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Abstract

This paper estimates the jumbo-conforming mortgage rate spread back to 2000. We show that jumbo rates were above conforming rates before the financial crisis – consistent with many previous studies – and that the spread widened during the crisis. However, the spread turned negative in 2013 and remained so through 2019, with jumbo rates about a quarter percentage point below conforming rates. We consider a variety of explanations for the shift to a negative spread. The primary factor appears to be a substantial rise in GSE guarantee fees. Increased bank supply of jumbo loans may also have played some role, though the evidence is weak. With the onset of the Covid-19 pandemic, we estimate that the jumbo-conforming spread increased enough to move slightly above zero. Renewed Federal Reserve purchases of agency MBS, a refinancing boom, and increased caution by banks in the jumbo market are likely to be behind the rise in the spread.

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Introduction

The government-sponsored enterprises Fannie Mae and Freddie Mac (the GSEs) are the dominant institutions in the U.S. residential mortgage market. An important question is the extent to which their presence has led to lower mortgage rates for borrowers. The answer to this question feeds directly into the debate about the future role of the GSEs in U.S. housing finance, which has yet to be resolved more than a decade after the financial crisis.¹ If GSE loans carry lower rates than other loans, changes that reduce the GSEs' role would result in higher mortgage rates for many borrowers. Conversely, if the rates on GSE loans are similar to or above those on unguaranteed loans, the impact on rates of shrinking the GSE footprint could be muted; many borrowers who previously had relied on GSE loans might be able to obtain private loans without a jump in rates, although the terms of lending could be different.²

Researchers have measured this rate differential by the “jumbo-conforming spread,” the difference in mortgage rates between jumbo loans, which are ineligible to be purchased by the GSEs, and conforming loans, which adhere to the size limit for GSE purchase. Pre-crisis estimates of the jumbo-conforming spread generally range from 10 to 30 basis points.³ The rate advantage for conforming loans then widened enormously during the financial crisis. Fuster and Vickery (2015) estimate that the jumbo-conforming spread for fixed-rate loans jumped from about 20 basis points immediately before the crisis to an average of 90 basis points from August 2007 to April 2008. Pradhan (2018a,b) and Gough (2019) find similar spikes in the spread during the crisis. This increase reflected the

¹ The future role of the GSEs remains a topic of intense interest, with the Treasury Department recently releasing its proposal for housing finance reform and the Federal Housing Finance Agency seeking comments on a notice of proposed rulemaking regarding a new regulatory capital framework for Fannie Mae and Freddie Mac. See U.S. Department of the Treasury (2019) and Enterprise Regulatory Capital Framework (2020).

² The change in rates on unguaranteed loans would depend, of course, on the elasticity of supply of loans from private lenders. Our point is simply that if the rates on GSE loans are similar to or above the rates on unguaranteed loans, the starting point for this adjustment process is more favorable for borrowers than if the rates GSE loans were below those on unguaranteed loans.

³ See McKenzie (2002) for a summary of early studies in this literature. More recent estimates of the pre-crisis spread include Ambrose, LaCour-Little, and Sanders (2004), Passmore, Sherlund, and Burgess (2005), Blinder, Flannery, and Lockhart (2006), Sherlund (2008), Kaufman (2014), An and Yao (2016), DeFusco and Paciorek (2017), Pradhan (2018a,b), and Gough (2019).

freeze in the market for private-label mortgage-backed securities and the general rise in lender and investor risk aversion at that time.

Before the financial crisis, government backing for the GSEs was only implicit. In 2008, Fannie Mae and Freddie Mac were placed into conservatorship, and the GSEs were backstopped by the U.S. Treasury. The implicit backing of the U.S. government became more explicit, although uncertainty regarding the future status of the GSEs remains. Given this change, one might have expected the jumbo-conforming spread to increase. However, in the post-crisis market, it in fact decreased, and as discussed below, was negative from mid-2013 through 2019.

This study re-examines the jumbo-conforming spread, utilizing two loan-level datasets. The first dataset is drawn from the Monthly Interest Rate Survey (MIRS) conducted by the Federal Housing Finance Agency and its predecessor, the Federal Housing Finance Board. Most studies of the jumbo-conforming spread have used the MIRS data. Although MIRS does not provide information on important risk factors that affect mortgage rates, such as credit scores, we nonetheless use the MIRS data to connect with the existing literature. Our MIRS dataset covers the period January 2000 to April 2019.⁴ The second dataset we use overcomes the most significant deficiencies in MIRS. We combine loan-level data from Black Knight and CoreLogic that include a much larger set of risk factors than in the MIRS data. In addition, the Black Knight and CoreLogic data allow us to identify not only whether the loan amount is above or below the applicable conforming loan limit, but also whether the loans below the applicable limit were actually purchased by the GSEs. We can also observe whether the jumbo loans are placed in securities or held in portfolio. Hence, we are able to estimate not only the conforming versus jumbo rate differential as in prior studies, but also to compare the rate differential between conforming loans actually purchased by the GSEs and jumbo portfolio loans, which comprise nearly the entire post-crisis jumbo market. This second dataset spans the period January 2000 to December 2019.

⁴ On May 29, 2019, FHFA announced that the survey would be discontinued “due to dwindling participation.”

Our estimates of the jumbo-conforming spread before and during the financial crisis are similar to those in the literature. Using the MIRS data, we find the spread averaged about 15 basis points over 2000-2006 and then jumped in the second half of 2007, averaging about 50 basis points over 2007-2009. The Black Knight/CoreLogic dataset, with its larger set of controls, produces somewhat higher jumbo-conforming spreads in both periods: 40 basis points on average over 2000-2006 and nearly 70 basis points on average over 2007-2009. The more specific jumbo portfolio-GSE spread closely tracks the broader jumbo-conforming spread over most of this period (and in later years) but exceeds the broader spread in 2000-2001 and 2006-2007.⁵

After the economy began to recover from the financial crisis, the jumbo-conforming spread came back down, reaching levels in 2011-2012 that were similar to those before the crisis. The spread, however, continued to decline from that point. It turned negative in mid-2013, indicating that rates on jumbo loans had dropped below those on otherwise similar conforming loans. Over 2014-2019, all of our measures show that jumbo rates, on average, were roughly a quarter percentage point below conforming rates. This finding is consistent with the few other studies that include post-crisis estimates. Using CoreLogic data, Pradhan (2018a,b) estimates that the jumbo-conforming spread turned negative in 2013 and remained so through the end of her estimation period in 2018:Q2. Gough (2019) uses the MIRS data to estimate the spread on an annual basis through 2016, finding that the spread was roughly negative 20 basis points in each year from 2014 to 2016. We build on these studies by using a broader combination of datasets and estimating different variants of the spread through 2019.

We also examine why some borrowers continued to take out GSE loans right at the loan limit from 2014 to 2019 despite the lower rates in the jumbo market. We show that these borrowers likely

⁵ During these years, the main reason for the difference is that rates on GSE loans were below those on observably similar conforming loans held in portfolio or securitized in the private market, which widens the spread when only GSE loans are used. Analyzing why GSE rates were relatively low in these handful of years is beyond the scope of this paper but would be of interest for future research.

did not meet the underwriting requirements for a jumbo loan or did not undertake the rate shopping required to obtain a substantial jumbo rate advantage.

With estimates of the spread in hand, the next step is to account for the pattern over time, focusing on the emergence of negative spreads. We test a number of hypotheses. First, did the increase in GSE guarantee fees (g-fees) reduce the spread? Pre-crisis g-fees were about 20 basis points, but since 2013 they have averaged close to 60 basis points. We assess whether the timing of the increase in g-fees coincides with the decline in the spread.

Second, did an increase in bank supply of jumbo loans lead to a reduction in the spread? Since the financial crisis, the banking system has had abundant, low-cost deposits with which to fund the holding of loans and securities. Jumbo loans likely would have been an attractive asset for banks because they carry low risk and offer an opportunity to cross-sell other products to affluent customers. We develop a new measure of bank supply of jumbo loans, which moved up to a relatively high level after the financial crisis. We test whether this shift is associated with a decline in the spread.⁶

Third, did the change from a national conforming loan limit to market-specific limits push down the spread? In response to the reduced availability of jumbo loans during the crisis, Congress expanded the conforming limit to as much as 150 percent of the national limit in designated “high-cost” areas. Institutional investors, however, were concerned that these large conforming loans would prepay more quickly than other GSE loans. Acting through their trade association, the Securities Industry and Financial Markets Association (SIFMA), they succeeded in limiting the share of such loans in the most liquid form of GSE mortgage-backed securities (MBS). This constraint on GSE demand boosted the rates on high-balance GSE loans. We analyze the importance of this factor for the jumbo-conforming spread.

⁶ This hypothesis lines up with results in Loutskina and Strahan (2009) showing that banks with greater low-cost deposits and access to liquidity are more likely to approve jumbo loans. For the banking sector as a whole, deposits soared after the financial crisis, which would be expected to increase the supply of jumbos. See Martin (2015) and Ensign (2016) for press reports of strong bank interest in jumbo loans.

Fourth, as noted above, the GSEs benefitted from implicit federal backing before the crisis and more explicit backing since then. As a result, they have been able to fund themselves at lower cost than other financial institutions. We examine whether changes in the advantage can explain movements in the spread, not only in recent years but also during the crisis period.⁷

Fifth, the Federal Reserve's large-scale purchases of agency MBS beginning in late 2008 influenced the jumbo-conforming spread through their stronger effect on conforming mortgage rates than on jumbo rates (Di Maggio, Kermani, and Palmer, 2020). The spread widened with the onset of MBS purchases in the QE1 program and then partially reversed in 2013 when the Fed announced plans to taper down the purchases. Although the Fed's purchases boosted the spread on net and thus cannot explain the post-crisis drop, they can help account for variation in the spread. Our empirical work controls for this effect.

Finally, the jumbo-conforming spread may be affected over short periods by changes in the amount of mortgage refinancing. Refi booms strain capacity among mortgage originators, who likely prioritize loans that are easy to underwrite and ration the supply of loans that require more work (Sharpe and Sherlund, 2016). Jumbo loans tend to be resource-intensive, as the income and assets of jumbo borrowers often take more effort to evaluate. We assess whether the volume of refinancing has a measurable short-term effect on the spread.

To assess these potential explanations, we estimate a regression for monthly changes in the spread, supplemented by an event study of two increases in the g-fee. This analysis provides evidence that increases in the g-fee were a primary factor behind the post-crisis decline in the spread. In contrast, the regression analysis does not uncover a significant effect of jumbo loan supply. This non-

⁷ Passmore, Sherlund, and Burgess (2005) examine the effect of the GSE funding advantage on mortgage rates before the financial crisis. They estimate the funding advantage to have been about 40 basis points over 1997-2003, of which a bit more than 6 basis points passed through to conforming mortgage rates, resulting in a wider jumbo-conforming spread.

result likely stems from monthly volatility in our jumbo supply indicator and points to the value of developing an indicator with less short-term noise. Nonetheless, the fact that our indicator reached a high level starting in 2013 is suggestive of a role for jumbo loan supply. Among the other possible explanations for the negative spread, we can rule out the establishment of the high-cost area limits and the GSE funding advantage. The high-cost area limits had only a minimal effect on the spread after the crisis, and the level of the funding advantage was little different after the crisis than before. To complete the round-up of our findings, we show that the Fed's asset purchases left a clear imprint on the spread, confirming the results in Di Maggio, Kermani, and Palmer (2020), and we document that refinancing intensity helps explain shorter-term movements in the spread after the financial crisis.

The end of our sample period pre-dates the onset of the Covid-19 pandemic in the United States by only a few months. The severe market volatility and economic stress from the pandemic produced significant variation in both the spread and several of our explanatory variables. We estimate the impact of the pandemic through June 2020 by extrapolating forward the December 2019 level of the jumbo-conforming spread with the use of high-frequency indicator series. We estimate that the spread moved back above zero in the wake of the pandemic – ending the multi-year run of negative spreads – and stood at about 10 basis points in June 2020. This increase was not related to g-fees, which were essentially constant over the relevant period. Rather, the rise in the spread likely owed to a combination of renewed Fed purchases of agency MBS, a burst of mortgage refinancing, and a pullback by banks from the jumbo market.

History of the GSEs and the Conforming Loan Limits

Fannie Mae and Freddie Mac are Congressionally-chartered government sponsored enterprises established to support a stable and liquid secondary mortgage market in the United States through the purchase, guarantee, and securitization of single-family and multifamily mortgages. Fannie Mae was established by Congress in 1934 and originally was a buy-and-hold investor in Federal Housing

Administration (FHA) mortgages. In 1968, Fannie Mae became a private company focused on conventional mortgages, and Ginnie Mae, a government agency, was established to provide guarantees for securities composed of FHA, Department of Veterans Affairs (VA), and Rural Housing Service mortgages. Freddie Mac was granted a charter by Congress in 1970 and was originally mutually owned by the thrift industry before becoming a public company in the 1980s. Given their growing role in the U.S. home mortgage market, in 1992, Congress passed legislation leading to more formal supervision and regulation of Fannie Mae and Freddie Mac, including the establishment of capital requirements and other changes to their operating framework.

Immediately prior to the financial crisis in 2008, Congress created a new regulator, the Federal Housing Finance Agency (FHFA), to regulate Fannie Mae, Freddie Mac, and the Federal Home Loan Banks. In September 2008, at the height of the financial crisis, FHFA placed the GSEs into conservatorship due to the risk they would become insolvent. Under the conservatorship, the Treasury purchased almost \$200 billion worth of senior preferred shares from the GSEs, and committed another \$250 billion to keep them solvent in the event of further losses. This financial backing by the Treasury converted what had been viewed before the crisis as an implicit government guarantee for the GSEs into an explicit, but limited, guarantee.⁸

The GSEs charge a guarantee fee, made up of a base fee collected from incoming principal and interest payments over time and an upfront fee that partially reflects each loan's credit characteristics. During and after the crisis, FHFA took steps to increase base guarantee fees and make the upfront fees more risk-based. By 2013, guarantee fees had risen to nearly triple the pre-crisis level, making the fees more similar to what would be charged in the private market. In addition to increasing the base

⁸ Beginning in 2008, shortly after the GSEs entered conservatorship, the Treasury Department committed to support each GSE up to a cap that has varied over time. At its peak, the commitment equaled \$233.7 billion for Fannie Mae and \$211.8 billion for Freddie Mac. As of July 2020, the remaining commitment was \$113.9 billion and \$140.2 billion, respectively.

guarantee fees, upfront fees – which had previously been charged only for certain types of loans such as those on investor properties – were greatly expanded, resulting in higher fees for loans with higher LTVs, lower credit scores, and other riskier attributes.

The conforming loan limit was established by Congress in an effort to focus the GSEs on loans for lower and middle-income households. For much of their history, their charters imposed a national conforming loan limit, with a higher loan limit only for properties in Alaska, Hawaii, and U.S. Territories. During the crisis, given the lack of liquidity for jumbo mortgages, the Economic Stimulus Act (ESA) of 2008 and subsequent legislation enabled the GSEs to acquire larger loans in high-cost areas of the country, primarily markets on the East and West coasts. The limits in these high-cost areas are as much as 50 percent above the national limit. These loans have gone by a number of names in the market, including “jumbo conforming,” “agency jumbo,” or “super-conforming” loans. We use the term “super-conforming,” reserving the term “jumbo” for loans that are too large to be purchased by the GSEs.

