following three steps:

1. Find transactions of comparable properties that best match the subject in physical attributes, proximity, and recentness of sale.
2. Adjust for property and market differences in attributes between each comparable transaction and the subject property to estimate an adjusted indicated value for each transaction.

⁶According to the Dodd-Frank Act, real estate agents and loan officers are explicitly permitted to ask an appraiser to consider additional comps, provide additional detail pertaining to the appraisal and/or to correct errors (see <https://www.congress.gov/bill/111th-congress/house-bill/4173/text>).

⁷ Other potential methods of valuation include income-based and cost approaches. See Pagourtzi *et al.* (2003) for an overview of the alternative methods used in real estate appraising.

3. Apply weights to individual adjusted comparable transactions to arrive at an appraised value of the subject property.

Whereas several recent studies have shown that appraised values are often higher than alternative AVM estimates, it is often left unexplored why such deviations occur (Agarwal *et al.*, 2015; Kruger and Maturana, 2017). This is especially important given that an appraiser visits the property and is aware of property-specific attributes or recent renovations otherwise unobserved in data used to derive the AVM or other estimates. An appraiser therefore has an opportunity to account for otherwise unobserved heterogeneity that would bias AVM estimates through his/her selection and adjustments of comparable transactions.

Incentives to differentially weight comparable transactions after already adjusting for unmatched property differences are less clear. Vandell (1991) illustrated the potential for appraisers to reduce the variance of their estimates by applying additional weight to the most similar properties. Green (1994) further illustrated the proposed estimator by Vandell to have superior properties relative to alternatives, especially in small samples. Unfortunately such discretion enables appraisers to introduce their own biases into appraisal estimates. We describe in the next section the novel data collected for our analysis to test for the presence of bias.

III. Data

Data limitations have been a main constraint faced by researchers in identifying the means and circumstances by which appraisers potentially introduce bias. One of several limitations was that their observable data was limited to final appraised values associated with successfully originated loans. Researchers also had limited information on the appraiser's selection, quality-adjustment, and weighting of comparable transactions used to formulate his/her estimate. Until recently, it

was also difficult to identify individual appraisers and loan officers in the aggregate data that was often used in analysis.⁸ The small number of studies that have addressed at least a subset of the above limitations, are often limited to small geographic areas and time periods (e.g., Dotzour, 1988).

Fannie Mae has undertaken significant effort to address these limitations to better understand the collateral backing the loans it purchases on the secondary mortgage market. This was possible because a significant share of loan originators in the country use a common software platform to organize their appraisals owned by Fannie Mae. Many financial institutions use this software platform during the loan underwriting process even if they do not intend to sell the loan to Fannie Mae or Freddie Mac. By capturing data entered through each step of the application process, including data for failed loan applications, Fannie Mae was able to uniquely document attributes of the appraisal not previously available for research.

This effort resulted in collecting data on 6,507,867 unique appraisals associated with home purchase loan applications from 2013 until 2017.⁹ The sample includes appraisals commissioned in all 50 states over this time period and includes detailed information on the subject property, including a unique identification number for each property, appraiser, financial institution, loan officer, and real estate broker associated with the loan application. Merged with the data are detailed information on the 25.3 million comparable transactions selected by each of the 53,850 unique appraisers to formulate their valuation estimates. These data include the initial contract price negotiated by the buyer and seller, detailed property attributes, whether an AMC was involved, adjustments to selected comparable transactions to account for differences in attributes,

⁸ The Secure and Fair Enforcement for Mortgage Licensing Act of 2008 (SAFE) created a nationwide mortgage licensing system and registry.

⁹ The sample was also restricted to appraisals associated with a home purchase in a metropolitan area with an initial contract price greater than \$50,000 and less than \$1 million.

and appraised value. Based on a comparison of loan applications reported due to the Home Mortgage Disclosure Act (HMDA), the constructed sample represents roughly two-thirds (65.6%) of similar HMDA loan applications in metropolitan areas over this time period.¹⁰

The first column of Table 1 illustrates average attribute values for this sample. The average contract price of the property subject to the appraisal was \$308,506. The assigned appraiser selected 3.9 comparable transactions as a basis of his/her valuation. The average appraised value after accounting for price differences and weighting of comps was \$311,680. That appraised value exceeded contract price for 92.1% of the properties.

Figure 1 illustrates the distribution of appraised values as a percentage of contract price agreed on by the buyer and seller. The bins are in 1% intervals, and differences in appraised values greater or less than 10% of contract price are aggregated into a single category. As evident from the figure, a dramatic clustering of appraised values occurs exactly at contract price. Over half (54.5%) of appraised values were from 0-to-1% above contract price, and 29.4% were exactly equal to contract price. An additional 29.3% of appraised values were from 1-to-5% above contract price, resulting in 83.7% of appraised values from 0-to-5% above contract price. In contrast, only 7.9% of appraisals had an appraised value below contract price.

Fannie Mae generates its own independent estimate of a property's value using a combination of empirical methods using what is traditionally labeled as an Automated Valuation Model (AVM). Figure 2 illustrates the distribution of Fannie Mae's estimated property value as a percentage of contract price for the same 6.5 million appraisals. In contrast to appraised values, AVM estimated property values were significantly more dispersed and likely to be below contract

¹⁰ According to HMDA records, there were 9,915,229 complete first-lien loan applications associated with home purchase of a 1-to-4 family home in a metro area with a loan value between \$50,000 and \$1,000,000 between 2013 and 2017.

price. We estimate 46.3% of AVM estimates were below contract price as compared to only 7.9% of appraised values. We also find only 40.9% of AVM estimates were within +/- 5% of contract price as compared to 89.1% of appraised values. Despite the differences in distributions, appraised values were on average only 0.4% higher than AVM estimates. We compare where differences between the AVM and appraised values originate in the next two sections.

IV. Selection and Adjustment of Comparable Transactions

A comparison of Figures 1 and 2 suggests that appraisers have very different valuations than an AVM for the same property, especially relative to contract price. One explanation for the large discrepancy in the share of appraisals at least equal to contract price is that appraisers were aware of omitted variables that were otherwise unaccounted for when formulating the AVM estimate. In this section, we focus on the first two steps of the sales-comparison method used by appraisers to value residential properties and account for such omitted variables directly.

Selection of Comparable Transactions

The first step of the sales-comparison approach is to identify recent transactions of comparable properties in the same market as the subject property. This includes defining property features of the subject and potential comparable transactions, with the goal of selecting the “most similar” properties, and therefore requiring the fewest price adjustments to account for unmatched differences between the two properties. For example, an appraiser may only select recent transactions of properties with a swimming pool if the subject property has a swimming pool to avoid having to assign a value to that specific feature. As explained above, this endogenous selection of comparable transactions by appraisers based on potentially unobserved and otherwise

difficult to value property attributes is both a feature and limitation of this approach. A successful matching of properties could limit biases associated with unobserved or difficult to measure property attributes, but the discretion provided in the matching step could enable some appraisers to purposely ignore comparable transactions for invalid reasons.

Our assembled data do not enable us to test directly the underlying motivations of appraisers when selecting comparable transactions, but do indicate appraisers select only a small percent of available comps to base their valuation. The first column of estimates in Table 1 indicates that appraisers reported there were on average 34 potential comparable transactions, of which they selected 3.9 to formulate their estimate. The main empirical challenge in identifying whether appraisers were biased in their selection of comparable transactions is the attributes of the properties they did not select, and their basis for excluding them, which were not specified in our data.

