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Kevin A. Park

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The Economic Stimulus Act of 2008 dramatically but temporarily increased the mortgage loan amount eligible for insurance through the Federal Housing Administration. We use the implementation and expiration of these loan limits as a source of exogenous variation in the availability of FHA insurance to measure the impact on the overall mortgage market and conventional lending. We find that the introduction of higher loan limits increased the number of mortgages newly eligible for FHA financing, but that the expiration of those loan limits roughly six years later did not significantly decrease affected loan originations. Moreover, the degree of substitution between FHA and conventional market segments was lower in 2008-09 than in 2014, when substitution was nearly one-for-one. The smaller impact on the overall mortgage market and greater degree of substitution when the ESA loan limits expired may be explained by the return of a stronger conventional lending industry than existed during the housing crisis.

[1] U.S. Department of Housing and Urban Development, 451 Seventh Street SW, Washington, DC, 20410 (kevin.park@hud.gov). The opinions expressed are those of the author, and do not necessarily reflect the policies of the Department of Housing and Urban Development or the Administration. The author thanks Josh Miller and William Reeder for invaluable comments and suggestions. Any omissions and errors belong solely to the author.

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Introduction

Section 203 of the National Housing Act of 1934 created the Federal Housing Administration (FHA) to provide federally-backed insurance of home mortgages against the risk of default. FHA insurance typically serves borrowers with higher perceived credit risk, including first-time homebuyers and minority borrowers. FHA is also restricted to loan amounts less than a maximum limit. Historically, these loan limits have tended to not keep pace with house price appreciation, further focusing FHA insurance on a narrowing segment of the mortgage market. But in response to the collapse of house prices and rising foreclosures, Congress enacted legislation in 2008 that drastically increased the maximum loan amount eligible for FHA insurance. Although subsequently extended, the higher loan limits expired at the end of 2013. The changes in loan limits create a natural experiment to measure the effect of the availability of FHA mortgage insurance on the mortgage market. The exogenous variation in FHA eligibility provides an improvement over previous research on the substitution between FHA and conventional (i.e., not insured by the Veterans Administration, Department of Agriculture, or FHA) mortgage lending.

Literature Review

FHA has typically maintained less stringent underwriting than the conventional mortgage market, accepting borrowers with smaller downpayments and worse credit histories. In the extension of the theoretical model used by Ferguson and Peters (1995) by Ambrose, Pennington-Cross and Yezer (2002), this creates an FHA "wedge" between borrowers served by the conventional market and borrowers deemed unacceptable credit risks, with a clear delineation between market segments. Under this conception, there is very little room for product substitution because borrowers will always select the least expensive option available at any given point in time. Bunce et al. (1995) argue, "[O]verlap is only possible when the lender and borrower fail to take advantage of a bonafide [private mortgage insurance] offer of the same service at lower cost." And given the complexity of the underwriting process, even observed incidences are only evidence of potential, not actual, overlap.

Not surprisingly, indicators of greater credit risk are associated with greater reliance on FHA insurance. Pennington-Cross and Nichols (2000) find that a 10-point increase in credit score lowers the probability of using FHA insurance by 2.8 percent. Decomposing credit scores into specific components of credit history such as revolving credit balance, ever delinquent, and derogatory public notices provides even more explanatory power. Lacour-Little (2004) supports the finding that credit score predominantly distinguishes FHA and subprime mortgages from conventional prime mortgages, but also notes that documentation requirements appear to separate subprime and FHA loans.

Neighborhood characteristics and economic conditions impact risk assessments given their potential to affect the value of the collateral securing the mortgage. Ambrose, Pennington-Cross and Yezer (2002) find that the FHA rejection rate is less sensitive to cyclical economic risk factors than the conventional rejection rate and actually inversely related to some permanent risk factors like house price volatility. Holmes and Horvitz (1994) find that the neighborhood default rate is negatively associated with conventional mortgage lending activity but positively associated with FHA activity. Immergluck (2011) also notes that falling house prices are associated with an increase in the likelihood of FHA insurance.

However, evidence suggests the mortgage market is not nearly as segmented as theory would dictate. One US Department of Housing and Urban Development study from 1986 noted, "It appears, therefore, that Section 203(b) and private insurers are less different…than may be commonly believed." Ambrose, Pennington-Cross and Yezer (2002) attribute the overlap to applicants' tolerance for rejection. For example, risk-averse applicants might apply for FHA insurance even when they would qualify for typically less expensive conventional mortgage credit alternatives.

Institutional factors appear to influence the likelihood of FHA financing. Karikari, Voicu and Fang (2011) find loans originated through depository institutions (commercial banks, thrifts and credit unions) are more likely to use FHA insurance compared to independent mortgage companies. In contrast, Immergluck (2011) finds wholesale or correspondent lending channels were associated with an increased likelihood of being an FHA loan. The difference may be due to the fact that Karikari, Voicu and Fang use data from 2005, at the peak of the housing bubble, while Immergluck uses data from 2008, when conventional mortgage credit was becoming less available.