Figure 1 displays the national conforming loan limit since 2000 and the maximum high-cost area limit since its inception in 2008.⁹ As shown by the blue line, the national limit increased from 2000 to 2006 in line with the rise in house prices. Although house prices plummeted during the crisis, the national limit was not reduced – following established convention – but instead stayed at \$417,000 through 2016 when home prices regained their pre-crisis peak. The national limit moved up in 2017 and increased again in 2018, 2019, and 2020. The red line shows that the maximum high-cost area limit was set initially at \$729,750, far above the national limit. The maximum limit dipped temporary to \$625,500 in January 2009 but soon returned to \$729,750 and remained there through September 2011, before

⁹ The loan limits shown in the figure and used in our analysis come from FHFA. The national limits for 2000-2007 are from Table 26 of https://www.fhfa.gov/AboutUs/Reports/ReportDocuments/OFHEO_Report_Congress-2007.pdf. For 2008 and later years, the national limit and high-cost area limits are posted at <https://www.fhfa.gov/DataTools/Downloads/Pages/Conforming-Loan-Limits.aspx>.

dropping again to \$625,500, where it stayed through the end of 2016.¹⁰ Since 2017 the high-cost area limits have been adjusted in sync with the national limit.

While the GSEs could acquire higher balance loans with the advent of the high-cost area limits, they could not securitize them on the same terms as their standard business, as investors were concerned that these loans would have faster prepayment speeds than other GSE loans. Institutional investors acting through SIFMA, their trade association, established “good delivery” guidelines which determine the characteristics of loans pooled into MBS that are eligible for “to-be-announced” (TBA) trading. The TBA market allows the forward trading of MBS that have not yet been issued and plays a vital role in the hedging of interest-rate risk. It is the most liquid portion of the agency MBS market, and MBS that do not meet good delivery guidelines typically trade at a discount to TBA eligible securities. The guidelines established that in order for an agency MBS to be TBA eligible, no more than 10 percent of the pooled loans could be super-conforming. Agency MBS that exceed this percentage have indeed traded at a significantly worse price, and hence higher yield, than TBA eligible pools.¹¹

Data

This section describes the datasets used in the paper; additional detail can be found in Appendix A. Our first dataset is constructed from the Monthly Interest Rate Survey (MIRS), the primary data source used by previous studies to estimate the jumbo-conforming spread. Prior to being discontinued with the release of the April 2019 data, the survey was conducted by FHFA, and before that, by the

¹⁰ The oscillation between \$625,500 and \$729,750 owes to the effects of legislation after the ESA to support the jumbo loan market. The initial ESA limits expired at the end of 2008 and were replaced by lower permanent limits set by the Housing and Economic Recovery Act (HERA). However, the American Recovery and Reinvestment Act and two subsequent Acts re-established the higher ESA limits on a temporary basis through September 2011. The lower HERA limits have been in effect since then. See Table 2 in Vickery and Wright (2013) for a chronology of the legislation affecting the high-cost area limits.

¹¹ Data presented in Compass Analytics (2019) show that Fannie Mae super-conforming pools of 30-year loans (carrying the prefix “FNCK”) trade 27/32 to 98/32 worse than the TBA price. Similarly, Fannie Mae super-conforming pools of 15-year loans (carrying the prefix “FNCL”) trade 12/32 to 66/32 worse than the TBA price. The Compass Analytics data also show that pools of lower balance loans can trade at a premium to TBA given that these loans prepay more slowly.

Federal Housing Finance Board. MIRS provides loan-level information for conventional single-family, fully-amortizing home purchase loans closed by an originator during the last five business days of the month. The survey includes the mortgage rate, loan amount, purchase price, loan-to-value ratio (LTV), the state and five-digit zip code for the property, whether the property is new or existing, origination fees, a jumbo indicator, and the type of lender, among other variables.¹² The survey does not include information on the extent to which the lender documented the borrower's income or assets because loans in the survey were expected to be fully documented. MIRS also does not include data on two key determinants of loan risk – the borrower's credit score and the debt payment-to-income ratio (DTI). We use the MIRS data for 30-year fixed-rate mortgages (FRMs) originated from January 2000 to April 2019 throughout the United States excluding Alaska and Hawaii. Our MIRS dataset excludes loans with LTVs below 25 percent, which we believe may be second liens misclassified as first liens.

We also combine three loan-level data sources to create a second dataset with greater detail about loan characteristics. The first two sources are the Loan Level Market Analytics (LLMA) dataset from CoreLogic and the McDash dataset from Black Knight, both of which compile data provided by mortgage servicers. Unlike MIRS, these datasets contain information on credit scores, DTIs, documentation status, and other risk factors that we use in our analysis.¹³ Importantly, LLMA and McDash include a "current investor code" and monthly performance information that indicates whether the loan was acquired by the GSEs. For loans with amounts below the applicable conforming loan limit, the investor information allows us to distinguish between loans that were purchased by the GSEs and loans that were retained by private-sector lenders.

¹² In using the MIRS data, we discovered that the jumbo indicator erroneously classifies super-conforming loans as jumbos. This happens because the jumbo indicator is defined using the national conforming loan limit and does not incorporate the high-cost area limits. Given this problem, we do not use the jumbo indicator and instead classify MIRS loans as conforming or jumbo by comparing the loan amount to the applicable conforming loan limit.

¹³ Some loans have incomplete data on risk factors. This is especially true for DTIs in the early part of the sample period. Our regressions to estimate the jumbo-conforming spread include a "missing" category for each risk factor, which allows us to use loans with missing data.

The third data source is CoreLogic's Non-Agency Residential Mortgage-Backed Securities dataset, which contains information on the loans packaged into private mortgage backed securities (PMBS). These data cover nearly the entire PMBS market.¹⁴

To create the dataset for our empirical work, we combine the LLMA, McDash, and PMBS datasets (collectively, LMP) and limit the combined dataset to conventional, first-lien, 30-year FRMs originated between January 2000 and December 2019 to purchase one-unit, primary owner-occupied properties with reported zip codes and loan amounts. As with the MIRS dataset, we exclude loans secured by properties in Alaska and Hawaii and loans with LTVs below 25 percent. We also exclude three other groups of loans from the LMP dataset: (1) those with LTVs above 125 percent, as the LTV likely is reported with error (there were no such high-LTV loans in MIRS), (2) the PMBS loans included in LLMA and McDash to avoid double counting when we merge the datasets, and (3) McDash loans for which we cannot determine the applicable conforming loan limit or whether the loan is conforming or jumbo.¹⁵

Given the importance of accurate interest rates to estimate the jumbo-conforming spread, we screen the MIRS and LMP datasets for rates that are implausibly high or low. On the high end, we exclude the small number of loans with reported rates above 20 percent. These very high rates appear to result largely from missing decimal points in the data (e.g., 8.5 percent is recorded as 85 percent). On the low end of the rate distribution, we remove loans with interest rates more than 100 basis points below the monthly 30-year FRM rate in Freddie Mac's Primary Mortgage Market Survey (<http://www.freddiemac.com/pmms/>). We believe these loans are mainly ARMs that were misclassified as FRMs. After removing these loans, we impose an additional screen for jumbo loans with low

¹⁴ See Mayer, Pence, and Sherlund (2009), p. 29, for a discussion of the PMBS data.

¹⁵ This uncertainty arises because McDash reports the loan amount rounded to the nearest thousand dollars for all loans along with only a three-digit zip code for GSE loans and a smattering of other loans. The rounded loan amount makes it impossible to tell whether some loans with amounts very close to the loan limit are conforming or jumbo. In addition, with the introduction of the high-cost area limits in 2008, a three-digit zip is insufficient to determine the applicable loan limit for some loans. See Appendix A for details.

reported rates during the crisis years of 2007-2009. In particular, we remove jumbo loans originated in a given month with rates at or below the 5th percentile of the rate distribution for conforming loans in that month; this comparison is done separately for the LMP and MIRS datasets. Given the sharp pullback from the jumbo market during the financial crisis, we believe the low reported rates either contain errors or pertain to ARMs.

The cleaned MIRS dataset includes 1.9 million loans. Conforming loans account for almost 95 percent of the total count, reflecting the dominant position of the GSEs and the relatively small jumbo share of other conventional loans. The annual distribution of the roughly 100,000 jumbo loans in the MIRS dataset is very uneven, with only scant volume during the financial crisis. Some months during 2008-2010 have fewer than 50 jumbo loans in MIRS. Because of the very low jumbo counts in some months, we use the entire MIRS dataset to estimate the jumbo-conforming spreads.¹⁶

The cleaned LMP dataset is much larger, containing 28.5 million loans; 80.7 percent are GSE loans, 8.6 percent are portfolio loans, 5.4 percent are PMBS loans, and 5.3 percent are loans with an unknown investor.¹⁷ Given the large size of the dataset, we are able to estimate the spread using a fairly narrow window around the conforming loan limit, though we expand the window on the jumbo side in months with low jumbo volume. Our baseline window is 80 to 120 percent of the applicable conforming loan limit. However, if this window includes fewer than 300 jumbo loans in a given month, we expand the upper end of the window until there are 300 jumbo loans or we have used all the jumbos originated in that month. We refer to the resulting upper end of the jumbo range as “120+ percent.” The extension of the jumbo range above 120 percent of the loan limit occurs each month from January 2008 through April 2012; in all other months, the top end of the jumbo range is exactly 120 percent of the limit.

¹⁶ Although it is not feasible to restrict the jumbo sample to loans close to the loan limit, the estimated MIRS spreads are similar to those reported below if we use only the conforming loans between 80 and 100 percent of the loan limit instead of all conforming loans.

¹⁷ The “unknown investor” loans are all conforming loans that cannot be identified as either GSE or portfolio loans due to missing investor codes in LLMA or McDash.

The remaining data series consist of variables used to test hypotheses about changes in the jumbo-conforming spread. Data on GSE guarantee fees come from Fannie Mae financial statements; we use the average guarantee fee on new acquisitions of single-family mortgages.¹⁸ The GSE funding advantage is measured by the spread between an index of bank AA note rates and an agency benchmark reference note index, obtained from the Intercontinental Exchange (ICE). We measure refinancing intensity with the ratio of refinance applications to mortgage industry employment, as in Sharpe and Sherlund (2016). The data on refinance applications are from the Home Mortgage Disclosure Act (HMDA) reports and the Mortgage Bankers Association, while mortgage industry employment is from the Bureau of Labor Statistics. Finally, we construct a new measure of jumbo loan supply at portfolio lenders by combining the LMP data with data from HMDA and other sources. This measure equals the jumbo share of portfolio loans, scaled by the ratio of average home prices to the average conforming loan limit. The scaling factor accounts for changes in home prices relative to the loan limit that would move the jumbo share independent of shifts in the supply curve for jumbo loans. Our jumbo supply variable measures the change in the jumbo share after controlling for this home price effect. See Appendix A for details on the jumbo supply measure and the other explanatory variables.

Empirical Design: Estimating the Jumbo-Conforming Spread

We first mimic the specification used by Passmore, Sherlund, and Burgess (2005) to estimate a jumbo-conforming spread from the MIRS sample. For each year, we estimate a separate regression of the form:

$$(1) \text{Rate}_i = \alpha + \sum_j \beta_{1,j} \text{Month}_{j,i} + \text{Jumbo}_i \sum_j \beta_{2,j} \text{Month}_{j,i} + \sum_j \delta_{1,j} \text{LTV}_{j,i} + \delta_2 \text{New}_i + \delta_3 \text{Small}_i + \delta_4 \text{Fees}_i + \delta_5 \text{MtgCo}_i + \sum_j \delta_{6,j} \text{State4}_{j,i} + e_i$$

¹⁸ We rely on data from Fannie Mae because Freddie Mac reported only the average guarantee fee on their entire book of business, not on new acquisitions, for most of our sample period.

where i indexes the mortgage loan, $Rate$ is the note rate on the loan, $Month$ is a set of dummy variables for a loan's origination month within the year (indexed by $j = 1, \dots, 12$), and $Jumbo$ is a dummy variable for jumbo loans. To avoid perfect collinearity, we omit the month dummy for January in the first summation, effectively setting $\beta_{1,1} = 0$. LTV is a set of dummy variables for loan-to-value ranges of 75 percent or less, >75 to 80 percent, >80 to 90 percent, and more than 90 percent; we omit the lowest LTV bucket. New is a dummy variable for new construction, $Small$ is a dummy variable for loan amounts less than \$100,000, $Fees$ is a dummy for loans with fees, and $MtgCo$ is a dummy for non-depository originators. $State4$ is a set of dummy variables for whether the property is in California, New Jersey, Maryland, Virginia, or a residual category comprising all other states.¹⁹ The $\beta_{2,j}$ coefficients ($j = 1, \dots, 12$) provide the monthly estimates of the jumbo-conforming spread for each of the yearly regressions.²⁰

For comparison, we also estimate a reduced specification with the MIRS data that excludes New , $Fees$, and $MtgCo$, as these variables are not observed in the LMP data. This reduced specification allows us to compare the results across the MIRS and LMP data for a common set of explanatory variables.

We then take advantage of the additional loan characteristics in the LMP data to control more fully for factors that likely influence the mortgage rate, echoing the approach in DeFusco and Paciorek (2017) to estimate the jumbo-conforming spread. We estimate the spread with the following regression estimated separately for each year:

$$(2) \quad Rate_i = \alpha + \sum_j \beta_{1,j} Month_{j,i} + Jumbo_i \sum_j \beta_{2,j} Month_{j,i} + Conf_i (\gamma_1 Pct_i + \gamma_2 Pct_i^2 + \gamma_3 Pct_i^3) + Jumbo_i (\gamma_4 Pct_i + \gamma_5 Pct_i^2 + \gamma_6 Pct_i^3) + \sum_j \delta_{1,j} LTV_{2,j,i} + \sum_j \delta_{2,j} Score_{j,i} + \sum_j \delta_{3,j} DTI_{j,i} + \sum_j \delta_{4,j} State_{j,i} + \delta_5 Prepay_i + \delta_6 PMI_i + \delta_7 Doc_i + \delta_8 Amort_i + e_i$$

¹⁹ Passmore, Sherlund, and Burgess (2005) distinguish these four states from others because they contained the majority of jumbo lending.

²⁰ In estimating equation 1, we depart in some minor ways from Passmore, Sherlund, and Burgess's treatment of the MIRS data to enhance comparability between the MIRS and LMP results. While Passmore, Sherlund, and Burgess use the effective mortgage rate, which includes amortized fees, we use the note rate itself because that is the rate reported in the LMP data. Passmore, Sherlund, and Burgess also exclude loans with a principal balance of less than \$50,000 or more than twice the conforming loan limit, while we impose no size limits and only exclude loans with LTVs below 25 percent or interest rates that fail our various screens. These departures from Passmore, Sherlund, and Burgess's treatment of the MIRS data have no material effect on the estimated jumbo-conforming spread using MIRS.

As in equation 1, we omit the month dummy for January in the first summation to avoid perfect collinearity. *Pct* represents the percent difference in loan amount from the applicable conforming loan limit. The cubic polynomial function in *Pct*, estimated separately for conforming and jumbo loans, accounts for any relationship between the note rate and loan amount. *LTV2*, *Score*, and *DTI* are sets of dummy variables for LTV, credit score, and DTI respectively.²¹ *State* is a set of dummy variables for each of the 48 contiguous states and the District of Columbia, *Prepay* is a dummy variable for the presence of a prepayment penalty, *PMI* is a dummy for the presence of private mortgage insurance, *Doc* is a dummy for the loan's documentation type (full doc or low/no doc), and *Amort* is a dummy variable for whether the loan fully amortizes or has a feature, such as an interest-only period, that reduces the amortization below the full amount; all of these dummies include a category for missing values, which is omitted to avoid perfect collinearity. This large set of dummy variables controls for differences in loan characteristics that affect pricing.^{22,23}

We estimate equation 2 using the sub-sample of LMP loans with amounts between 80 and 120+ percent of the applicable conforming loan limit to minimize the influence of any unobserved loan and borrower characteristics that vary with loan size. As noted above, 120+ signifies that the range extends above 120 percent as needed to ensure that the regression includes a minimum of 300 jumbo loans each month (or all the jumbo loans in that month if there are fewer than 300). We then estimate the

²¹ The dummy variables for these risk factors are defined as follows: LTV2 buckets ($\leq 60\%$, $>60-70\%$, $>70-75\%$, $>75-80\%$, $>80-85\%$, $>85-90\%$, $>90-95\%$, $>95-97\%$, $>97\%$, missing LTV), credit score buckets (300-619, 620-639, 640-659, 660-679, 680-699, 700-719, 720-739, ≥ 740 , missing credit score), and DTI buckets (1-33%, $>33-38\%$, $>38-43\%$, $>43-50\%$, $>50\%$, missing DTI). The LTV2 and credit score buckets match the structure of the GSEs' pricing grids. The GSE grids do not include DTI buckets.