We are able to illustrate the contributing role of comparable transaction selection to explain differences with the AVM, especially relative to contract price. As the third column of Table 1 shows, approximately 46% of subject properties have an AVM value below the contract. Furthermore, from the first column of Table 1, approximately 92% of subjects end up with an appraised value at or above contract. Thus, if we think of the AVM value as the appraiser-free starting point for value, by the end of the appraisal process, an additional 46% of properties will have appraised values that at least confirms the contract price. The first column of Table 1 indicates the average price of unadjusted comparable transactions selected by appraisers at least equaled the contract price of the subject property for 70% of appraisals. For these properties, the appraiser could have made no price-adjustments and applied equal weights to each transaction and justified an appraised value to be equal to or above contract price. Thus, the choice of comparable

transactions results in appraisers confirming an additional 24% of subject property contract prices compared with the AVM. As discussed above, there is no clean empirical test to determine if appraisers were actually biased in their selection of comps without more information on the properties they did not select.

Adjustments of Comparable Transactions

Appraisers adjust the price for each individual comparable transaction based on unmatched differences in attributes during the second step of the sales-comparison approach. Table 1 indicates appraisers on average made 3.9 price adjustments to the 25.3 million selected comparable transactions. These adjustments resulted in average transaction prices being lowered by \$976, implying the subject property had less desirable attributes on average than selected comparable transactions.

Table 2 lists the frequency and average dollar amount of adjustments by appraisers. Adjustments are used to account for both differences in physical attributes (e.g., gross living area, view, quality of construction, condition of property, number of bedrooms, and location), or of the transaction itself (e.g., seller-paid financing). The most frequent adjustment by appraisers (74.4%) was to account for differences in living area. This means that appraisers on average selected slightly larger properties as comps and indicated the subject property should transact for \$123 less than the comparable transaction holding other attributes constant. The second most frequent adjustment was for an unspecified "other" category (46.3%), with an average adjustment of \$65. The largest average dollar adjustment were for market conditions (6.2%), which indicated the subject property should transact for \$624 more than the average comparable transaction holding other attributes constant.

An appraiser attempting to upwardly bias an appraised value to confirm a contract price may indicate comparable transactions have lower-valued characteristics than they actually do in order to justify the higher transaction price of the subject property through value adjustments. As mentioned above, it is empirically difficult to identify whether appraisers actively engage in such behavior because actual differences of unmatched attributes between the two properties are unobserved. For example, an appraiser may incorrectly indicate a subject property has a similar view to a recently transacted property that actually has a superior view, prompting no adjustments when the appraiser should have otherwise indicated the subject property should transact for less holding other attributes constant. Given the lack of precise data on views and several other property attributes, this misvaluation would generally go undetected by hedonic and other AVM approaches.

The last two columns of Table 2 list the frequency and average dollar value of adjustments when the AVM estimate is below contract price. The frequency of adjustments between the two columns were similar, although the magnitudes of dollar adjustments to selected comparable transactions were often quite different. For example, appraisers were equally likely to make an adjustment for living area when the AVM estimate was below contract price, but seemingly selected much larger properties requiring greater adjustments. The appraiser also indicated that the property subject to the appraisal on average should transact for \$901 more dollars than the selected comparable transaction after adjusting for an unspecified “other” category when the AVM estimate was below contract price, as compared to only \$65 when the AVM estimate was above contract. Whether these properties actually had “other” attributes justifying the additional \$836 in adjustments by appraisers remains unclear. It is important to note that if these properties did have such features, then traditional AVM estimates failing to account for such features would be biased.

The first column of Table 1 indicates the above adjustments resulted in 75% of all properties having an unweighted average of adjusted comp values at least equal to contract price. This estimate implies comp adjustments were used to confirm contract price for an additional 5% of subject properties. Given data limitations, we are unable to evaluate whether the differences between the subject property and comps justify the adjustments made by appraisers for any given appraisal.

Figure 3 further illustrates the limited role of price adjustments in increasing the share of appraisals that confirm contract price. The *x*-axis in the figure is defined as the percentage difference between the AVM estimate and contract price, where a value greater than 0 implies the AVM estimate was above the contract price. The top line in the figure illustrates the share of appraisals with an appraised value equal to or above contract price by relative AVM estimate. This line illustrates approximately 80% of appraised values confirmed contract price even when the AVM estimate was more than 10% below contract price. The lower most line in Figure 3 represents the percent of appraisals with an average unadjusted comparable transaction price at least equal to the contract price. These are properties that would have had an appraised value confirming contract price before adjustments for observable differences and differential weighting. Less than 55% of properties with an AVM estimate less than 10% below contract would have an appraised value at or above contract price based on this standard.

The middle dashed line of Figure 3 represents the share of appraisals with an average adjusted comp above contract, with the gap between the bottom and middle line representing the increase in share due to comp price adjustments. This gap indicates price adjustments account for a diminishing role of the explainable differences when the AVM estimate is below contract price,

with virtually no increase in share observed from properties with an AVM estimate more than 10% below contract price.

V. Weighting of Comparable Transactions

The third and final stage of the sales-comparison approach is for the appraiser to implicitly weight each adjusted price of comparable transactions to determine a final appraised value for the property. An appraiser choosing to weight each adjusted transaction equally would set the appraised value equal to the average of adjusted transactions. We estimate that appraisers use unequal weighting to increase appraised values for 34% of all appraisals, and occasionally by more than 5%. This reweighting accounts for an additional 23% of appraisals confirming contract price that would have otherwise been below. In this section, we provide evidence that appraisers apply more weight to higher valued comps to justify contract price even after controlling for other potential justifications for unequal weighting.

The bottom part of Table 1 indicates the importance to appraisers' use of unequal weighting in confirming contract price. The first column indicates only 75% of all appraisals had an average adjusted comp at least equal to contract price. Of properties with an adjusted average below contract price, appraisers used unequal weighting to increase appraised value to confirm contract price for 69% of properties. In comparison, for less than 0.5% of properties with an average adjusted comp was above contract price did appraisers use unequal weighting to reach an appraised value below contract price. Appraisers' use of unequal weighting increased the share of properties with an appraised values at least equal to contract price from 63% to 87% if the AVM estimate was below contract price. The distance between the middle and top line of Figure 3 further

illustrates unequal weighting was the most important for properties with an AVM estimate more than 10% below contract price.

There are potentially valid reasons for appraisers to apply unequal weighting to comps even after accounting for unmatched observable differences. For example, Vandell (1991) proposes applying more weight to the most similar comparables based on the variance of adjustments. Similarly, appraisers may wish to apply more weight to properties in closer proximity to account for unobservable differences in the subject's location. Some appraisers may also have their own idiosyncratic or seasonal tendencies in how they make adjustments. Last, since most appraisals are represented in thousands of dollars, it would not be unreasonable for appraisers to round to the nearest thousand.

We present results in Tables 3 and 4 of empirical tests for how much more likely appraisers were to apply additional weight to higher valued comps to justify contract prices conditional upon the above justifications. The results presented in Table 3 were estimated based on a linear probability model where the dependent variable is a binary indicator for whether the appraised value was greater than the unweighted average of adjusted comparable transactions. The main explanatory variable of interest is an indicator variable for whether the unweighted average adjusted comp was less than contract price, where a positive coefficient value is indicative of the appraiser applying more weight to above average priced comps (i.e., using unequal weighting to confirm contract price). The dependent variable associated with results presented in Table 4 is the percentage difference between the appraised value and unweighted average of adjusted comparable transactions.

The first column of each table represents results from a bivariate regression of each dependent variable on the indicator variable for whether the unweighted average was below

contract price, and a constant. The constant indicates the appraised value was greater than the unweighted average for 15.8% of appraisals when the average adjusted comp was equal to or above contract price. We estimate the appraised value was 73.8 percentage points (pp) more likely to be above the unweighted average adjusted comp if the average was below contract price. This result was highly statistically significant using standard errors clustered at the appraiser level, and represents appraised values were 467.1% more likely to be above the average adjusted comp given the base value.

Results reported in the second column of Table 3 include appraiser and year-quarter fixed effects, and the third column includes controls for the three justifications for applying more weight to certain comps discussed above. In particular, the specification includes separate indicators for whether the most proximal comp or the comp requiring fewest adjustments (i.e., most similar) had an above average adjusted price.¹¹ The specification also includes an indicator variable for whether the last three digits of the average of adjusted comps was between \$500-\$999 to account for rounding up. Both sets of fixed effects were found to be highly statistically significant and coefficients on each of the three indicators variables were positive as expected. The addition of these variables had virtually no change on the main result, with the appraised value estimated to be 72.6pp more likely to be above the adjusted average comp if the comp was below contract price for the full specification.

Results presented in Table 4 confirm similar patterns when the dependent variable was defined as the percentage difference between the appraised value and average adjusted comp. Having an unweighted average adjusted comp below contract price resulted in the appraiser

¹¹ The comparable transaction determined to have the fewest adjustments was determined by calculating the absolute value of all cumulative adjustments relative to the subject property. Approximately half of all appraisals with an average adjusted comp below contract price had the adjusted price of either the most proximal, or similar, comp above the average of all comps.

adjusting weights such that the appraised values were 2.5% higher regardless of specified fixed effects and other control variables. These estimated effects were again highly statistically significant using appraiser-specific clustered standard errors. They are also thought to represent lower bounds of total appraiser introduced biases since they only represent those from unequal weighting of adjusted comps as further biases could be introduced based on their selection and adjustment of comps.

Figures 4 and 5 present perhaps the strongest evidence that appraisers apply differential weights to adjusted comps based on proximity of the unweighted average to contract price. Instead of assuming a constant effect above and below contract price, estimates reported in each figure illustrate the marginal effects in 1% intervals (i.e., 1-to-2%, 2-to-3%, etc.) of the difference in the average adjusted comp divided by contract price. The results presented in Figure 4 are parallel to those presented in Table 3 in representing the increased likelihood the appraised value was greater than the unweighted average of adjusted comps. The results presented in Figure 5 are parallel to those presented in Table 4 representing the percentage difference in the appraised value and average adjusted comp. The estimates are conditional upon both sets of fixed effects and three justification indicator control variables, and should be interpreted relative to the omitted category when the unweighted average adjusted comp was from 0-to-1% above contract price. Dashed lines represent 90% confidence intervals based on appraiser clustered standard errors, although often not visible in the figure given the precision of the estimates.

We estimate appraised values were 68.2pp (260.3%) more likely to be above the average adjusted comp compared to when the average was from 0-to-1% below contract price. This indicates appraisers used weights to increase the appraised value for 94.4% of these properties. Although the discontinuity is sharpest immediately below contract price, we estimate it persists

even when average adjusted comps were much further below contract price. For example, appraised values were an estimated 53.0pp (202.3%) more likely to be above the average adjusted comp when the average was from 4-to-5% below contract price. These differences persisted even when average adjusted values were more than 10% below contract price.

Figure 5 indicates the estimated percentage difference between the appraised value and average adjusted comp was between 0.7% and 2.1% higher than the omitted category when the average adjusted comp was below contract price. The magnitude of these estimates reflect that often only small adjustments to weights were required to justify contract prices. For example, we estimate that appraised values were 1.4% higher than average adjusted comps if the average was 1-to-2% below contract price as that is all that would be required to raise appraised values to match contract price. It is also important to recognize the estimates presented in the figure are not conditional upon actually making an adjustment. Results presented in Figure 4 indicate appraisers use unequal weighting to increase the appraised value for approximately 50% of properties if the average adjusted comp was at least 3% below contract price. Based on average appraised values, our estimates would imply appraised values were \$12,280 higher conditional upon the appraiser making an adjustment and the average adjusted comp being from 4-to-5% below contract price conditional upon the appraiser applying unequal weights.

VI. Repeated Interactions with Counterparties

The previous section provided evidence that appraisers bias appraised values in order to confirm contract price. In particular, appraisers apply more weight to higher-valued comps in order to justify contract prices. This result is robust to both appraiser and year-quarter fixed effects,

potential rounding to nearest thousands of dollars, and attributes of the most proximal or otherwise similar comp.

In this section, we explore how repeated interactions of appraisers with financial institutions, loan officers, and real estate brokers affect their appraised values. We use interactions to test whether an appraiser was more likely to sufficiently adjust weights to justify an appraised value at least equal to contract price for the counterparties they work with most frequently, conditional upon having an average adjusted comp below contract price. Our intuition is that these estimates represent lower bounds of the true effects as appraisers may have already been influenced in their selection and adjustment of comparable transactions.

Financial Institutions

Results presented in Table 5 test directly whether appraisers were more likely to set appraised values at least equal to contract price for the financial institutions they worked with most frequently. Financial institutions employ the loan officer and will at least temporarily fund the mortgage loan before being sold on the secondary mortgage market. The sample is restricted to the 2,539,411 appraisals where the financial institution, loan officer, and real estate broker were identified.¹² This sample identifies 40,987 appraisers working with 162,294 loan officers located at 4,756 unique financial institutions. Each column represents the results of a separate regression and includes both sets of fixed effects and the three indicator justification control variables discussed before. Standard errors remained clustered at the appraiser level and are reported in parentheses below each coefficient estimate.

¹² The financial institution was identified for all appraisals in the original sample, although loan officer and real estate broker were only identified for loans that were successfully originated and eventually purchased by either Fannie Mae or Freddie Mac on the secondary mortgage market. Results were nearly identical across the restricted and expanded samples for financial institution.

On average, the appraised value exceeded or equaled the contract price for 96.9% of the appraisals in the restricted sample. An average adjusted comp below contract price resulted in property estimated 26.6% less likely to have an appraised value at least equal to contract price. The median appraiser in the sample conducted 45.3% of their appraisals for the financial institution they worked with most frequently, with an interquartile range of 30-to-67%. Estimates reported in the first column of Table 5 indicate the same appraiser was 2.0pp more likely to apply sufficient weights to justify contract prices if the average adjusted comp was below contract price for the financial institution he/she worked with most frequently. This corresponds to a 2.7% increase in likelihood a property is assigned an appraised value at least equal to contract price.

Results presented in Figure 6 relax the assumption of a constant effect of relationships when the average adjusted comp is above or below contract price. The intuition is that appraisers may use weights to confirm contract price for all properties with an average adjusted comp less than 1% below contract price, but be more likely to make larger adjustments to confirm contract prices for counterparties they work with most frequently. The solid line in Panel A of Figure 6 represents the percent difference in likelihood of the appraised value being at least equal to contract price (i.e., adjusted comps were sufficiently weighted to confirm contract price) for the financial institution the appraiser works with most frequently.¹³ The dashed lines represent the 90% confidence interval of each estimate based on appraiser clustered standard errors.

As anticipated, there was virtually no difference based on relationship status of the appraiser with the financial institution when the average adjusted comp was less than 1% below contract price. Virtually all appraisers rounded appraised values to contract price for these properties. However, a significant and meaningful difference is estimated to consistently exist

¹³ The percentage difference is calculated by dividing the estimated coefficient on the interaction by the estimated effect subtracted by the constant term.

when the average adjusted comp was at least 1% below contract price for the financial institution the appraiser worked with most frequently. The largest differential effect (8.4%) was estimated to occur when average adjusted comps were at least 5% below contract price. A 5% increase in appraised value translates to \$14,691 for the average property in our sample.