²² We use buckets for the LTV, rather than the combined loan-to-value ratio that includes junior liens at origination (the CLTV), to be consistent with the measure available in the MIRS data. As a robustness check, we also estimated equation 2 with CLTV buckets in place of the LTV buckets and found the results were virtually identical to those reported below. The same was true when we kept the LTV buckets in the regression and included a dummy variable for the presence of a junior lien.

²³ There is no need to control for loan term and type, loan purpose, occupancy status, or property type – all of which can affect pricing – because, as noted above, the sample is limited to 30-year, fixed-rate home purchase loans used to acquire one-unit, primary owner-occupied properties.

regression with only the GSE conforming and jumbo portfolio loans in this window, as this offers the cleanest estimate of the relative GSE advantage. For both variants of the regression, $\beta_{2,j}$ provides the estimate of the jumbo-conforming spread in month j . In a final specification, we further control for whether a loan is super-conforming by adding another loan type dummy, *Superconf*, to equation 2. This extra loan type modifies equation 2 by adding a new set of monthly dummies and a new cubic polynomial in *Pct*. The terms for the month dummies in equation 2 become

$$\sum_j \beta_{1,j} \text{Month}_{j,i} + \text{Superconf}_i \sum_j \beta_{1,j}^* \text{Month}_{j,i} + \text{Jumbo}_i \sum_j \beta_{2,j} \text{Month}_{j,i}$$

from which we estimate the jumbo-conforming spread in month j as $\beta_{2,j}$ and the super-conforming to conforming spread as $\beta_{1,j}^*$.

Estimates of the Jumbo-Conforming Spread

Before presenting the results from estimating equations 1 and 2, we use simple scatter plots to illustrate the key findings in the paper. Figure 2 shows the average mortgage rates in bins on either side of the conforming loan limit. Each dot, except the left- and right-most, includes loans in a five percentage point bin (for example, >90 percent to 95 percent of the loan limit); the left-most dot includes the very few loans with amounts less than or equal to 10 percent of the limit, and the right-most dot is a catch-all for loans with amounts above 200 percent of the limit. We calculate the binned average rates using all conforming and jumbo loans in the cleaned MIRS and LMP datasets in 2005 and separately in 2015. These years are representative of the period before the financial crisis and after.

As shown in the top panels, the jumbo-conforming spread in 2005 – measured by the gap in rates for bins close to the conforming loan limit – was positive. The exact value of the spread depends on the number of bins included on each side of the limit, and it differs somewhat across the two datasets. This simple averaging points to a spread of roughly 20 to 40 basis points. The lower panels display the analogous plots for 2015. Here, the configuration of rates near the limit is the opposite of what it was in

2005, with jumbo rates below conforming rates by roughly 20 to 30 basis points. Thus, the switch to a negative spread after the financial crisis is evident in the raw data.

The regressions sharpen the estimate of the spread by controlling for a variety of variables that affect loan pricing. We present six alternative estimates of the jumbo-conforming spread utilizing alternative specifications. Results from each of these regressions can be found in Appendix B.

To begin, we use equation 1 to estimate three measures for the rate spread between all jumbo and conforming loans in the MIRS and LMP datasets. The first measure in Figure 3 (MIRS Full) mimics Passmore, Sherlund, and Burgess (2005). The second measure (MIRS Reduced) uses MIRS data but only the variables available in the LMP data, and the third measure repeats this exercise using the LMP data (LMP Reduced).

As shown in Figure 3, the two MIRS series lie virtually on top of one another (the red line for the MIRS Reduced series is barely visible), and the LMP series is highly correlated with the MIRS measures. Across the three measures, the jumbo-conforming spread averaged 14 to 19 basis points over 2000-2006, before jumping in 2007-2009 to an average of 50 to 58 basis points. This increase is consistent with the disruptions in the mortgage market and the pullback from risk-taking during the crisis period. As the economy recovered from the crisis, the spread declined from 2010 to 2012 and then turned negative in mid-2013. From 2014 to 2019, jumbo rates averaged 24 to 32 basis points less than conforming rates.²⁴

We next use the LMP data to estimate the spread with equation 2. As discussed above, this specification controls for more borrower and loan characteristics than equation 1, generating more precise estimates of the spread. In addition, the investor information in the LMP data make it possible to estimate the spread of most interest for this study: the rate differential between GSE conforming

²⁴ It is possible to verify that rates for jumbo portfolio loans indeed were below those for loans eligible to be sold to the GSEs by checking the rates offered on lender websites. See the discussion in the next section for details.

loans and jumbo portfolio loans. We focus on this spread because it provides a cleaner read on the effects of changes in g-fees on conforming loan rates and because we wish to explore the impact of changes in the supply of jumbo loans by banks. Excluding jumbo PMBS loans also controls for compositional shifts in the jumbo market that resulted from the sharp expansion of the PMBS share during the boom and its near disappearance after the crisis.

Figure 4 presents three measures of the jumbo-conforming spread, all based on loans from the LMP dataset in a window from 80 percent to 120+ percent of the applicable conforming loan limit. Ideally, we would like to observe the interest rates provided by the market to a particular borrower who requests a loan one dollar above and one dollar below the conforming loan limit. Although we cannot implement that experimental design, focusing on loans relatively close to the limit removes the influence of unobserved factors that may affect rates on loans further from the limit.

The first measure in Figure 4 uses all conforming and jumbo loans in the specified window. The second measure includes only the GSE loans and jumbo portfolio loans in this group. The final measure uses the same sample as the second measure but adds a control for whether the GSE loan is super-conforming, allowing the estimated spread to vary for this subset of loans. With this control, the third spread shown in Figure 4 represents the mean rate differential between jumbo portfolio loans and GSE loans below the national loan limit that applies to all counties except high-cost areas. Because the high-cost area limits were not established until 2008, this third estimate of the spread is not available for earlier years.

The spread estimates in Figure 4 averaged 41 to 49 basis points over 2000-2006, compared with 19 basis points for the LMP results in Figure 3. The higher spread prior to 2007 in Figure 4 mainly reflects the restriction of loans to the window around the loan limit.²⁵ The spreads shot up during the

²⁵ A noteworthy aspect of Figure 4 is the sharp decline in spreads in early 2002 from the relatively high level prevailing in 2000-2001. Blinder, Flannery, and Lockhart (2006) find a similar drop after 2001 and argue that this pattern reflected a change in risk-based capital requirements (the "Recourse Rule") that took effect at the

2007-2009 crisis period – to an average of 67 to 76 basis points – and then declined over 2010-2013, becoming negative in mid-2013 and remaining so through 2019.²⁶ Over 2014-2019, the three spreads nearly lie on top of one another. During this period, the jumbo-conforming spread averaged negative 23 basis points; the jumbo portfolio-GSE spread averaged negative 26 basis points when we control for super-conforming loans and negative 28 basis points without this control.

To summarize our main results, we show that rates on jumbo loans exceeded GSE rates before the financial crisis. During the crisis, the LMP estimates – which we believe to be more reliable than the MIRS estimates for these years due to the thinness of the MIRS jumbo sample – jumped to an average around three-quarters percentage point. However, the estimates from both data sources and every regression specification agree that from mid-2013 through 2019 the rates on jumbo loans were below conforming rates by roughly one-quarter percentage point. As shown in Appendix B, the standard errors associated with the negative spreads are very small, producing tight confidence bands.

Robustness Tests

We perform several robustness tests for the results in the previous section. The tests all focus on the jumbo portfolio-GSE spread using the LMP data, and each one excludes a different set of loans that could potentially influence the estimates. The first test narrows the window around the conforming loan limit from 80-120+ percent to 90-110 percent to reduce the effects of loan size on the mortgage rate. The second test excludes loans that are bunched at the limit, defined as GSE loans with amounts greater than 98 percent of the limit, to explore the possibility that these borrowers could be different in

beginning of 2002. This rule reduced the capital required for holding PMBS and other privately securitized loans, while leaving the capital required to hold GSE MBS and whole mortgage loans unchanged. Given that GSE loans comprise a sizable majority of conventional conforming loans, this rule change benefitted jumbo loans to a greater degree than conforming loans. See Kling (2009) and Miller (2018) for details on the Recourse Rule.

²⁶ The spike in late 2007 is likely due to the shock from the initial defining event of the financial crisis – the announcement on August 9, 2007, by the French bank BNP Paribas that it was suspending withdrawals from three funds that invested in U.S. mortgage-related securities because it was unable to value those holdings. See Christie (2007) for an account of the effects on the jumbo loan market.

unobserved ways from other borrowers. The third and fourth tests exclude loans with DTIs above 43 percent and LTVs above 80 percent, respectively. These characteristics have been more common since 2014 among GSE loans than jumbo portfolio loans, so removing these loans makes the two groups of loans more homogeneous.

Table 1 reports the results of these robustness tests relative to the baseline estimates, which are shown in the first row. Although there are cases in which the exclusions affect the numerical values of the spread, the story told by the baseline estimates never changes materially. The period-average spreads are always positive through 2013, with a peak during 2007-2009, and then turn negative in 2014-2019, clustering in a tight band around the baseline estimate. This analysis shows that the negative spread since 2014 is a robust feature of the data.

Why Do GSE Loans Still Bunch at the Conforming Loan Limit?

Before the financial crisis, borrowers bunched at the GSE conforming loan limit to take advantage of the lower mortgage rates for conforming loans versus jumbo loans (Kaufman, 2014; An and Yao, 2016; DeFusco and Paciorek, 2017). With the switch to lower rates for jumbo loans starting in 2014, one might expect the bunching to have disappeared, as borrowers at the limit could have reduced their mortgage rate by taking out a slightly larger loan. However, as shown in Figure 5, GSE borrowers have continued to bunch at the loan limit.

An important reason for the continued bunching is that some GSE borrowers would not have met the tighter credit standards in the jumbo market. Table 2 compares the credit characteristics of GSE loans at the conforming loan limit to jumbo portfolio loans over 2014-2019. The table shows that the “credit box” for jumbo portfolio loans is indeed smaller than that for GSE loans at the loan limit. Only 5 percent of jumbo portfolio loans have DTIs above 43 percent, compared with one-fifth of GSE loans at

the limit.²⁷ In addition, the share of GSE loans at the limit with credit scores below 720 or LTVs above 90 percent has been much larger than the shares for jumbo portfolio loans. Figure 6 shows that this difference in credit standards holds throughout the entire size range for GSE and jumbo portfolio loans. The implication is that some GSE borrowers could not have obtained a jumbo portfolio loan.²⁸

Another potential reason for the bunching is borrower knowledge or effort. To obtain the lower jumbo rates that we document, borrowers may have had to shop around or negotiate with lenders. If some borrowers did not understand the benefits of rate shopping or negotiation, or knew they could benefit from these activities but chose not to expend the effort, we could observe a bunching of GSE loans at the limit, despite the higher GSE rate.

Support for this explanation comes from data on posted offer rates, which show that borrowers could not have obtained the jumbo rate advantage that we document by passively accepting the rates posted by lenders. We “scraped” online offer rates from the websites of two large lenders, Wells Fargo and JP Morgan Chase, from May 2017 to December 2018 for loans slightly below and slightly above the applicable conforming loan limit.²⁹ On average, the posted jumbo rate was about 10 basis points below the posted conforming rate, considerably less than the quarter-percentage point advantage that we estimated for closed loans over 2014-2019. Bhutta, Fuster, and Hizmo (2019) obtain similar results with different data. They show that jumbo borrowers locked-in rates that were roughly 10 to 20 basis points

²⁷ As discussed in DeFusco, Johnson, and Mondragon (2019), the Qualified Mortgage (QM) rule implemented in 2014 by the Consumer Financial Protection Bureau provides lenders with a strong incentive to cap the DTIs on jumbo loans at 43 percent. Jumbo loans must have a DTI of 43 percent or less to obtain QM status, which provides a safe harbor against legal claims that the lender failed to assess the borrower’s ability to repay the loan. GSE loans are not subject to the 43 percent QM limit, nor are other conforming loans that meet the GSEs’ underwriting requirements but are retained by the lender.

²⁸ Interestingly, the relatively tight credit box for jumbo loans was not a feature of the pre-crisis mortgage market. During 2000-2006, GSE loans at the loan limit and jumbo portfolio loans had broadly similar risk characteristics. This changed after the financial crisis, when portfolio lenders adopted tighter underwriting standards than the GSEs.

²⁹ For each lender, we scraped rates for a number of geographic markets and various combinations of credit scores and LTVs. We focus on the results for loans with an LTV of 80 percent and a credit score of about 760, which is representative of the low-risk loans prevailing in the jumbo market.

lower relative to the median offer rate than did borrowers with conforming loans, after controlling for a variety of risk factors.³⁰ These findings imply that some of the jumbo rate advantage reflected the greater knowledge and effort on the part of jumbo borrowers to lock-in attractive rates. Faced with a small average difference in offer rates, some borrowers may have simply opted for widely-available GSE loans.

What Explains the Negative Jumbo-Conforming Spread?

There are a number of potential explanations for the negative spread that prevailed from mid-2013 through 2019. These include changes over time in the GSE funding advantage and guarantee fees, bank supply of jumbo loans, and the availability of GSE backing for super-conforming loans.

We can address the role of super-conforming loans with the results from estimating equation 2. As described above, the final variant of that equation yields an estimate of the rate differential between super-conforming and conforming GSE loans. Given the limit on the share of super-conforming loans in TBA pools, we would expect that rate differential to be positive, boosting the overall rate on GSE loans. Figure 7 shows that the estimated super-conforming to conforming spread was initially quite large and then dropped to an average of 12 basis points over 2009-2013 and 6 basis points over 2014-2019.³¹ The small rate premium for super-conforming loans over 2014-2019 had a miniscule effect on the jumbo-conforming spread over those years. As we showed in Figure 4, controlling for the effect of super-conforming loans makes the spread only a bit less negative over 2014-2019, shaving the average spread from -28 basis points to -26 basis points. Thus, we can cross super-conforming loans off the list of

³⁰ See their Table 5. These results only approximate the rate advantage obtained by jumbo borrowers through shopping and negotiation relative to conforming loan borrowers, as their analysis groups loans into size buckets with boundaries that do not map exactly to the applicable conforming loan limit.

³¹ The super-conforming spread was wide at the outset because SIFMA determined that these loans would not be eligible for TBA trading. Three months later, in May 2008, Fannie Mae acted to support the super-conforming market by announcing it would purchase pools comprised of these loans on par with TBA pools through the end of 2008. SIFMA's subsequent announcement that super-conforming loans could be included in TBA pools, subject to the 10 percent limit, provided support for the super-conforming market beyond 2008. See Vickery and Wright (2013) for additional discussion of these events.

significant explanations for the negative spread. With this result in hand, our analysis of other factors uses the jumbo portfolio-GSE conforming spread, which has been purged of the influence of super-conforming loans.³²

Turning to these other factors, Figure 8 plots the spread against several potential explanatory variables. The top left panel shows the average g-fee on new single-family loan acquisitions. After having been essentially flat at about 20 basis points through 2007, the GSEs increased their guarantee fees in 2008. They continued to adjust g-fees over 2009-2011, resulting in a small further net increase. At the end of 2011, FHFA directed the GSEs to increase ongoing fees by 10 basis points pursuant to the Temporary Payroll Tax Cut Continuation Act. This increase applied to new acquisitions starting in April 2012. FHFA directed the Enterprises to raise fees by another 10 basis points in August 2012, effective for acquisitions in December of that year, to better align the fees with perceived credit risk. By mid-2013, the average g-fee had reached nearly 60 basis points, and remained close to that level through 2019.³³

The post-2007 rise in g-fees is broadly coincident with the decline in the jumbo-conforming spread, and we explore the connection below through regression analysis and an event study. We undertake the event study because two features of our g-fee series induce some degree of measurement error in a regression setting. First, the data are reported quarterly, so we have to interpolate to obtain a monthly series. Second, the average g-fee reflects changes in the composition of loans sold to the GSEs and thus is not a clean measure of changes in fee schedules. In addition, aligning the data on g-fees with the estimated spread is complicated because the impact of changes in g-fees occurs when the change is built into mortgage rates, which precedes the GSE acquisition date.