Loan Officers

Whether financial institutions benefit from upwardly biased appraisals is unclear. Since underlying collateral values would be actually lower than appraisers indicate, financial institutions may retain undocumented exposure to additional credit risk, or even face repurchases from secondary mortgage market counterparties.¹⁴ The incentives for loan officers that represent financial institutions are more transparent. Their compensation is either directly or indirectly associated with successfully originated loans, and they are rarely held accountable for subsequent credit losses. Individual loan officers may interact with appraisers either formally during the loan underwriting process, or informally through local professional functions.

Results reported in the second column of Table 5 indicate appraisers were indeed more likely to adjust weights to justify contract prices for the loan officer they worked with most frequently. The loan officer each appraiser worked with most frequently represented 4.8% of his/her appraisals, with an interquartile range from 3-to-8%. Appraisers were 1.9pp (2.7%) more likely to sufficiently adjust weights to justify contract prices for appraisals associated with that specific loan officer.

Results illustrated in panel B of Figure 6 indicate appraisers were also more likely to sufficiently adjust weights to justify contract prices for loan officers than financial institutions as

¹⁴ See Goodman et al. (2015) for a historical overview and analysis of GSE repurchase activity.

the size of necessary adjustments increased. This differential was the greatest (17.8%) when the average adjusted comp was at least 5% below contract price.

Real Estate Brokers

Real estate brokers act as agents to buyers and sellers in the transaction and stand to receive the greatest financial benefit from a property transacting, which an appraised value below contract price may prevent. Real estate brokers may directly consult with an appraiser by supplying additional comparable transactions when a property appraises below contract price, or through local professional functions. There were 24,964 real estate brokers identified in the data, and the broker the median appraiser worked with most frequently represented 13.6% of his/her business. The interquartile range was 8.3-to-23.0%.

Results presented in the third column of Table 5 indicate appraisers were also more likely to sufficiently adjust weights for brokers they worked with most frequently. A property associated with the broker the appraiser worked with most frequently was 2.4pp (3.1%) more likely to have an appraised value at least equal to contract price if the average adjusted comp was below contract price. Panel C of Figure 6 illustrates relationships with brokers were directly related to appraisers likelihood to sufficiently adjust weighting to confirm contract price. We estimate appraisers were 10.3% more likely to sufficiently adjust contract price when the average adjusted comp was at least 5% below contract price for these brokers.

The last column of Table 5 includes all three interactions simultaneously. The estimated effects of loan officers and real estate brokers were similar, although that of most frequent financial institutions were reduced by 75% than when specified separately. A summation of all three effects indicate that appraisers were 3.5pp (5%) more likely to sufficiently adjust weights to justify

appraised values when simultaneously working with the financial institution, loan officer, and real estate broker they worked with most frequently.

Appraisal Management Companies

The last relationship we test for is the effect of Appraisal Management Companies (AMCs) on appraisal practices. These companies serve as an intermediary between the appraiser and lender, and became more prominent after the 2008 financial crisis to help ensure appraiser independence as mandated by the HVCC and the subsequent Dodd-Frank Act (Shui and Murthy, 2018). An AMC provided oversight on 64.6% of all appraisals in the sample, and 92.4% of appraisers conducted at least one appraisal associated with an AMC. We further find only 22.3% of appraisers worked exclusively with an AMC. We exploit this variation within appraisers to estimate if the same appraiser behaved differently for properties associated with an AMC.

We first test whether appraisers were more likely to adjust weights such that the appraised value exceeded the average adjusted comp (i.e., the appraised value was greater than the average adjusted comp). This specification includes the same fixed effects and other controls as the third column of Table 4, with the exception of an indicator variable in Table 6 for whether an appraisal is associated with an AMC and the interaction of this variable with whether the average adjusted comp was also below contract price. We estimate appraisers were 1.2pp (1.5%) less likely to make a positive weight adjustment when an AMC was involved in the transaction. Using a specification similar to Table 5, we estimate appraisers were 3.3pp (3.8%) less likely to sufficiently adjust weights on adjusted comps to confirm contract price when working with an AMC. Thus, we find evidence that AMCs are effective in curbing some appraiser behavior that is associated with appraisal bias in confirming contract prices. Still, it should be kept in mind that this is a marginal

effect and that appraisers still used unequal weighting to justify an appraised value greater than the average adjusted comp for 68.7% of properties when the average was below contract price even when an AMC was associated with the loan application.

VII. CONCLUSIONS AND POLICY IMPLICATIONS

Earlier research suggests inaccurate and biased appraisals of residential property contributed to the 2008 financial crisis. Subsequent reforms to appraisal practices have been enacted since the crisis, but we provide evidence that appraisers continue to bias estimates in support of contract prices. In particular, we use a novel data set to show a key mechanism behind this continued appraiser bias and that appraisers are most likely to submit biased values for the loan officers and real estate brokers they work with most frequently.

It is important to emphasize our estimated effects are most likely lower bounds of introduced biases by appraisers. The majority of our analysis focuses on the final step on the appraisal process, where appraisers implicitly apply their own weights to comparable transactions after already adjusting for observable differences between properties. The magnitude of these biases are potentially larger after accounting for appraisers' ability to introduce additional bias through their selection and adjustment of comparable transactions. In a related study, Eriksen *et al.* (2018) compares the estimated values of the same property appraised twice within six months following foreclosure, where one appraiser was uninformed of the contract price and no repairs were conducted on the property between appraisals. The appraiser informed of the contract price engaged in almost identical differential weighting of adjusted comps as the current study, and justified an appraised value approximately 4% higher than the uninformed appraiser after adjusting for market wide price increases between appraisal dates.

Several caveats of the research are important to discuss. First, our sample of appraisals is restricted to those associated with home purchase loan applications in metropolitan areas with contract prices between \$50,000 and \$1,000,000 from 2013 until 2017. Although our sample represents an estimated 65.6% of all appraisals associated with a home purchase over this period, we do not analyze appraisals commissioned due to refinancing of a previous loan balance or by lenders not using Fannie Mae's appraisal software platform. This period also had relatively stable residential price appreciation in most local markets, and it is unclear how our results would generalize to more volatile markets. Although we have shown an effect of repeated interactions with loan officers and real estate brokers on appraised values and appraisal practices, the exact mechanism for why these interactions matter in confirming contract prices deserves further consideration in future research, especially regarding eventual loan performance.

The economic cost of biased appraisals is potentially quite large. LaCour-Little and Malpezzi (2003) first provided evidence that borrowers were more likely to default on loans associated with upwardly biased appraisals. More recently, Agarwal *et al.* (2015) demonstrated that appraisals from 1990 to 2011 for cash-out refinance loans often valued homes above the authors' own estimates of value, and that over-valued homes were more likely to subsequently default. Other potential costs of the bias include an exaggeration of the procyclicality of housing booms and busts (Calem *et al.*, 2015; Nakamura, 2010; Ding, 2014), information loss to borrowers who could potentially renegotiate or walk away from sales (Ding and Nakamura, 2016; Fout and Yao, 2016), and distortions in the valuation of mortgage investments. Removing or reducing the highest bids relative to recent market prices for similar homes might have slowed the rapid price appreciation that occurred in some markets, and limited additional exposure to default risk by financial institutions.