³² Before April 2008, when the high-cost area limits became effective, we use the jumbo portfolio-GSE spread, which we splice together with the jumbo portfolio-GSE conforming spread for April 2008 onward.

³³ See Federal Housing Finance Agency (2019) for additional detail on the changes in g-fees.

The upper right panel of the figure shows the spread against our indicator of jumbo loan supply.³⁴ According to this indicator, jumbo supply plunged during the financial crisis and then recovered over 2010-2013, reaching a higher level than before the crisis. This pattern suggests that strong interest by banks in holding jumbo loans could have been associated with a drop in the spread. At the same time, the indicator is volatile from month to month, which could limit its explanatory power in a regression.

The lower left panel displays the GSEs' funding cost advantage over private financial institutions. This funding advantage jumped during the crisis, potentially helping to explain the wider jumbo-conforming spread at that time. After the crisis, the GSEs' funding advantage returned to the range observed before the crisis, while the jumbo-conforming spread over 2014-2019 was well below the pre-crisis level. This implies that we can rule out the funding advantage as a cause of the negative spread.

The final panel shows our measure of refinance intensity, which cycles up and down over time. These swings have at least a loose positive correlation with changes in the spread, making the refi intensity measure a potentially useful control to include in regressions to explain the spread.

Regression analysis

As a preliminary step, we tested whether the spread and the explanatory variables are non-stationary using the DF-GLS test recommended by Stock and Watson (2015).³⁵ The results strongly suggest that the series are non-stationary, which implies that we need to difference the data to produce valid results. We also tested for a cointegrating relationship among the series in levels and found little evidence that one exists. Accordingly, we estimate the regression in first-differences with no error correction term.

³⁴ This series begins in 2004 because it relies on HMDA data on first liens, which are not broken out from subordinate liens before that year. The refinance intensity measure begins in 2004 for the same reason.

³⁵ This test has more power to reject the null of non-stationarity than the often-used Augmented Dickey Fuller test.

The regression to explain the monthly changes in the jumbo portfolio-GSE conforming spread has the following form:

$$(3) \Delta Spread_t = \alpha + \beta_1 \Delta gfee_t + \beta_2 \Delta Ggee_{t+1} + \beta_3 \Delta gfee_{t+2} + \beta_4 \Delta gfee_{t+3} + \beta_5 \Delta FA_{t-1} + \beta_6 \Delta FA_{t-2} + \beta_7 \Delta JumboSup_t + \beta_8 \Delta Refi_t + \theta_1 QE1_t + \theta_2 QE3_t + \theta_3 Taper_t + e_i$$

We include the contemporaneous g-fee and three monthly leads to account for the time between loan origination and acquisition by the GSEs. For the funding advantage, we use two monthly lags to reflect the usual period from the mortgage application, for which pricing embeds contemporaneous market yields, to the origination date. No leads or lags are needed for the jumbo supply indicator or refinance intensity because both are measured in the origination month. Among the Federal Reserve's quantitative easing programs, we focus on QE1 and QE3 because those were the two that involved purchases of agency MBS. The QE1 and QE3 dummies equal one for February through May 2009 and October-November 2012, respectively. We also include a dummy for the Fed's announced plan to taper down its asset purchases; the Taper dummy equals one for June through August 2013.³⁶

The first column of Table 3 presents the estimation results over the full period with data on all series, 2004-2019. The current-month g-fee has a significant negative effect on the spread, indicating – as expected – that higher g-fees compress the spread, though the other terms for the g-fee are not significant. The GSE funding advantage lagged one month has a significant positive effect on the spread, while the two-month lag is insignificant. The significant result conforms with expectations, with an increase in the GSE funding advantage widening the jumbo-conforming spread. Neither the jumbo supply indicator nor refinance intensity is significant. The QE dummies show that QE1 increased the

³⁶ See <https://www.newyorkfed.org/markets/programs-archive/large-scale-asset-purchases> for a timeline of the Fed's purchase programs and Harrison (2019) for the dating of the taper announcements. To allow for the lag between news events and loan originations, our QE-related dummies turn on one to two months after the initial announcement (one month for the QE3 and Taper dummies and two months for the QE1 dummy as there is a sharp break in the spread two months later). All three dummies remain turned on through the second month after the final announcement related to each event.

spread more than 30 basis points, QE3 had a smaller and insignificant effect on the spread, and the taper announcement unwound roughly 20 basis points of the earlier increase in the spread. These QE results are qualitatively consistent with those in Di Maggio, Kermani, and Palmer (2020).

To abstract from the volatility of the spread during the financial crisis, column 2 presents estimates over the period starting in 2010. Here, the g-fee, the GSE funding advantage, and the jumbo supply indicator are all insignificant, while refinance intensity becomes positive and significant, indicating that refi waves are associated with a wider jumbo-conforming spread. The QE1 dummy is omitted from the shorter sample, but the QE3 and Taper effects are similar to those in column 1.

These regression results show a clear imprint of the Fed's asset purchases, but they provide less information than we might have hoped about the factors accounting for the shift to a negative spread. The key problem is that our two main explanatory variables – g-fees and jumbo loan supply – have some limitations. The mixed evidence for g-fees likely owes to the measurement error noted above, highlighting the value of the event study we undertake in the next section. The insignificance of the jumbo supply indicator reflects the month-to-month volatility in this series, much of which may be noise. Nonetheless, this result does not rule out that increased supply of jumbo loans – as documented by the high level of the indicator starting in 2013 – contributed to the negative spread. Beyond these two variables, we found that refinance intensity helps explain shorter-term movements in the spread after the financial crisis, and the GSE funding advantage is significant when the sample period includes the crisis but not otherwise.

G-fee event study

As described above, the GSEs raised their g-fees by 10 basis points in each of two separate moves in 2012. Knowing the size and timing of these changes allows us to conduct an event study of their effect on the spread. Figure 9 plots the jumbo portfolio-GSE conforming spread over the period that

spans the two increases in the g-fee. The shading for each increase runs from the announcement month to the month in which the increase became effective.³⁷

Both increases were associated with a drop in the spread, though the timing differs across the two cases. For the second increase, the spread edged down for loans originated in November 2012 and then fell 10 basis points for loans originated in December, the first month in which all loans sold to the GSEs were subject to the higher g-fee. It makes sense that there is no evident effect for September and October originations because these loans could have been sold to the GSEs before the December effective date. The same is true for many loans originated in November, as most loans are sold to the GSEs soon after origination. The 10 basis point drop in the December spread in response to an increase in the g-fee of the same size implies a one-to-one passthrough of the g-fee to the spread.

The timing for the first 10 basis point increase in the g-fee is more complicated. The Temporary Payroll Tax Cut Continuation Act of 2011, which authorized the increase, was signed into law on December 23, 2011. However, the Act did not specify when the increase would become effective, leaving that determination to the Director of the FHFA.³⁸ Also of note, the mandated rise in the g-fee was not a surprise. The Senate version of the Act was introduced on December 5 with the same language regarding g-fees as the final legislation, and the idea to use a higher g-fee to fund a temporary payroll tax cut had received bipartisan support dating back to the summer (Timiraos and Zibel, 2011). Thus, lenders had good reason to believe as early as December 5 – and likely even earlier – that the g-fee would rise but did not know when the increase would be effective. In the face of that uncertainty, the prudent course of action may have been to build the higher g-fee into mortgage rates even before the ink was dry on the Act.

³⁷ The second increase was announced on August 31, 2012. Because that was the final day of the month, we begin the shading in September.

³⁸ Acting Director DeMarco issued a statement on December 29 directing the GSEs to raise their g-fees on new loan acquisitions starting on April 1, 2012 (<https://www.fhfa.gov/Media/PublicAffairs/Pages/Statement-of-FHFA-Acting-Director-Edward-J-DeMarco-Regarding-Implementation-of-Guarantee-Fee-Increase.aspx>).

This intuition helps explain why the first increase in the g-fee may have affected the jumbo-conforming spread well ahead of the April 2012 effective date. Figure 9 shows that the spread fell 10 basis points for originations in January, consistent with lenders having adjusted rates on loan applications in December. The spread fell slightly further on net from February through April, but most of the action was in January.

This event study strongly suggests that the two increases in the g-fee passed through essentially one-for-one into the jumbo-conforming spread. Hogan (2016) also found a one-for-one passthrough to the spread in his analysis of these two increases in the g-fee. This result can help size the contribution of the total rise in the g-fee to the change in the spread. If the other 20 basis points of the total rise in the g-fee also had the same pass-through rate, then the total 40 basis point g-fee increase would account for the majority of the drop in the jumbo-conforming spread from the pre-crisis period to 2014-2019.

The Effects of the Covid-19 Pandemic: A First Look

The results presented so far pre-date the onset of the pandemic, which began to significantly disrupt economic activity and financial markets in the United States in March 2020 (see Board of Governors of the Federal Reserve System, 2020). This section provides initial estimates of the effects of the pandemic on the jumbo-conforming spread.

Although our LMP-based spread ends in December 2019, we use high-frequency indicator series to estimate it through June 2020. The two indicator series are measures of the jumbo-conforming spread from Optimal Blue and the Mortgage Bankers Association (MBA). Optimal Blue obtains mortgage rates from lenders using its software platform to lock-in rates on loans that will be sold to investors. The Optimal Blue rates are available daily back to 2013 and cover about a third of the mortgage market. We estimate the spread for conventional 30-year primary owner-occupied purchase FRMs with a regression that closely approximates equation 2 above. The sample is restricted to loans within +/- 20 percent of the applicable loan limit in the contiguous U.S. The MBA mortgage rate data

are collected as part of its weekly mortgage application survey. Participating lenders report their average rates on mortgage applications from the prior week for specified types of loans. We use the rates and the implied spread for 30-year conventional FRMs (both purchase and refinance loans) with LTVs of 80 percent or less. The Optimal Blue and MBA data are reported without seasonal adjustment, consistent with the LMP data.

The solid lines in Figure 10 plot the average monthly jumbo-conforming spreads from the Optimal Blue and MBA data through June 2020, along with the jumbo-conforming spread from the LMP data through December 2019. The figure shows that both indicator series are highly correlated with the LMP spread and thus can be used to extrapolate the spread beyond December 2019.³⁹ Importantly, after February 2020, the Optimal Blue and MBA spreads both moved up to their highest levels in at least six years, implying that the LMP spread rose as well.

To generate forecasts of the LMP spread, we estimate the fit among the three spreads over 2013-2019 by regressing the LMP spread in month m on the Optimal Blue and MBA spreads in months m and $m-1$ and a constant. We include the prior-month spread because applications and rate locks tend to precede originations by about that amount of time. The regression has an R^2 of 0.70, and the sum of the coefficients on each spread is statistically significant. The dotted line shows the fitted LMP spread through 2019 and the projected monthly spread over the first half of 2020 using the estimated regression.

³⁹ The figure also shows that the Optimal Blue and MBA spreads are consistently higher than the LMP spread. For Optimal Blue, the loans locked through their software exclude those originated by banks to be held in portfolio. The mortgage investors who post rates on Optimal Blue's platform may not have an incentive to bid as aggressively for jumbo loans as the large bank lenders with access to cheap deposit funding and an ability to cross-sell other products and services. As for the MBA series, there are two likely reasons for the higher spread. First, the MBA publishes an unweighted average of rates reported by survey respondents. This will tend to reduce the influence of the large lenders that dominate the jumbo market relative to our LMP-based spread, which uses individual loans as the unit of observation. Second, some MBA respondents may report data from rate sheets rather than the actual average rate on loan applications. As noted above, average offer rates tend to overstate the actual rates obtained by jumbo borrowers.

The conclusion from this exercise is that the LMP spread moved back above zero in the wake of the pandemic, reaching about 10 basis points in May and June 2020. Although the future path for the jumbo-conforming spread is uncertain, the lengthy period of negative spreads has come to an end.

A full analysis of what pushed up the spread is beyond the scope of this paper. That said, we can offer a few observations. First, through the second quarter of 2020, g-fees played no role in the increase, as Fannie Mae's 10-Qs show that the average g-fee on new acquisitions of single-family mortgages was virtually unchanged on net between 2019:Q4 and 2020:Q2. Second, although the GSE funding advantage shot up in March, by May it had returned to a normal level, suggesting that any effect on the spread was short-lived. However, the other factors we considered in the regression analysis above could have played a significant role. Our regression results showed that the Fed's asset purchases can have a powerful effect on the spread. On March 15, the Fed announced it would purchase at least \$200 billion of agency MBS to counter financial market disruptions and support the economy; a second announcement, on March 23, pledged to buy as much as the Fed deemed necessary.⁴⁰ Second, with the Fed's policy easing, mortgage rates dropped sharply, which spurred a refinancing boom. The MBA's refinance applications index spiked in March, and although it has retraced some of that jump, in June it remained at a very high level. Recall that our regression results for the post-crisis period showed that refi waves are associated with a higher jumbo-conforming spread. Finally, bank supply of jumbo loans has retreated in the face of heightened default risk and other demands for bank credit (McCaffrey, 2020). Although our jumbo supply indicator was not significant in the regressions, it nonetheless stands to reason that a pullback by lenders in the jumbo market would widen the spread.

⁴⁰ See <https://www.federalreserve.gov/newsevents/pressreleases/monetary20200315a.htm> and <https://www.federalreserve.gov/newsevents/pressreleases/monetary20200323a.htm>. As of August 2020, the Fed's pandemic-related purchases of agency MBS totaled about \$600 billion.

Conclusions

Previous research has documented that rates on jumbo loans were above those on conforming loans before the financial crisis. This study re-examines the jumbo-conforming spread since 2000 in light of market and policy changes in the post-crisis environment. We confirm the pre-crisis results from previous studies and show that the spread jumped during the financial crisis. Importantly, we find that the spread turned negative in 2013 and remained so over 2014-2019, with jumbo rates averaging roughly one-quarter percentage point less than conforming rates. This finding emerges from two different datasets and holds up under a variety of robustness tests. Although we are not able to fully account for the factors driving the spread into negative territory, we present evidence pointing to the rise in GSE guarantee fees as a significant contributor.

Despite the rate advantage for jumbo loans, some borrowers over 2014-2019 continued to opt for GSE loans at the conforming limit over a jumbo loan. Our findings suggest that borrowers bunching at the limit likely would not have met the underwriting requirements for a jumbo loan or did not undertake the rate shopping and negotiation required to obtain a substantial jumbo rate advantage.

With the onset of the Covid-19 pandemic, we estimate that the jumbo-conforming spread increased enough to move slightly above zero. Renewed Fed purchases of agency MBS, a refinancing wave, and increased caution by banks in the jumbo market are likely to be behind the rise in the spread. The future path for the spread is uncertain, depending in large part on how the economy recovers from the pandemic and the outcome of housing finance reform, both of which will affect the factors we have highlighted.

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Table 1. Robustness tests for estimated rate spread between jumbo portfolio loans and GSE loans

| | Average spread (bps) | | | |
|---|----------------------|-----------|-----------|-----------|
| | 2000-2006 | 2007-2009 | 2010-2013 | 2014-2019 |
| 1. Baseline | 49 | 76 | 19 | -28 |
| 2. Narrower window around the limit | 52 | 62 | 13 | -30 |
| 3. Excluding loans bunched at the limit | 48 | 76 | 20 | -24 |
| 4. Excluding loans with DTIs > 43% | 30 | 80 | 24 | -29 |
| 5. Excluding loans with LTVs > 80% | 38 | 68 | 18 | -31 |

Note: These spreads are calculated from the coefficients on the monthly dummy variables in equation 2 estimated annually using jumbo portfolio and GSE loans in the cleaned LMP dataset. The baseline regression includes all such loans with amounts between 80 and 120+% of the applicable conforming loan limit, where 120+% means that the range is increased above 120% as needed to ensure that a minimum of 300 jumbo loans are included in each month. Row 2 limits the sample to loans between 90 and 110% of the loan limit, row 3 excludes GSE loans from the baseline sample that have loan amounts greater than 98% of the loan limit, row 4 excludes loans from the baseline sample that have DTIs greater than 43%, and row 5 excludes loans from the baseline sample that have LTVs greater than 80%.

Source: Authors' calculations using data from CoreLogic and Black Knight, Inc.

Table 2: Characteristics of GSE and jumbo portfolio home purchase loans, 2014-2019

| Loan type | Percent of loans with: | | |
|-----------------------|------------------------|--------------------|-----------|
| | DTI > 43% | Credit score < 720 | LTV > 90% |
| GSE at the loan limit | 20 | 23 | 15 |
| All jumbo portfolio | 5 | 7 | 4 |

Note: Included GSE loans have loan amounts greater than 98% of the applicable conforming loan limit. GSE and jumbo portfolio loans with missing data for a given risk factor are excluded.
Source: Authors' calculations using data from CoreLogic and Black Knight, Inc.

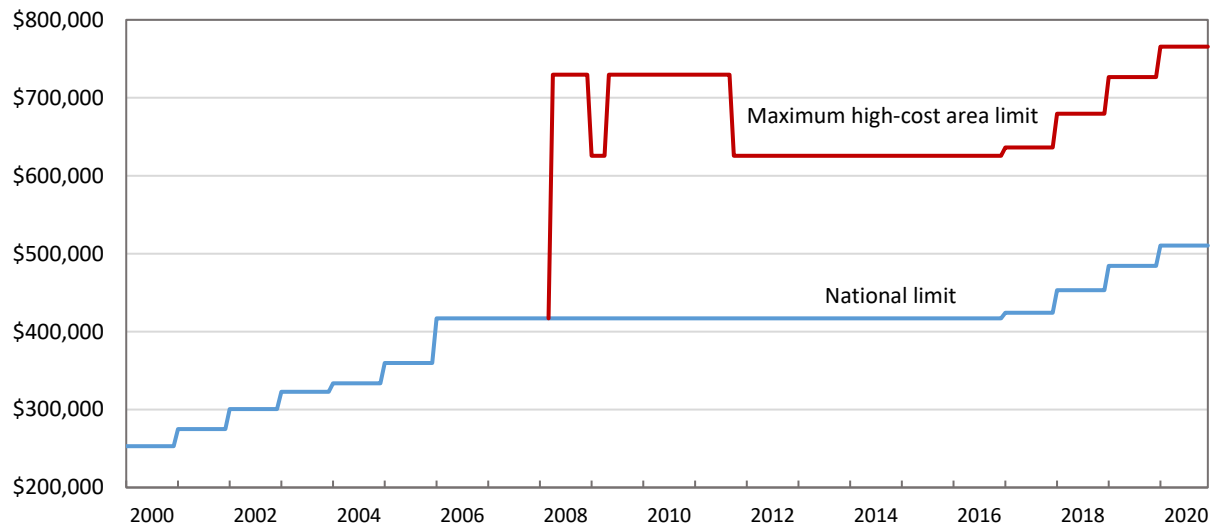
Table 3: Regression results to explain monthly changes in the jumbo portfolio-GSE conforming spread

| Explanatory variable | 2004-2019 (1) | 2010-2019 (2) |
|------------------------|------------------|------------------|
| G-fee | | |
| Current | -1.60* (.81) | -.90 (.60) |
| 1 month ahead | -.37 (1.74) | 1.08 (.80) |
| 2 months ahead | 1.45 (1.67) | -.98 (.83) |
| 3 months ahead | -.75 (.91) | -.04 (.61) |
| GSE funding advantage | | |
| 1 month prior | .135** (.040) | .056 (.038) |
| 2 months prior | -.055 (.061) | -.013 (.033) |
| Jumbo supply | 2.57 (17.1) | -2.66 (7.67) |
| Refinance intensity | 2.41 (2.60) | 5.93** (1.93) |
| QE1 | 33.2** (6.1) | |
| QE3 | 6.9 (5.7) | 2.6 (2.6) |
| Taper | -21.3** (5.5) | -18.0** (3.0) |
| Constant | -.14 (.54) | -.40 (.43) |
| Number of observations | 189 | 120 |
| R ² | .205 | .279 |

Note: The dependent variable is the jumbo portfolio-GSE conforming spread estimated using equation 2 as described in the text and in the note to Figure 4. The g-fee is the average fee on Fannie Mae's new acquisitions of single-family mortgages. The jumbo supply indicator is the jumbo share of portfolio loans scaled by average house prices relative to the average conforming loan limit. The GSE funding advantage is measured as the spread between an index of bank AA note rates and an agency benchmark reference note rate. Refinance intensity is measured as refinance application volume divided mortgage industry employment. The estimates shown for QE1, QE3, and Taper represent the sum of the coefficients for the months in which the dummy for each variable is equal to one (February-May 2009 for QE1, October-November 2012 for QE3, and June-August 2013 for Taper). Robust standard errors are shown in parentheses. * and ** indicate significance at the five-percent and one-percent levels, respectively.

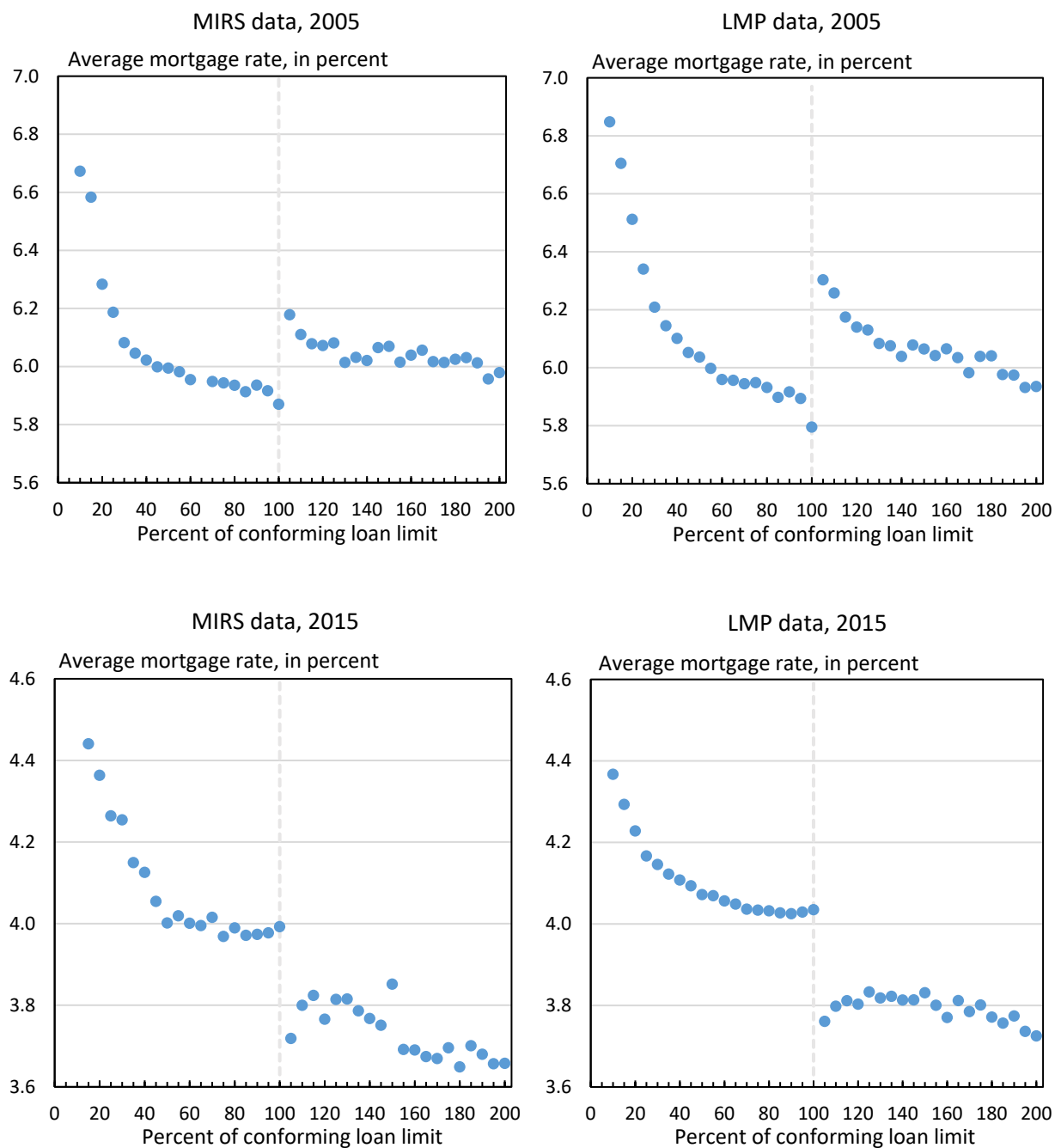
Source: Authors' calculations using data from CoreLogic, Black Knight, Inc., Fannie Mae, HMDA, Intercontinental Exchange, and the Mortgage Bankers Association.

Figure 1: Conforming loan limit, 1-unit properties



Note: Both limits apply to the contiguous United States (i.e., excluding Alaska, Hawaii, and U.S. Territories). High-cost area limits were first established in the Economic Stimulus Act of 2008 and then renewed in subsequent legislation. The limits for designated high-cost areas depend on area median house prices, subject to the maximum limit shown in the figure.
Source: Federal Housing Finance Agency.

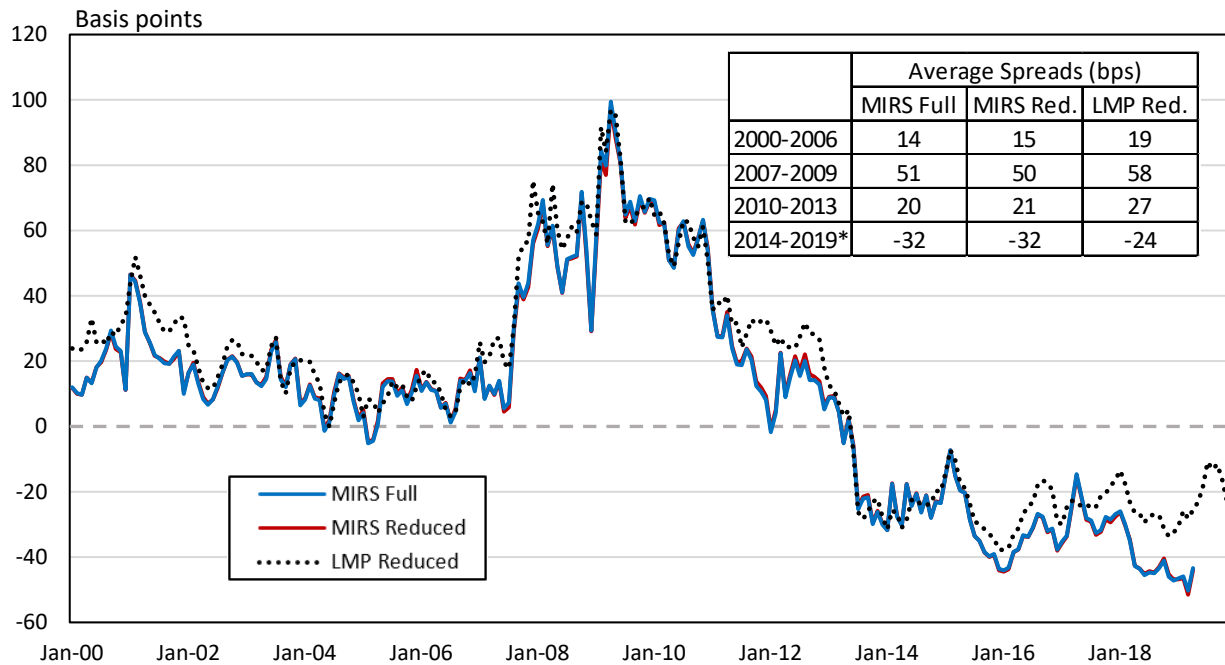
Figure 2: Average mortgage rates, 2005 and 2015



Note: The panels show the average mortgage rate in either 2005 or 2015 for loans grouped into size bins defined relative to the applicable conforming loan limit. The bins to the left of the loan limit include all conforming loans in the cleaned MIRS and LMP datasets; similarly, the bins to the right of the loan limit include all jumbo loans in the cleaned datasets. The lowest bin includes loans with amounts up to 10% of the loan limit. The next bin includes loans with amounts greater than 10% and less than or equal to 15% of the limit. All successive bins, except the final one, are defined analogously. The final bin includes all loans with amounts greater than 200% of the loan limit.

Source: Authors' calculations using data from MIRS, CoreLogic, and Black Knight, Inc.

Figure 3: Jumbo-conforming spreads for loans in the MIRS and LMP datasets, 2000-2019

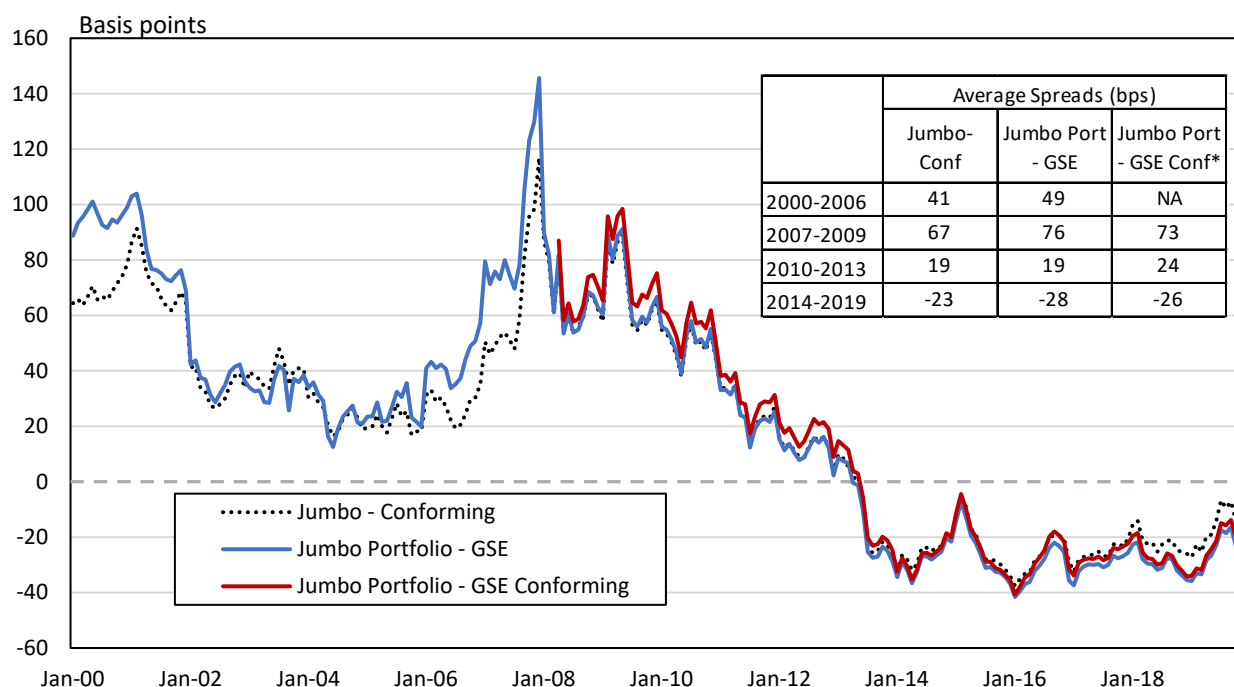


* The average 2014-2019 MIRS spreads are based on data through April 2019, the final month before the survey was discontinued. The average 2014-2019 LMP spread includes data through December 2019.