The main policy implication of this research is that further reform is required to improve the accuracy and utility of appraisals for market participants. Four adjustments to the appraisal process could mitigate the patterns seen in our analysis. The first is to require that appraisers document and justify weights applied to adjusted comparable transactions during the reconciliation process. Second, the practice of purposefully informing the appraiser of the purchase price should be reconsidered. Third, the practice, role, and documentation of AMCs should be formalized to provide consistent oversight when used. Last, regulators should allow appraisers to document uncertainties in valuation and relax the requirement that they must arrive at a single dollar value. For example, appraisers could provide a confidence interval or range of adjusted comps that loan underwriters could account directly for during their underwriting process. The implementation of these above reforms would strengthen mortgage markets, and potentially prevent future financial crises.

REFERENCES

- Agarwal, Sumit, Brent Ambrose, Souphala Chomsisengphet, and Chunlin Liu, 2011. The Role of Soft Information in a Dynamic Contract Setting: Evidence from the Home Equity Credit Market, *Journal of Money, Credit, and Banking* 43(4): 633-655.
- Agarwal, Sumit, Brent Ambrose and Vincent Yao, 2016. The Effects and Limits and Regulation: Appraisal Bias in the Mortgage Market, SSRN Working Paper.
- Agarwal, Sumit and Itzhak Ben-David, 2012. Do Loan Officers' Incentives Lead to Lax Lending Standards?, Working Paper, Ohio State University.
- Agarwal, Sumit, Itzhak Ben-David and Vincent Yao, 2015, Collateral Valuation and Borrower Financial Constraints: Evidence from the Residential Real Estate Market, *Management Science*, 61(9): 2220-2240.
- An, Xudong, Yongheng Deng, Eric Rosenblatt and Vincent Yao, 2012. Model Stability and the Subprime Mortgage Crisis, *The Journal of Real Estate Finance and Economics*, 45(3): 545-568.
- Ben-David, Itzhak, 2011. Financial Constraints and Inflated Home Prices during the Real Estate Boom, *American Economic Journal: Applied Economics*, 3: 55-67.
- Bhutta, Neil, Jane Dokko and Hui Shan, 2010. The Depth of Negative Equity and Mortgage Default Decisions, Working Paper, Federal Reserve Board.
- Calem, Paul, Lauren Lambie-Hanson and Leonard Nakamura,, 2015. Information Losses in Home Purchase Appraisals, Working Paper, Federal Reserve Bank of Philadelphia, 2015 Q1.
- Cho, Man and Isaac Megbolugbe, 1996, An Empirical Analysis of Property Appraisal and Mortgage Redlining, *The Journal of Real Estate Finance and Economics*, 13(1), 45-55.
- Ding, Lei, 2014. Information Externalities and Residential Mortgage Lending in the Hardest Hit Housing Market: The Case of Detroit, *Cityscape*, 16(1): 233-252.
- Ding, Lei, and Leonard Nakamura, 2016. The Impact of the Home Valuation Code of Conduct on Appraisal and Mortgage Outcomes, *Real Estate Economics* 44(3): 658-690.
- Elul, Ronel, Nicholas Souleles, Souphala Chmosisenghpert, Dennis Glennon and Robert Hunt, 2010, What Triggers Mortgage Default? *American Economic Review Papers and Proceedings*, 100(2): 490-494.
- Eriksen, Michael D., Hamilton B. Fout, Mark Palim, and Eric Rosenblatt, 2018. Contract Price Confirmation Bias: Evidence from Repeat Appraisal. Fannie Mae working paper.
- Foote, Christopher, Kristopher Gerardi and Paul Willen, 2008. Negative Equity and Foreclosure: Theory and Evidence, *Journal of Urban Economics* 64(2): 234-245.
- Fout, Hamilton and Vincent Yao, 2016, Housing Market Effects of Appraising Below Contract, Working Paper, Fannie Mae Housing Whitepaper.
- Green, Richard K., 1994. Optimal Comparable Weighting and Selection: A Comment, *Real Estate Economics* 22 (4): 647-654.
- Goodman, Laurie, Jim Parrott and Jun Zhu, 2015, The Impact of Early Efforts to Clarify Mortgage Repurchases, Working Paper, Urban Institute.

- Griffin, John M. and Gonzalo Maturana, 2016. Who Facilitated Misreporting in Securitized Loans? *The Review of Financial Studies* 29(2): 384-419.
- Horne, David and Eric Rosenblatt, 1996, Property Appraisals and Moral Hazard, Working Paper, *Social Science Research Network*.
- Kelly, Austin, 2008, Skin in the Game: Zero Downpayment Mortgage Default, *Journal of Housing Research* 17(2): 75 – 99.
- Kruger, Samuel and Gonzalo Maturana, 2017. Collateral Misreporting in the RMBS Market. Working paper. July 28, 2017.
- LaCour-Little, Michael and Stephen Malpezzi, 2003. Appraisal Quality and Residential Mortgage Default: Evidence from Alaska, *Journal of Real Estate Finance and Economics* 27(2): 211 – 233.
- Mayer, Christopher, Karen Pence and Shane Sherlund, 2009. The Rise in Mortgage Defaults, *Journal of Economic Perspectives* 23(1): 27 – 50.
- Nakamura, Leonard, 2010, How Much is That Home Really Worth? Appraisal Bias and Home-Price Uncertainty, *Business Review*, Federal Reserve Bank of Philadelphia, 2010 Q1.
- Pagourtzi, Elli, Vassilis Assimakopoulos, Thomas Hatzichristos and Nick French, 2003. Real estate appraisal: a review of valuation methods, *Journal of Property Investment & Finance* 21(4): 383 – 401.
- Petersen, Mitchell A. and Raghuram G. Rajan, 2002. Does Distance Still Matter? The Information Revolution in Small Business Lending, *Journal of Finance* 57(6): 2533-2570.
- Shi, Lan and Yan Zhang, 2015. Appraisal Inflation: Evidence from the 2009 GSE HVCC Intervention, *Journal of Housing Economics* 27: 71 – 90.
- Shui, Jessica and Shriya Murthy, 2018. Are Appraisal Management Companies Value-Adding? Stylized facts from AMC and Non-AMC Appraisals, Federal Housing Finance Agency working paper 18-01, March.
- U.S. Congressional Budget Office, 2012. The Budget and Economic Outlook: Fiscal Years 2012 to 2022. (Washington, D.C.) January.
- Vandell, Kerry D., 1991. Optimal Comparable Selection and Weighting in Real Property Valuation, *AREUEA Journal*, 19: 2, 213-239.

Table 1. Descriptive Statistics of Appraisal Sample

	All Appraisals	AVM Estimate Above Contract Price	AVM Estimate Below Contract Price
Selected Comparable Transactions (Comp)	3.9	3.9	3.9
Potential Recent Comparable Transactions	34.8	34.6	34.9
Contract Price	308,505.7	301,874.6	316,207.1
Appraised Value	311,680.7	307,632.2	316,382.6
Number of Price Adjustments to Comps	3.9	3.9	3.9
Dollar Value of Adjustments to Comps	-976.2	-1,008.7	-938.4
Avg Unadjusted Comp \geq Contract Price (%)	69.7	77.5	60.6
Avg Adjusted Comp \geq Contract Price (%)	74.8	85.0	62.9
Appraised Value \geq Contract Price (%)	92.1	96.8	86.6
Appraisals	6,507,867	3,496,933	3,010,934
Unique Appraisers	53,850	51,456	51,168

Notes: Sample limited to appraisals associated with a home purchase in a metro area conducted between 2013 and 2017 with a contract price between \$50,000 and \$1,000,000. The sample in the second and third columns are restricted based on whether the contract price was above or below Fannie Mae's independent assessment of property value using their Automated Valuation Model (AVM).

Table 2. Adjustments to Comparable Transactions

	% Adjusted	Average Adjustment (\$)	AVM Estimate Below Contract Price	
			% Adjusted	Average Adjustment (\$)
Living Area	74.4	-122.9	74.2	-2,085.0
Other	46.3	64.6	48.0	901.4
# of Bedrooms / Baths	43.3	-108.2	42.8	-368.2
Garage / Carport	32.7	-133.5	32.9	-258.2
Porch / Deck	31.0	157.0	31.9	290.4
Lot Size	28.1	-68.9	27.8	-179.9
Basement (gross area)	22.5	15.5	23.4	170.5
Condition of Property	22.5	-328.0	22.4	210.1
Basement (finished area)	21.7	34.4	22.9	184.1
Financing and Sale Conditions	14.1	-537.5	13.3	-495.8
Age	10.6	6.2	10.7	-19.4
Heating and Air Conditioning	9.5	-3.2	9.1	22.7
View	9.4	-58.7	9.1	22.1
Location	8.1	-183.7	8.1	-32.7
Quality of Construction	6.9	-231.1	7.1	-16.7
Market Conditions	6.2	624.0	7.3	775.7
Energy Efficiency	2.5	13.7	2.6	31.1
Design / Style	2.5	-19.8	2.2	14.5
Function / Utility	1.9	-18.1	1.8	1.1

Notes: The table indicates both the likelihood and dollar amount of adjustments to 25.3m comparable transactions selected by appraisers to value 6.5m properties. The last two columns are restricted to the 3m appraisals where the contract price was below the Automated Valuation Model (AVM) estimate. A negative dollar adjustment means the property subject to the appraisal is inferior based on that feature and should transact for a lesser amount than the comparable transaction holding other attributes constant.

Table 3. Appraised Value Greater than Unweighted Average of Adjusted Comparable Transactions

		w/ Appraiser and Year-Quarter Fixed Effects	
			w/ Comp- Specific Controls
I(Avg Adjusted Comp < Contract Price)	0.738*** (0.001)	0.737*** (0.001)	0.726*** (0.001)
Most Proximal Comp Above Average			0.067*** (0.001)
Most Similar Comp Above Average			0.092*** (0.001)
Round up to nearest \$1,000			0.053*** (0.0001)
Constant	0.158*** (0.001)	0.149*** (0.001)	0.054*** (0.001)
Observations	6,507,867	6,507,867	6,507,867
Unique Appraisers	53,850	53,850	53,850
R-Squared	0.455	0.450	0.470

Notes: The dependent variable is an 0,1 indicator variable for whether the appraised value was higher than the average adjusted comp, indicating the appraiser applied above average weight to higher-indicated value comps. The dependent variable is the average increase in appraised value relative to average adjusted comp. The contract price is the price negotiated between the buyer and seller. Results presented in the second column control for appraiser and year-quarter fixed effects, and the specification in the third column also includes indicators variables for whether the nearest comp or comp requiring fewest adjustments was above average, and whether the last three digits of the average adjusted comp was between \$500 and \$999 to adjusting for rounding to nearest thousands of dollars. Standard errors clustered at the appraiser level are reported in parentheses and asterisks indicate statistical significance at the following levels: *** p<0.01, ** p<0.05, * p<0.1.

Table 4. Percentage Difference of Appraised Value and Unweighted Average of Adjusted Comparable Transactions

		w/ Appraiser and Year-Quarter Fixed Effects	
			w/ Comp- Specific Controls
I(Avg Adjusted Comp < Contract Price)	0.025*** (0.001)	0.025*** (0.001)	0.025*** (0.001)
Most Proximal Comp Above Average			0.002*** (0.001)
Most Similar Comp Above Average			0.003*** (0.001)
Round up to nearest \$1,000			-0.001*** (0.001)
Constant	-0.014*** (0.001)	-0.015*** (0.001)	-0.017*** (0.001)
Observations	6,507,867	6,507,867	6,507,867
Unique Appraisers	53,850	53,850	53,850
R-Squared	0.275	0.272	0.280

Notes: The dependent variable is the percentage differences between the appraised value and the unweighted average of adjusted comparable transactions. The contract price is the price negotiated between the buyer and seller. Results presented in the second column control for appraiser and year-quarter fixed effects, and the specification in the third column also includes indicators variables for whether the nearest comp or comp requiring fewest adjustments was above average, and whether the last three digits of the average adjusted comp was between \$500 and \$999 to adjusting for rounding to nearest thousands of dollars. Standard errors clustered at the appraiser level are reported in parentheses and asterisks indicate statistical significance at the following levels: *** p<0.01, ** p<0.05, * p<0.1.

Table 5. Effect of Repeated Interactions on Likelihood Appraiser Confirms Contract Price

	Interactions for who Appraiser Works Most Frequently			
	Financial Institution	Loan Officer	Real Estate Broker	Combined
I(Avg Adj Comp < Contract Price)	-0.266*** (0.002)	-0.261*** (0.002)	-0.267*** (0.002)	-0.269*** (0.002)
Most Frequent Institution	-0.003*** (0.001)			-0.001 (0.001)
I(Avg Adj Comp < Contract Price) x Institution	0.020*** (0.002)			0.005** (0.002)
Most Frequent Loan Officer		0.001 (0.001)		0.001*** (0.001)
I(Avg Adj Comp < Contract Price) x Loan Officer		0.019*** (0.002)		0.012*** (0.002)
Most Frequent Broker			-0.004*** (0.001)	-0.004*** (0.001)
I(Avg Adj Comp < Contract Price) x Broker			0.024*** (0.0016)	0.019*** (0.002)
Constant	0.966*** (0.001)	0.965*** (0.001)	0.967*** (0.001)	0.967*** (0.001)
Observations	2,725,510	2,725,510	2,725,510	2,725,510
Unique Appraisers	49,829	49,829	49,829	49,829
R-Squared	0.192	0.192	0.192	0.192

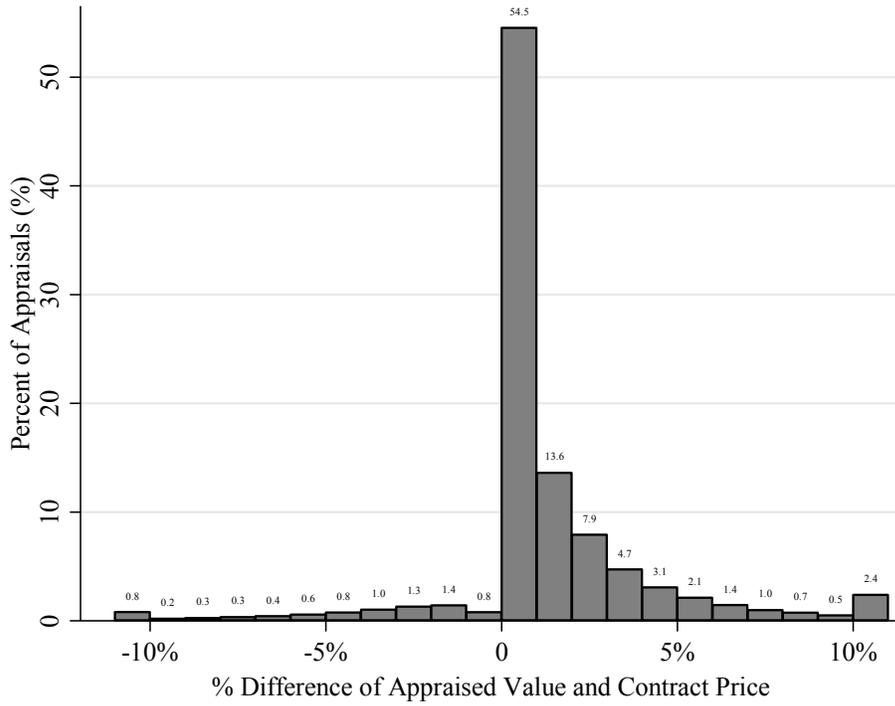
Notes: The dependent variable is a 0,1 indicator variable for whether the appraised value was greater than or equal to contract price. Each specification also includes appraiser and year-quarter fixed effects, and separate indicator variables for whether the nearest or most similar comparable transaction (comp) had an adjusted price greater than the average adjusted comp, and if last 3 digits of average adjusted comp was between \$500 and \$999. The average appraiser fixed effect was 0.97. Institution indicates the financial institution the appraiser worked with most frequently. Loan Officer and Broker indicate the loan officer and real estate broker the appraiser worked with most frequently. Standard errors clustered at the appraiser level are reported in parentheses and asterisks indicate statistical significance at the following levels: *** p<0.01, ** p<0.05, * p<0.1.