Note: The “MIRS Full” spread is calculated from the coefficients on the monthly dummy variables in equation 1 estimated annually using all loans in the cleaned MIRS dataset. The “MIRS Reduced” spread is calculated in the same way, except that the New, Fees, and MtgCo dummies are excluded as explanatory variables. The “LMP Reduced” spread is based on the same regression as the MIRS reduced spread but is estimated with all loans in the cleaned LMP dataset.

Source: Authors’ calculations using data from MIRS, CoreLogic, and Black Knight, Inc.

Figure 4: Jumbo-conforming spreads for loans in the LMP datasets between 80% and 120+% of the conforming loan limit, 2000-2019

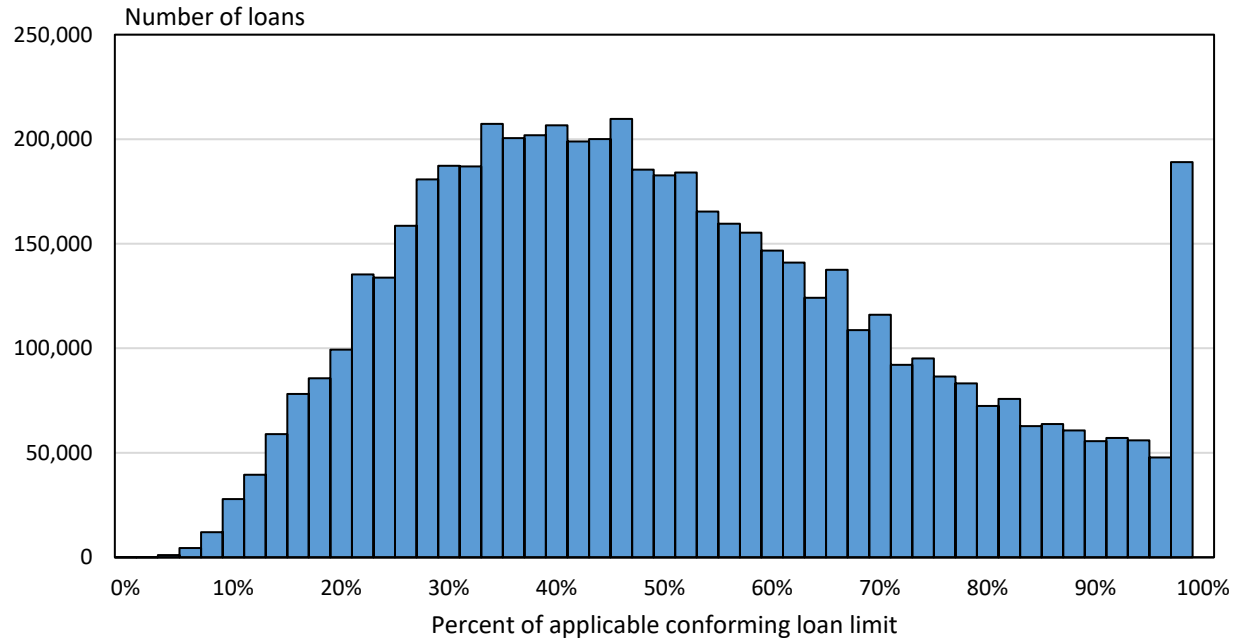


* This spread is calculated starting in April 2008, the first month in which the high-cost area limits had a material effect on mortgage originations. The spread shown for 2007-2009 is the average over April 2008-December 2009.

Note: The jumbo-conforming spread is calculated from the coefficients on the monthly dummy variables in equation 2 estimated annually using loans in the cleaned LMP dataset with amounts between 80 and 120+% of the applicable conforming loan limit, where 120+% indicates that the range is increased above 120% as needed to ensure that a minimum of 300 jumbo loans is included in each month. The jumbo portfolio-GSE spread is calculated in the same way except that the regression is estimated using only jumbo portfolio loans and GSE loans. To calculate the jumbo portfolio-GSE conforming spread, we use the same dataset as for the jumbo portfolio-GSE spread but modify equation 2 by splitting GSE loans into conforming and super-conforming loans. The jumbo portfolio-GSE conforming spread is calculated from the coefficients on the monthly dummy variables for GSE conforming loans and jumbo portfolio loans in the modified version of equation 2.

Source: Authors' calculations using data from CoreLogic and Black Knight, Inc.

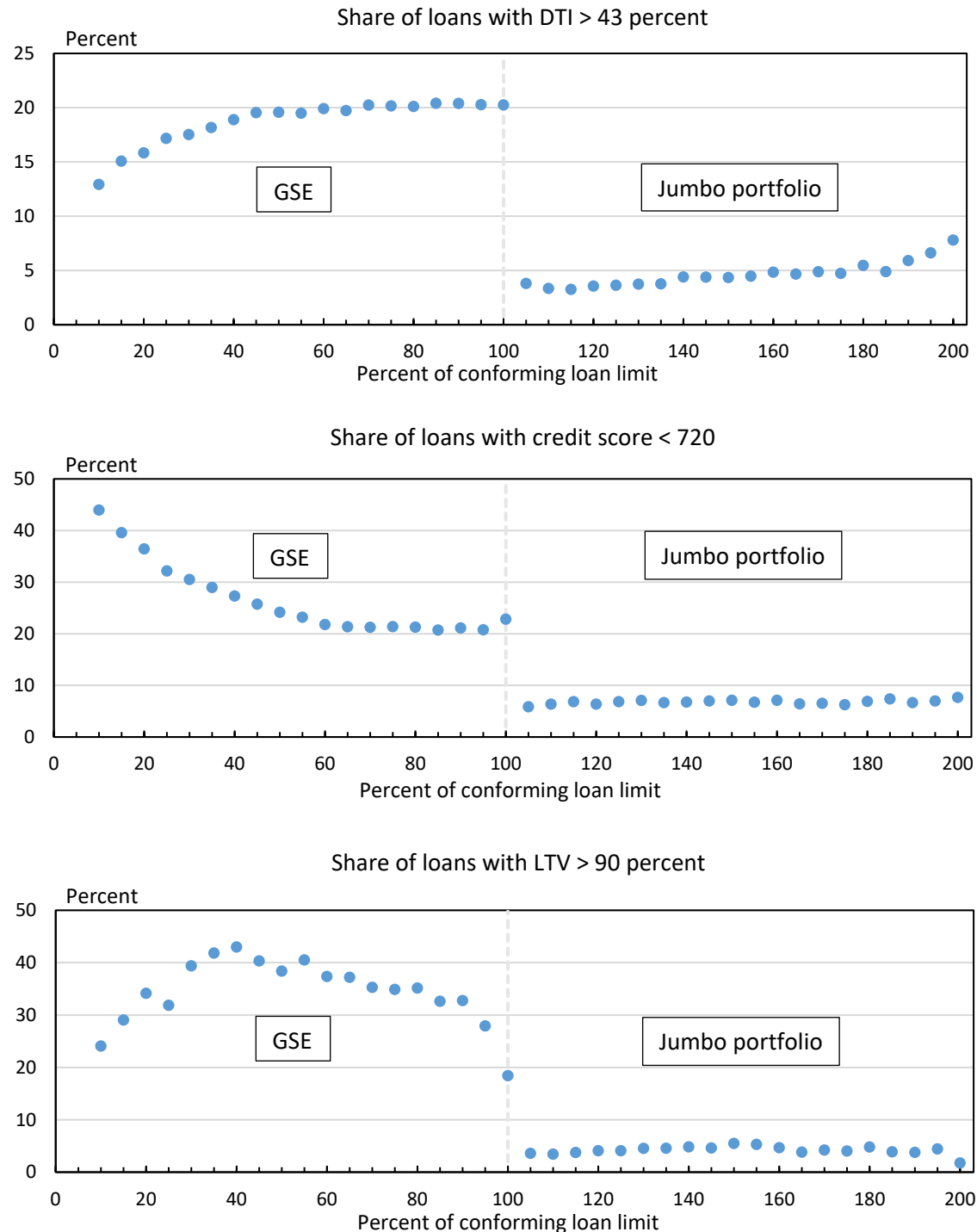
Figure 5: Distribution of 2014-2019 GSE loan amounts relative to the conforming loan limit



Note: The distribution is based on GSE loans in the cleaned LMP dataset, which includes 30-year fixed-rate GSE loans used to purchase one-unit, primary owner-occupied homes. The right-most bar contains the GSE loans with amounts greater than 98% of the applicable conforming loan limit.

Source: Authors' calculations using data from CoreLogic and Black Knight, Inc.

Figure 6: Characteristics of GSE and jumbo portfolio loans, 2014-2019



Note: Each panel pertains to GSE and jumbo portfolio loans in the cleaned LMP dataset that were originated in 2014-2019. The loans are grouped into size bins defined relative to the applicable conforming loan limit. The lowest bin includes loans with amounts up to 10% of the loan limit. The next bin includes loans with amounts greater than 10% and less than or equal to 15% of the limit. All successive bins, except the final one, are defined analogously. The final bin includes all loans with amounts greater than 200% of the loan limit.

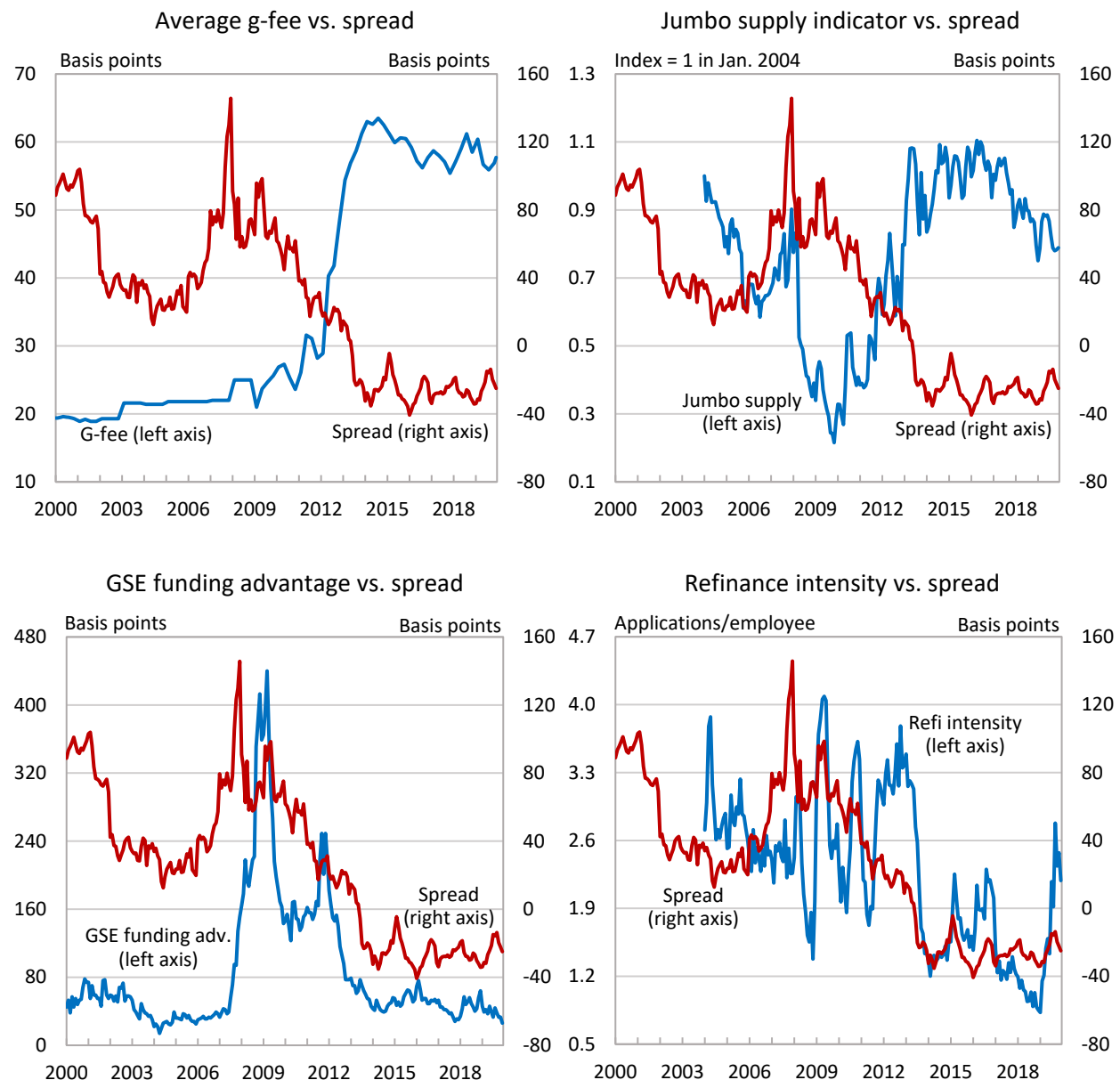
Source: Authors' calculations using data from MIRS, CoreLogic, and Black Knight, Inc.

Figure 7. Super-conforming to conforming GSE spread



Note: The super-conforming to conforming GSE spread is calculated from the coefficients on the monthly dummy variables for GSE conforming loans and GSE super-conforming loans in the modified version of equation 2 that splits GSE loans into these two groups. That regression is estimated using loans in the cleaned LMP dataset with amounts between 80 and 120+% of the applicable conforming loan limit, where 120+% indicates that the range is increased above 120% as needed to ensure that a minimum of 300 jumbo loans is included in each month.
Source: Authors' calculations using data from CoreLogic and Black Knight, Inc.

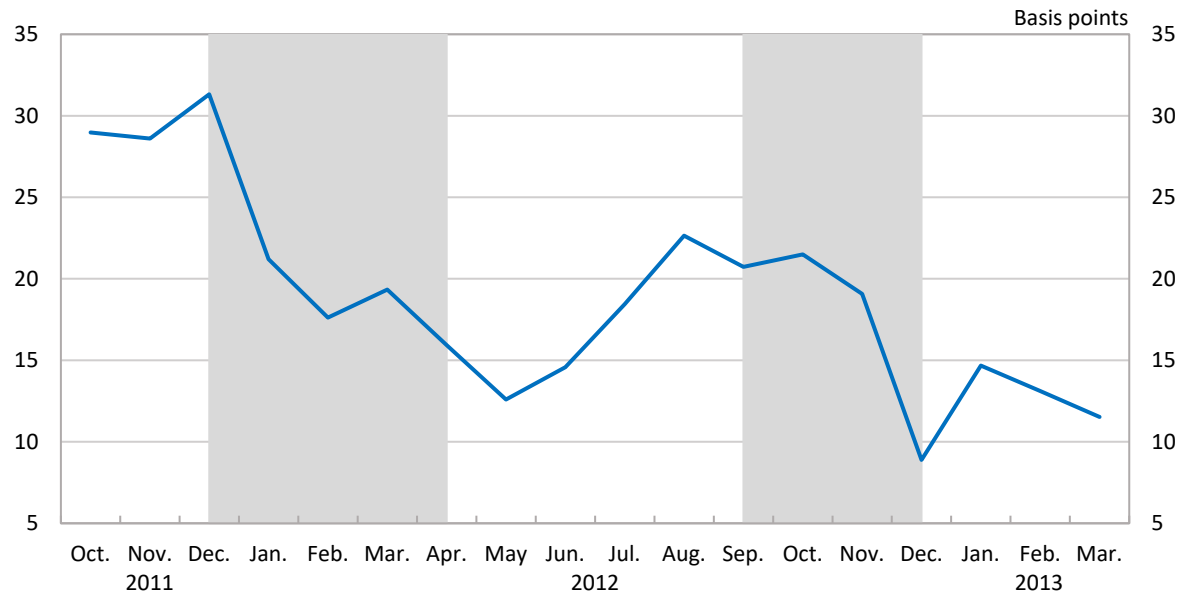
Figure 8. Jumbo portfolio-GSE conforming spread versus explanatory variables



Note: The spread shown is the jumbo portfolio-GSE conforming spread estimated using equation 2 as described in the text and in the note to Figure 4. The g-fee is the average fee on Fannie Mae's new acquisitions of single-family mortgages. The jumbo supply indicator is the jumbo share of portfolio loans scaled by average house prices relative to the average conforming loan limit. The GSE funding advantage is measured as the spread between an index of bank AA note rates and an agency benchmark reference note rate. Refinance intensity is measured as refinance volume divided by mortgage industry employment. All data are monthly.