Table 6. Effect of Working with an Appraisal Management Company (AMCs) on Confirming Contract Price

	Appraised Value Greater than Average Adjusted Comp	Appraised Value Greater Than or Equal to Contract Price
I(Avg Adj Comp < Contract Price)	0.750*** (0.002)	-0.235*** (0.002)
Appraisal Management Company (AMC)	0.001 (0.001)	0.006*** (0.001)
I(Avg Adj Comp < Contract Price) x AMC	-0.012*** (0.002)	-0.033*** (0.002)
Constant	0.080*** (0.001)	0.964*** (0.001)
Observations	2,539,411	2,539,411
Unique Appraisers	40,987	40,987
R-Squared	0.475	0.192

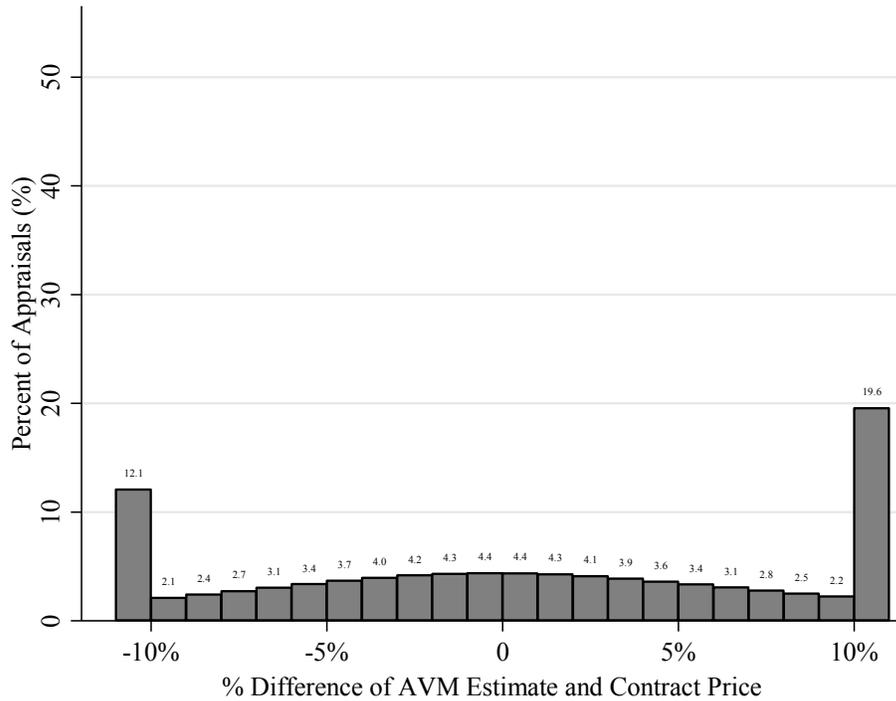
Notes: The dependent variable for each regression is indicated at the top of each column. Each specification also includes appraiser and year-quarter fixed effects, and separate indicator variables for whether the nearest or most similar comparable transaction (comp) had an adjusted price greater than the average adjusted comp, or the last three digits of the average adjusted comp was between \$500 and \$999. Appraisal Management Companies act as intermediaries between lenders and appraisers. Standard errors clustered at the appraiser level are reported in parentheses and asterisks indicate statistical significance at the following levels: *** p<0.01, ** p<0.05, * p<0.1

Figure 1. Distribution of Appraised Values relative to Contract Price



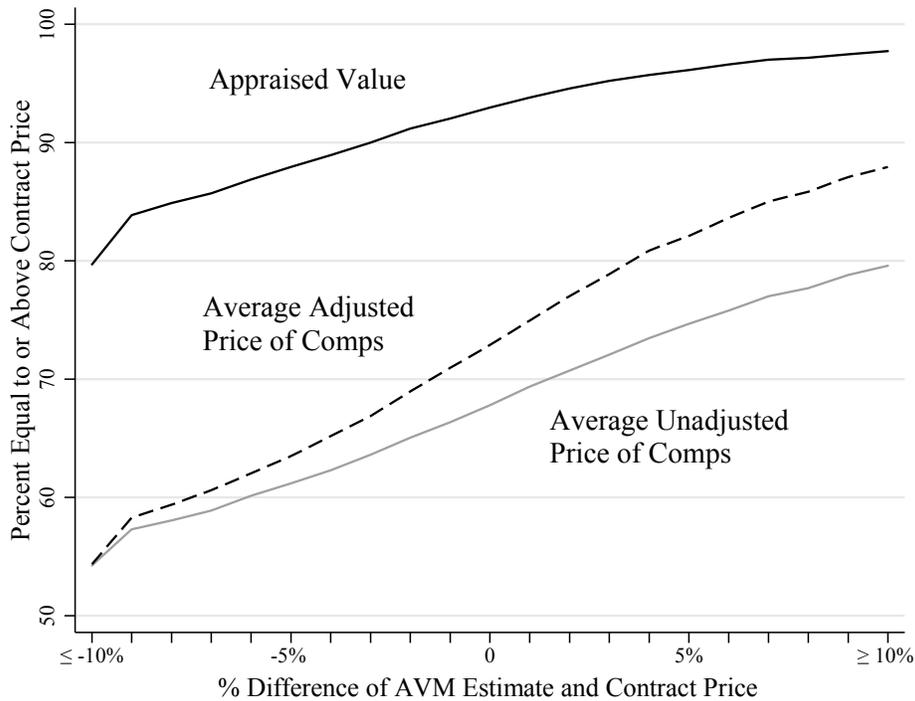
Notes: The *x*-axis is defined as the percent difference between the appraised value estimate and contract price. The bins are in 1% intervals, and differences in appraised values less than 10% or greater than or equal to 10% of contract price are separately aggregated. 92.1% of appraisals were above contract price and 27.8% of appraised values were exactly equal to contract price.