Source: Authors' calculations using data from CoreLogic, Black Knight, Inc., Fannie Mae, HMDA, Intercontinental Exchange, and the Mortgage Bankers Association.

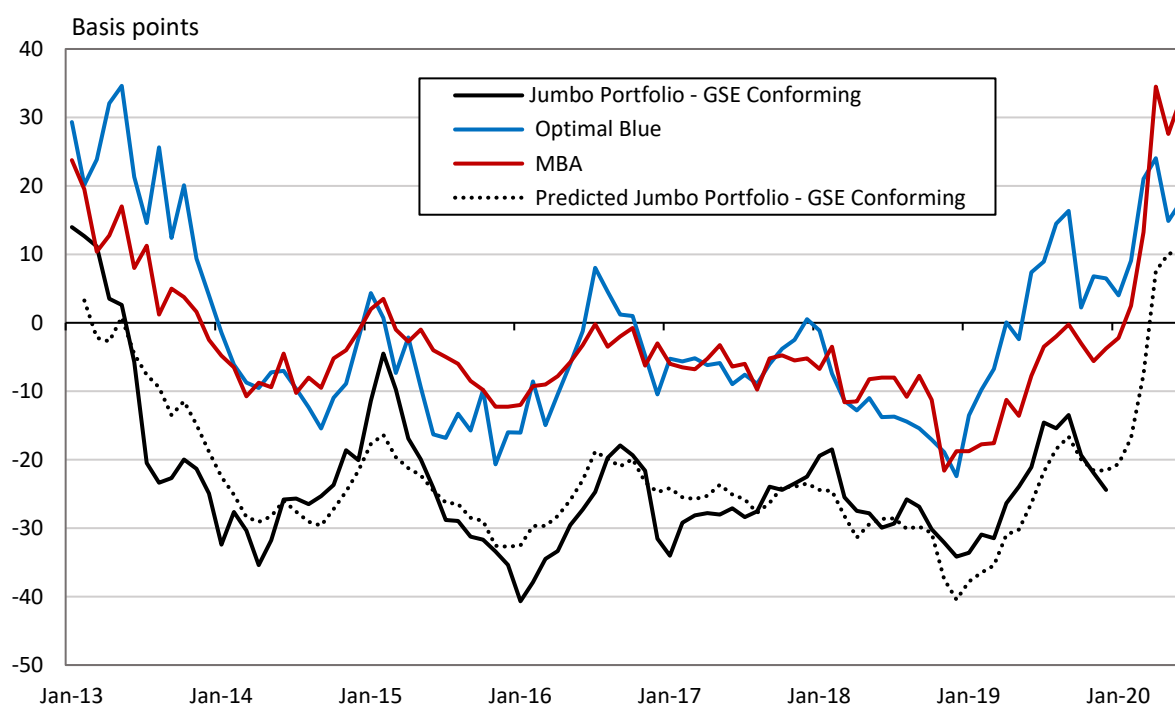
Figure 9. Effect of increases in the g-fee on the jumbo portfolio-GSE conforming spread



Note: The spread shown is the jumbo portfolio-GSE conforming spread estimated using equation 2 as described in the text and in the note to Figure 4. The shading covers the period from the announcement month to the implementation month for each 10 basis point increase in the g-fee during the period shown.

Source: Authors' calculations using data from CoreLogic and Black Knight, Inc.

Figure 10: Predicting the jumbo portfolio-GSE conforming spread



Note: The LMP jumbo portfolio-GSE conforming spread is the series shown in Figure 4. We estimate the Optimal Blue spread from rate-lock data by closely approximating the regression based on equation 2. The regression is estimated with loan-level data for conventional 30-year FRMs within +/- 20% of the applicable loan limit that are used to purchase primary owner-occupied homes in the contiguous U.S. The MBA spread comes directly from the Mortgage Bankers Association and is calculated as an unweighted average of the mortgage rates reported by survey respondents on conventional 30-year purchase and refinance FRMs with LTVs of 80 percent or less. All series are monthly averages.

Source: Authors' calculations using data from CoreLogic and Black Knight, Inc., Optimal Blue, and the Mortgage Bankers Association.

Appendix A: Data

Classifying loans as conforming or jumbo

Prior to the introduction of high-cost area loan limits in 2008, a loan could be classified as conforming or jumbo based solely on the loan amount. After the introduction of high-cost area limits, two pieces of information were required: the loan amount and the property location. MIRS, LLMA, and the PMBS dataset report both the actual (unrounded) loan amount and the five-digit zip code of the subject property, which allows us to determine unambiguously whether the loan is conforming or jumbo.⁴¹

The situation, however, is more complicated for the McDash dataset. McDash reports the loan amount rounded to the nearest thousand dollars, not the actual amount. McDash also reports only a three-digit zip for GSE loans and a smattering of other loans. With a rounded loan amount, one cannot tell if a loan is conforming or jumbo when the loan amount is very close to the loan limit. And with a three-digit zip, one cannot determine whether the national loan limit or a high-cost-area limit applies for some loans.

For McDash loans that are matched to loans in LLMA, we can use the five-digit zip in LLMA to determine the applicable loan limit for the matched loan. We can then compare the unrounded loan amount in LLMA to the applicable loan limit to determine whether a loan is conforming or jumbo.⁴²

For unmatched McDash loans, we use the following rules either to classify a loan as conforming or jumbo, or to exclude the loan from the cleaned dataset. These rules only apply to loans for which we

⁴¹ The small number of loans with a missing loan amount or zip code are omitted from cleaned dataset.

⁴² A minor complication arises when multiple LLMA loans are part of a McDash-LLMA match. In such cases, there can be small differences in the reported loan amounts across the linked LLMA loans. When the multiple loan amounts are all below the conforming loan limit, we classify the loan as conforming; conversely, when the loan amounts are all above the loan limit, we classify the loan as jumbo. In the rare instances that the loan amounts are on opposite sides of the loan limit, we remove the loan from the dataset. When the loan amounts are on the same side of the limit, we keep the loan and use the lowest of the loan amounts (the differences in loan amount are usually very small). This rule also applies to multiple LLMA loans not matched to McDash that are determined to be duplicates of one another.

can determine the applicable loan limit unambiguously.⁴³ If the loan limit cannot be determined, we remove the loan from the dataset.

McDash GSE loans

If the rounded loan amount is equal to the applicable conforming loan limit rounded to the nearest thousand dollars, we keep the loan as a conforming loan and assign the unrounded loan limit as the loan amount. That is, we assume the loan is bunched at the loan limit. If the rounded loan amount is below the rounded loan limit, we keep the loan as a conforming loan but do not adjust the loan amount. Finally, if the rounded loan amount is above the rounded limit, we remove the loan from the dataset, as the investor code and loan amount information are inconsistent.

McDash non-GSE loans

We drop the loan if the rounded loan amount is equal to the rounded loan limit. This rule differs from that for GSE loans because for non-GSE loans there is no presumption that the loans are conforming loans bunched at the limit. Hence, we cannot classify the loan as conforming or jumbo with any confidence. If the rounded loan amount is below the rounded loan limit, we keep the loan as a conforming loan without adjusting the loan amount. Finally, if the rounded loan amount is above the rounded limit, we keep the loan as a jumbo loan, again with no adjustment to the loan amount.

Jumbo loans originated shortly before year-end

A separate classification issue arises for loans in all of our datasets with amounts that are above the applicable conforming loan limit in the year of origination (i.e., are jumbo at origination) but are below the loan limit for the following year. We classify such loans originated in January through November as jumbos but classify loans originated in December as conforming even though they are jumbo at origination. The logic for classifying these loans as conforming is that the loan limits for the

⁴³ After the introduction of the high-cost area limits, the applicable loan limit can be determined unambiguously if the loan's three-digit zip lies within a single county or spans counties that all have the same loan limit or if the loan is in a state with no high-cost areas or a state that consists entirely of high-cost areas with the same loan limit.

coming year are announced in November; lenders are then able to originate loans in December with amounts above the current-year limits with the knowledge that they can sell these mortgages to the GSEs in January. This “December rule” is implemented for every year from 2000 to 2019 with the exception of 2005 where we divide the year into January-September and October-December originations.⁴⁴ Loans with amounts above the applicable conforming loan limit in both the origination year and the subsequent year are classified as jumbos regardless of the month of origination. We apply these rules to both the MIRS dataset and the LMP dataset.

Identifying GSE and portfolio loans in LLMA and McDash

We use the investor information in LLMA and McDash to identify the GSE and portfolio loans in those datasets. Both datasets contain two forms of investor information: the current investor code, which shows the latest information on the holder of the loan, and a monthly performance file, which provides month-by-month information on the loan holder.⁴⁵

We use the following procedure to classify conventional loans in LLMA and McDash as GSE or portfolio loans after we remove PMBS loans from both datasets (see “Identifying PMBS loans in LLMA and McDash” below for details).

Loans with amounts above the applicable conforming loan limit

If a non-PMBS loan has an amount above the applicable limit, it must be a jumbo portfolio loan, and we classify it as such even if the investor information for the loan is entirely missing.

Loans with amounts at or below the applicable conforming loan limit

If a non-PMBS loan has a conforming amount, we look to the available investor information. We classify an LLMA or McDash loan as a GSE loan if it has a current investor code of GSE or is ever shown as

⁴⁴ See <https://money.cnn.com/2005/10/14/news/economy/loans/index.htm> for details about lender behavior in 2005.

⁴⁵ This identification cannot be done in MIRS because there is no information to distinguish GSE loans from other conventional loans.

GSE in the monthly performance file. We use an analogous rule to classify a loan as a portfolio loan. Specifically, a conforming LLMA loan is classified as a portfolio loan if it has a current investor code of “portfolio” or is ever shown as such in the monthly performance file and is never shown as a GSE loan in any of these fields. McDash does not have a single code for portfolio loans, but we apply the same rule using the three codes in McDash for privately-held loans (7 for “Parent Owned”, 8 for “Self Owned”, and 9 for “Private/Other”).

If the investor information for a conforming loan is completely missing, we keep the loan in the dataset and classify its type as “unknown.”

Identifying PMBS loans in LLMA and McDash

We use PMBS flags in auxiliary datasets supplied by CoreLogic and Black Knight to identify and then remove PMBS loans from LLMA and McDash. Because the PMBS flags do not appear to identify all PMBS loans, we perform a secondary match of the unflagged loans to the PMBS dataset. Loans that match to the PMBS dataset are removed from the LLMA and McDash data.

Miscellaneous issues

Definition of 30-year loans

LLMA, McDash, and the PMBS dataset all define loan term in months rather than years. We designate a loan as having a 30-year term if its reported term is between 247 and 366 months inclusive, i.e., is more than 20½ years and less than or equal to 30½ years. The vast majority of the 30-year loans so defined have reported terms that round to 30 years. MIRS reports loan term in years. We use loans with exactly a 30-year term, which account for 99.6 percent of all MIRS loans with a term greater than 20 years and less than 40 years.

Use of estimated LTVs

For LLMA loans with a missing LTV, we create an estimated LTV equal to the loan amount at origination divided by the property’s appraised value when that value is reported. If this estimated LTV

is below 25 percent or above 125 percent, we exclude the loan from the dataset, just as we would have if the loan had a reported LTV outside these bounds. This check is the only use we make of the estimated LTV. If the loan has an estimated LTV of 25 to 125 percent, and thus remains in the dataset, we classify it as having a missing LTV in the regressions to estimate the jumbo-conforming spread.

Variables used to explain the jumbo-conforming spread: Data sources and definitions

GSE guarantee fees

We use the average guarantee fee on Fannie Mae's new acquisitions of single-family mortgages, which is reported quarterly.⁴⁶ The data source is Fannie Mae 10-Q and 10-K reports, along with financial supplements. To create a monthly series, we assign the quarterly guarantee fee to the middle month of the quarter and linearly interpolate between these months.

GSE funding advantage

We measure the GSEs' relative funding advantage by the monthly spread between an index of bank AA-rated note rates and an index of agency reference note rates. Both indices are constructed by the Intercontinental Exchange (<https://www.theice.com/market-data/indices/fixed-income-indices>). The series code for the bank rate index is COP2, while the series code for the agency reference note index is GOPR.

Refinance applications relative to mortgage industry employment

Refinance applications. For 2004-2018, we use the monthly HMDA refinance applications count in Consumer Financial Protection Bureau (2019). This series, which covers loans backed by 1-4 family housing units, appears in Table S1A, row 22. For 2019 and 2020:H1, we extrapolate the December 2018 HMDA application count using the monthly percent change in the non-seasonally-adjusted refinance applications index published by the Mortgage Bankers Association (MBA). To do the extrapolation, we

⁴⁶ We do not use data for Freddie Mac because for most of our sample period Freddie only reported an average effective guarantee fee for its entire single-family book of business, not for new acquisitions.

lag the MBA series by one month because the MBA series is dated when the application is received, while the HMDA series is dated when the final action is taken on the application.

Mortgage industry employment. This series is the sum of monthly employment from the Bureau of Labor Statistics in two industry series that roughly correspond to employees involved in mortgage origination activities: (1) real estate credit and (2) mortgage and nonmortgage loan brokers. We use the non-seasonally-adjusted series, which have series IDs CEU5552229201 (real estate credit) and CEU5552231001 (mortgage and nonmortgage loan brokers).

Jumbo share of portfolio purchase loans scaled by ratio of average house price to conforming loan limit

Jumbo share of portfolio purchase loans. We calculate this share, denoted by $\mu_{Jumbo,Port}$, with the following equation:

$$\begin{aligned}
 (A.1) \quad \mu_{Jumbo,Port} &\equiv \frac{Jumbo\ portfolio}{All\ portfolio} = \frac{(All\ jumbo - Jumbo\ PMBS)/All\ conv.}{All\ portfolio/All\ conv.} \\
 &= \frac{(All\ jumbo/All\ conv.) - (Jumbo\ PMBS/All\ PMBS) * (All\ PMBS/All\ conv.)}{All\ portfolio/All\ conv.} \\
 &= \frac{\mu_{Jumbo,Conv} - \mu_{Jumbo,PMBS} * \mu_{PMBS,Conv}}{\mu_{Port,Conv}}
 \end{aligned}$$

where all terms refer to first-lien home purchase loans, *conv.* denotes all such conventional loans, $\mu_{Jumbo,Conv}$ denotes the jumbo share of such conventional loans, and the other shares are defined analogously. The table below shows the source of annual data over 2004-2019 for each share in the equation.

| Share | Source |
|--------------------|---|
| $\mu_{Jumbo,Conv}$ | Authors' calculations using HMDA data |
| $\mu_{Jumbo,PMBS}$ | Authors' calculations using the CoreLogic PMBS dataset. |
| $\mu_{PMBS,Conv}$ | Data supplement to Davis et al. (2019). Data for Figure 2 in "Other" tab of data supplement. Not available for 2018 or 2019; assumed to be zero. |
| $\mu_{Port,Conv}$ | Data supplement to Davis et al. (2019). Data for Figure 2 in "Other" tab in data supplement. Not available for 2019; assumed to be the same as in 2018. |

Two features of the public-use HMDA data cause some imprecision in the estimate of the jumbo share of conventional loans from equation A.1. First, the data show the origination year, not the origination month, for each loan. In 2008, 2009, and 2011, there were within-year changes in the high-cost area limits due to switches between different pieces of authorizing legislation. For these years, it is not possible to assign the correct loan limit to individual loans in high-cost areas. To obtain a roughly correct jumbo share for these years, we use a weighted average of the two loan limits in effect within the year for high-cost areas, where the weight on each limit is the share of months for which it applied.⁴⁷ Second, the public-use data show the loan amount rounded to the nearest \$1000 through 2017 and to the nearest \$10,000 for 2018-2019. The rounding through 2017 causes only a minor misclassification of loans as conforming or jumbo, but the coarser rounding for 2018-2019 has the potential to introduce more significant error. We compare the 2017 to 2018 change in our calculated jumbo share of conventional loans to the change in the share using unrounded HMDA data reported in CFPB (2019) for a somewhat narrower set of conventional loans. We adjusted up our estimate of $\mu_{Jumbo,Conv}$ on the right side of equation A.1 by 0.2 percentage point for 2018 and 2019 based on this comparison.