Figure 2. Distribution of AVM Property Estimates Relative to Contract Price



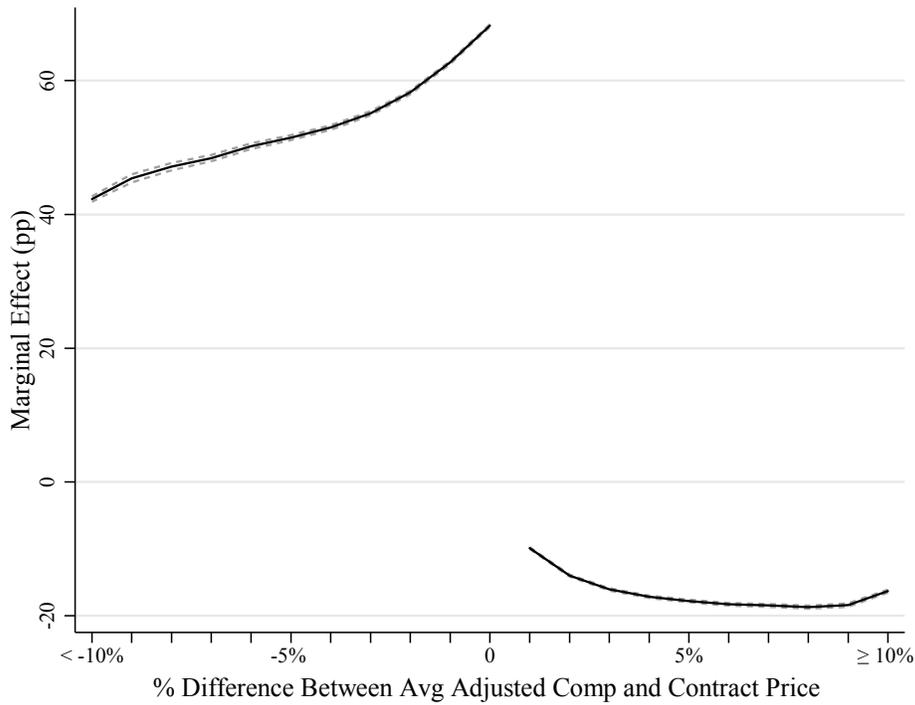
Notes: The *x*-axis is defined as the percent difference between the Fannie Mae’s Automated Valuation Model (AVM) estimate and contract price. The bins are in 1% intervals and differences in appraised values less than 10% or greater than or equal to 10% of contract price are separately aggregated. 53.7% of appraised values were equal to or above contract price.

Figure 3. Percent of Properties with an Appraised Value equal to or Above Contract Price by Each Stage of Appraisal Process Relative to AVM Estimated Property Value



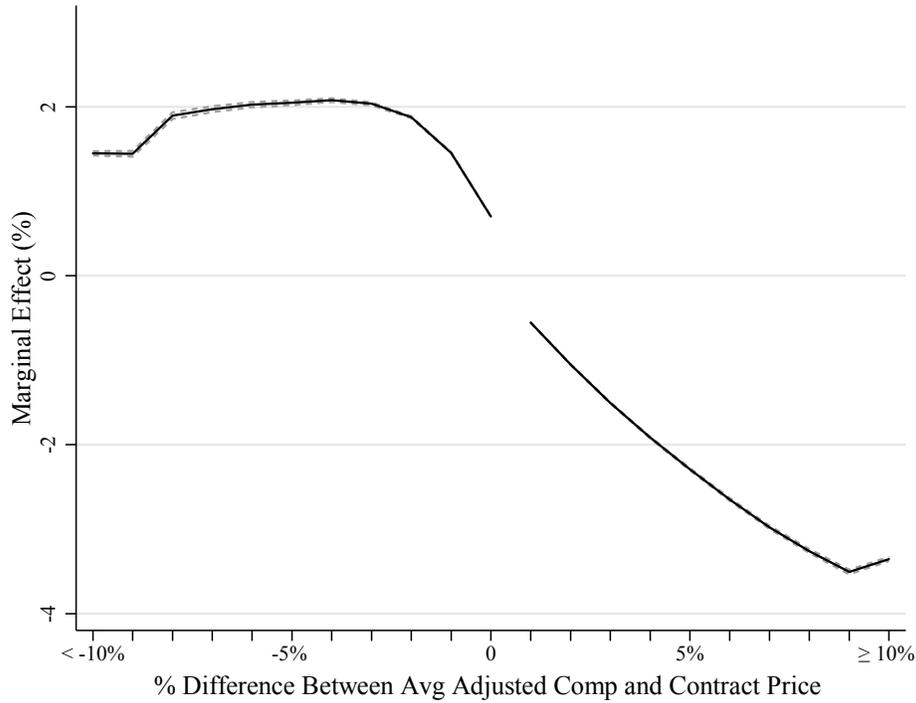
Notes: The x -axis is defined as the percent difference between Fannie Mae's automated valuation model (AVM) estimate and contract price. The bottom line represents the share of appraisals with an average unadjusted comparable transaction (comp) greater than or equal to contract price. The middle dashed line represents the share of appraisals with an average adjusted comp greater than or equal to contract price. The top line represents the share of properties with an appraised value greater than or equal to contract price, with the difference between the top two lines explained by appraisers applying above average weight to higher adjusted comparable transactions.

Figure 4. Probability the Appraised Value is Greater than the Unweighted Average of Adjusted Comparable Transactions Relative to Contract Price



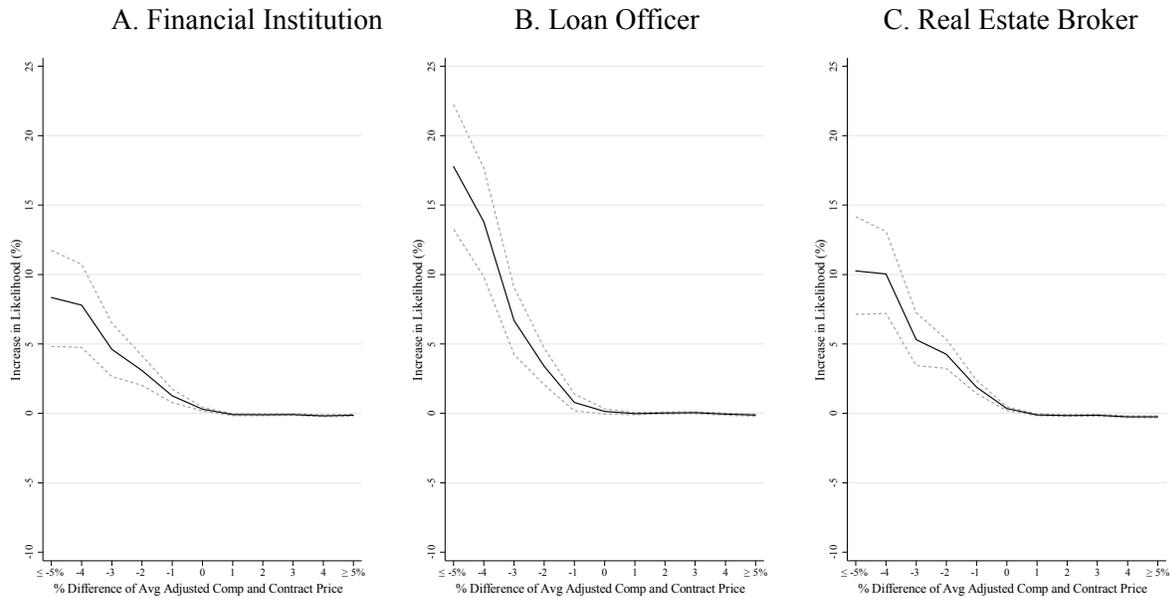
Notes: Dashed lines represent 90% confidence intervals based on standard errors clustered at the appraiser-level. The omitted category is having an average adjusted comparable transaction between 0 and 1% of the contract price.

Figure 5. Percentage Difference in Appraised Value from Unweighted Average of Adjusted Comparable Transactions Relative to Contract Price.



Notes: Dashed lines represent 90% confidence intervals based on standard errors clustered at the appraiser-level. The omitted category is having an average adjusted comparable transaction between 0 and 1% of the contract price.

Figure 6. Effect of Repeated Interactions with the Counterparty the Appraiser works most frequently on Likelihood Appraised Value Exceeds Contract Price as a Function of Unweighted Average Adjusted Comparable Transaction



Notes: The solid represents transformed coefficient to represent the percent increase in likelihood an appraised value is greater than or equal to contract price conditional upon average adjusted comp. Dashed lines represent 90% confidence intervals based on standard errors clustered at the appraiser-level.