The jumbo share of portfolio loans estimated with equation A.1 is an annual figure. We use monthly counts of conforming and jumbo portfolio loans from the LMP dataset to distribute the annual share across the months of each year. Specifically, we calculate the monthly jumbo shares from the LMP dataset, and then scale these monthly shares by the ratio of the annual share from equation A.1 to the annual share from the LMP dataset. This scaling ensures that the resulting monthly shares aggregate to the annual share from equation A.1. For the purpose of this calculation, we include both

⁴⁷ The lack of information on origination month implies that we also cannot implement the “December rule” that we discuss in the main text for classifying loans originated in December with amounts above the applicable loan limit as either conforming or jumbo. For the purpose of implementing equation A.1, all loans originated with amounts above the applicable loan limit are classified as jumbo loans.

ARMs and FRMs in the LMP counts and do not impose any of our data cleaning screens other than the requirement that a loan's LTV exceed 25 percent, which we use to remove likely second liens. The broader set of loans helps align the LMP data with the scope of the data used in equation A.1.⁴⁸

Average house price. We calculate county-level average home prices for December 2019 using an automated valuation model (AVM) estimate obtained from First American for about 97 million one-unit single-family homes across the United States excluding Alaska and Hawaii. Using the December 2019 value as a proxy for the 2019:Q4 value, we then move the county-specific average AVMs back from 2019:Q4 with FHFA's quarterly purchase-only house price index for the state in which the county is located. (We use state-level house price indices because FHFA does not publish quarterly county-level indices.) The next step is to aggregate the county-level average house prices to the national level. We do the aggregation with weights from the American Community Survey (ACS) that reflect the number of one-unit attached and detached homes in each county. The weights for periods through 2010:Q4 are based on the 2010 ACS five-year data, while the weights for later quarters are based on the 2018 ACS five-year data. Finally, to create a monthly series, we assign the quarterly national house price level to the middle month of the quarter and linearly interpolate between these months.

Average conforming loan limit. We use the national loan limit through March 2008, after which the high-cost area limits became effective. Starting in April 2008, we use the county-specific limits for high-cost areas and the national limit for all other counties, covering the entire United States excluding Alaska and Hawaii. From April 2008 onward, we aggregate the county-level loan limits to the national level with the same ACS weights as for average house prices.

⁴⁸ For three pairs of years – 2008-09, 2010-11, and 2011-12 – this procedure results in sizable jumps in the scaled jumbo share from the end of the first year to the beginning of the second. This occurs because the scaling factors are not stable across the years in each pair. We adjusted the scaling factors to smooth the jumbo share across these pairs of years. We also smoothed out spikes in the jumbo share in two months – July 2010 and June 2012 – by replacing these shares with the average of the shares in the adjacent months.

Appendix B: Parameter Estimates from First-Stage Regressions

Table B.1: MIRS Full, MIRS Reduced, and LMP Reduced regression results, 2000-2019

The dependent variable is the mortgage rate on the loan; the spread is calculated as the difference between the rate coefficients for jumbo and conforming loans.

| | MIRS Full | | | MIRS Reduced | | | LMP Reduced | |
|--|-----------|-------|--|--------------|-------|--|-------------|-------|
| | Coef. | S.E. | | Coef. | S.E. | | Coef. | S.E. |
| Annual Spreads (average of monthly coefficients) | | | | | | | | |
| 2000 | 0.175 | 0.006 | | 0.173 | 0.006 | | 0.274 | 0.003 |
| 2001 | 0.266 | 0.004 | | 0.266 | 0.004 | | 0.368 | 0.002 |
| 2002 | 0.148 | 0.004 | | 0.149 | 0.004 | | 0.197 | 0.002 |
| 2003 | 0.161 | 0.005 | | 0.165 | 0.005 | | 0.193 | 0.002 |
| 2004 | 0.085 | 0.005 | | 0.090 | 0.005 | | 0.123 | 0.002 |
| 2005 | 0.073 | 0.006 | | 0.082 | 0.006 | | 0.089 | 0.002 |
| 2006 | 0.100 | 0.007 | | 0.104 | 0.007 | | 0.115 | 0.002 |
| 2007 | 0.244 | 0.007 | | 0.237 | 0.007 | | 0.356 | 0.003 |
| 2008 | 0.541 | 0.020 | | 0.535 | 0.020 | | 0.626 | 0.008 |
| 2009 | 0.747 | 0.015 | | 0.732 | 0.015 | | 0.751 | 0.006 |
| 2010 | 0.582 | 0.011 | | 0.583 | 0.011 | | 0.584 | 0.004 |
| 2011 | 0.218 | 0.008 | | 0.226 | 0.008 | | 0.330 | 0.004 |
| 2012 | 0.126 | 0.006 | | 0.137 | 0.006 | | 0.262 | 0.003 |
| 2013 | -0.119 | 0.004 | | -0.115 | 0.004 | | -0.102 | 0.002 |
| 2014 | -0.244 | 0.005 | | -0.242 | 0.005 | | -0.250 | 0.002 |
| 2015 | -0.280 | 0.004 | | -0.280 | 0.004 | | -0.240 | 0.001 |
| 2016 | -0.347 | 0.004 | | -0.350 | 0.004 | | -0.262 | 0.002 |
| 2017 | -0.277 | 0.005 | | -0.283 | 0.005 | | -0.229 | 0.002 |
| 2018 | -0.409 | 0.005 | | -0.406 | 0.005 | | -0.263 | 0.002 |
| 2019 (MIRS, Jan.-Apr.) | -0.465 | 0.010 | | -0.472 | 0.011 | | -0.208 | 0.002 |
| Average of all Annual Regressions | | | | | | | | |
| LTV Buckets | | | | | | | | |
| ≤75% | Omitted | | | Omitted | | | Omitted | |
| >75-80% | 0.069 | 0.001 | | 0.068 | 0.001 | | 0.098 | 0.000 |
| >80-90% | 0.174 | 0.001 | | 0.173 | 0.001 | | 0.235 | 0.000 |
| >90% | 0.202 | 0.001 | | 0.203 | 0.001 | | 0.283 | 0.000 |
| Small Balance | 0.301 | 0.002 | | 0.297 | 0.002 | | 0.242 | 0.000 |
| New home | -0.007 | 0.001 | | | | | | |
| Fees charged | -0.064 | 0.001 | | | | | | |
| Mortgage company | 0.122 | 0.003 | | | | | | |
| | | | | | | | | |
| Loan Counts | 1,876,056 | | | 1,876,056 | | | 28,490,690 | |
| R-squared | 0.885 | | | 0.884 | | | 0.826 | |

Note: All regressions include dummy variables for California, New Jersey, Maryland, and Virginia and for all other states combined. Robust standard errors are shown for the estimated coefficients.

Appendix Table B.2: Regressions results using loans in the LMP dataset with amounts between 80 and 120+ percent of the conforming loan limit, 2000-2019

The dependent variable in all regressions is the mortgage rate on the loan; the spread is calculated as the difference between the rate coefficients for the two types of loans.

| | Jumbo-conforming | | Jumbo portfolio-GSE | | Jumbo portfolio-GSE conforming | |
|--|------------------|--------|---------------------|--------|--------------------------------|--------|
| | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. |
| Annual Spreads (average of monthly coefficients) | | | | | | |
| 2000 | 0.685 | 0.031 | 0.951 | 0.048 | 0.951 | 0.048 |
| 2001 | 0.725 | 0.028 | 0.817 | 0.039 | 0.817 | 0.039 |
| 2002 | 0.340 | 0.019 | 0.372 | 0.025 | 0.372 | 0.025 |
| 2003 | 0.394 | 0.020 | 0.344 | 0.025 | 0.344 | 0.025 |
| 2004 | 0.240 | 0.018 | 0.247 | 0.025 | 0.247 | 0.025 |
| 2005 | 0.212 | 0.013 | 0.258 | 0.019 | 0.258 | 0.019 |
| 2006 | 0.277 | 0.016 | 0.430 | 0.030 | 0.430 | 0.030 |
| 2007 | 0.668 | 0.028 | 0.922 | 0.047 | 0.922 | 0.047 |
| 2008 | 0.398 | 0.070 | 0.414 | 0.072 | 0.468 | 0.072 |
| 2009 | 0.508 | 0.094 | 0.536 | 0.093 | 0.615 | 0.091 |
| 2010 | 0.319 | 0.086 | 0.339 | 0.086 | 0.406 | 0.086 |
| 2011 | 0.222 | 0.053 | 0.204 | 0.053 | 0.274 | 0.053 |
| 2012 | 0.113 | 0.033 | 0.110 | 0.034 | 0.172 | 0.034 |
| 2013 | -0.106 | 0.012 | -0.122 | 0.012 | -0.076 | 0.012 |
| 2014 | -0.255 | 0.006 | -0.283 | 0.006 | -0.269 | 0.007 |
| 2015 | -0.222 | 0.008 | -0.250 | 0.007 | -0.230 | 0.007 |
| 2016 | -0.273 | 0.007 | -0.312 | 0.006 | -0.282 | 0.006 |
| 2017 | -0.257 | 0.007 | -0.298 | 0.006 | -0.270 | 0.006 |
| 2018 | -0.218 | 0.008 | -0.293 | 0.007 | -0.273 | 0.007 |
| 2019 | -0.171 | 0.011 | -0.257 | 0.009 | -0.234 | 0.020 |
| Average of all Annual Regressions | | | | | | |
| Jumbo | | | | | | |
| Loan Size | 1.072 | 0.311 | 0.613 | 0.338 | 0.521 | 0.336 |
| Loan Size ² | -9.748 | 3.304 | -5.916 | 3.582 | -4.867 | 3.563 |
| Loan Size ³ | 25.460 | 10.265 | 14.002 | 11.098 | 10.353 | 11.040 |
| Conforming | | | | | | |
| Loan Size | -0.231 | 0.026 | -0.365 | 0.024 | -0.327 | 0.035 |
| Loan Size ² | 0.872 | 0.354 | 2.138 | 0.325 | 1.851 | 0.399 |
| Loan Size ³ | 0.174 | 1.254 | -3.665 | 1.143 | -2.752 | 1.322 |
| Super-conforming | | | | | | |
| Loan Size | | | | | -1.011 | 0.028 |
| Loan Size ² | | | | | 6.643 | 0.209 |
| Loan Size ³ | | | | | -7.588 | 0.258 |
| LTV Buckets | | | | | | |
| ≤60% | -0.212 | 0.010 | -0.190 | 0.011 | -0.189 | 0.011 |
| >60-70% | -0.168 | 0.010 | -0.146 | 0.011 | -0.145 | 0.011 |
| >70-75% | -0.128 | 0.010 | -0.108 | 0.011 | -0.108 | 0.011 |

| | | | | | | | | |
|---------------------|-----------|-------|--|-----------|-------|--|-----------|-------|
| >75-80% | -0.103 | 0.010 | | -0.084 | 0.011 | | -0.083 | 0.011 |
| >80-85% | 0.028 | 0.010 | | 0.009 | 0.011 | | 0.010 | 0.011 |
| >85-90% | 0.079 | 0.010 | | 0.056 | 0.011 | | 0.058 | 0.011 |
| >90-95% | 0.114 | 0.010 | | 0.088 | 0.011 | | 0.092 | 0.011 |
| >95-97% | 0.147 | 0.011 | | 0.177 | 0.012 | | 0.183 | 0.012 |
| >97% | 0.304 | 0.010 | | 0.238 | 0.012 | | 0.238 | 0.012 |
| Missing | Omitted | | | Omitted | | | Omitted | |
| FICO Buckets | | | | | | | | |
| 300-619 | 0.543 | 0.022 | | 0.345 | 0.010 | | 0.347 | 0.010 |
| 620-639 | 0.428 | 0.004 | | 0.349 | 0.004 | | 0.351 | 0.004 |
| 640-659 | 0.339 | 0.003 | | 0.286 | 0.003 | | 0.288 | 0.002 |
| 660-679 | 0.249 | 0.002 | | 0.212 | 0.002 | | 0.213 | 0.002 |
| 680-699 | 0.131 | 0.001 | | 0.110 | 0.001 | | 0.111 | 0.001 |
| 700-719 | 0.055 | 0.001 | | 0.049 | 0.001 | | 0.049 | 0.001 |
| 720-739 | -0.015 | 0.001 | | -0.015 | 0.001 | | -0.016 | 0.001 |
| ≥740 | -0.082 | 0.001 | | -0.073 | 0.001 | | -0.075 | 0.001 |
| Missing | Omitted | | | Omitted | | | Omitted | |
| DTI Buckets | | | | | | | | |
| 1-33% | -0.064 | 0.001 | | -0.048 | 0.001 | | -0.049 | 0.001 |
| >33-38% | -0.037 | 0.001 | | -0.027 | 0.001 | | -0.028 | 0.001 |
| >38-43% | -0.016 | 0.001 | | -0.014 | 0.001 | | -0.016 | 0.001 |
| >43-50% | 0.015 | 0.001 | | -0.003 | 0.001 | | -0.004 | 0.001 |
| >50% | 0.002 | 0.005 | | -0.001 | 0.004 | | -0.001 | 0.004 |
| Missing | Omitted | | | Omitted | | | Omitted | |
| Prepayment Penalty | | | | | | | | |
| No | -0.056 | 0.001 | | -0.052 | 0.001 | | -0.052 | 0.001 |
| Yes | 0.145 | 0.007 | | 0.065 | 0.007 | | 0.065 | 0.007 |
| Missing | Omitted | | | Omitted | | | Omitted | |
| Priv. Mortgage Ins. | | | | | | | | |
| No | 0.012 | 0.001 | | 0.010 | 0.002 | | 0.010 | 0.002 |
| Yes | -0.063 | 0.002 | | -0.045 | 0.002 | | -0.044 | 0.002 |
| Missing | Omitted | | | Omitted | | | Omitted | |
| Documentation Type | | | | | | | | |
| Full-doc | -0.029 | 0.001 | | -0.018 | 0.001 | | -0.019 | 0.001 |
| Low- or No-doc | 0.024 | 0.002 | | -0.016 | 0.001 | | -0.016 | 0.001 |
| Missing | Omitted | | | Omitted | | | Omitted | |
| Amortization Type | | | | | | | | |
| Full | 0.010 | 0.001 | | 0.012 | 0.001 | | 0.013 | 0.001 |
| Less than Full | -0.036 | 0.012 | | -0.075 | 0.012 | | -0.072 | 0.012 |
| Missing | Omitted | | | Omitted | | | Omitted | |
| | | | | | | | | |
| Loan Counts | 3,493,677 | | | 2,909,361 | | | 2,909,361 | |
| R-squared | 0.910 | | | 0.930 | | | 0.930 | |

Note: All regressions control for state fixed effects. Loan size is measured as the percent difference between the loan amount and the applicable conforming loan limit, in absolute value. The jumbo

portfolio-GSE conforming regression also includes a control for super-conforming loans, the results for which are shown in Figure 7 in the main text. Robust standard errors are shown for the estimated coefficients.