Immergluck also notes that FHA's historical market share increases the likelihood of FHA insurance, indicating lenders' familiarity with FHA lending may have a legacy effect.

Even after controlling for these factors, the race and ethnicity of borrowers continues to be associated with differences in credit channel. Early empirical studies (e.g., Fullerton and MacRae 1978; Canner, Gabriel and Woolley 1991; Gabriel and Rosenthal 1991; Holmes and Horvitz 1994) typically found minorities were disproportionately more likely to rely on FHA insurance than conventional mortgages. However, later studies find different patterns, possibly reflecting changes in the mortgage industry such as the introduction of greater risk-based pricing in the form of subprime loans. Pennington-Cross and Nichols (2000) find that Hispanics are more likely to use FHA insurance but Blacks are less likely. Karikari, Voicu and Fang (2011) find minority borrowers and neighborhoods were more likely to receive subprime mortgages than FHA-insured loans.

Several studies have tried to empirically quantify the degree of overlap between FHA insurance and the conventional mortgage market. Rodda, Schmidt and Patrabansh (2005) estimate an 11 percent overlap in the combined borrower risk distributions of FHA endorsements and conventional loans purchased by the government-sponsored enterprises Fannie Mae and Freddie Mac. However, Gyourko and Hu (2002) find spatial differences, with Fannie and Freddie focusing on lower income borrowers in relatively high income neighborhoods and a large FHA presence associated with fewer conventional loans. Karikari, Voicu and Fang (2011) estimate that 29 percent of subprime loans made in 2005 could have qualified for FHA insurance. Results presented in Spader and Quercia (2012) indicate that every ten subprime loans in a Census tract between 2002 and 2006 was associated with roughly three fewer FHA-insured loans, although the opposite effect is observed between 1998 and 2001. There is also evidence that the market share of FHA was negatively impacted by other public policies, including affordable housing goals for the government-sponsored enterprises (An and Bostic 2008) and the Community Reinvestment Act (Spader and Quercia 2012). On the other hand, Ding et al. (2008) find FHA and subprime loans are complements at the neighborhood level, with the share of FHA loans in a census tract positively correlated with the share of subprime loans. These different findings suggest that the role of FHA may change over time depending on the context of the broader mortgage market.

A concern with many of these studies is that any observed inverse correlation between FHA and conventional mortgage market activity cannot prove causation. This study builds on the existing literature by exploiting an exogenous change in the availability of FHA insurance caused by restrictions on the maximum loan amount FHA is allowed to insure.

FHA Loan Limits

FHA is prohibited by section 203(b)(2) of the National Housing Act from insuring loans above certain amounts. Vandell (1995) provides a detailed history of FHA and these loan limits. At the creation, FHA was allowed to insure loan amounts up to $16,000 compared to a median house price in 1930 of only $4,778. Even after the limit was reduced to $6,000 in 1938, more than 85 percent of owner-occupied homes were eligible for FHA financing. Consequently, the loan limits were not exceptionally restrictive early in FHA's history.

FHA loan limits were periodically increased through the mid-20th century, but often failed to keep pace with house price appreciation. Although an exception was made for high cost areas[2], the national loan limit was $67,500 from 1980 through 1993 while the median sales price of a single-family home increased from $62,200 to $106,800. "While still intended to be actuarially sound, the Section 203(b) program was gradually targeted lower and lower in the income distribution by means of both more lenient terms … and binding loan ceilings" (Vandell 1995).

A new loan limit formula was adopted in 1994. The loan limit was set at 95 percent of the area median house price, as determined by the U.S. Department of Housing and Urban Development. However, the loan limit could not be less than 38 percent (the "floor") nor greater than 75 percent (the "ceiling") of the conforming loan limit used by the government-sponsored enterprises, Fannie Mae and Freddie Mac (Mortgagee Letters 1994-15; 1994-52). Loan limits were increased in 1998, raising the floor to 48 percent and the ceiling to 87 percent of the comparable Freddie Mac conforming loan limit (Mortgagee Letter 1998-28).

This loan limit formula remained in effect for the next decade. But in response to the collapse of the housing market in the mid-2000s, Section 202 of the Economic Stimulus Act of 2008 (ESA) increased the loan limit formula to 125 percent of the median

[2] Loan limits in high cost areas were set at 95 percent of the area median sales price up to $90,000. The maximum amount was increased to $101,250 in 1988 and $124,875 in 1989.

house price, not to exceed 175 percent of the comparable Freddie Mac limit nor be less than 65 percent, effective for loans endorsed on or after March 6, 2008. Moreover, the Freddie Mac conforming loan limit was increased to 125 percent of the area median, not to decline below the 2008 limit nor exceed 175 percent of the 2008 limit.[3] Overall, 3,141 counties had their FHA loan limits increased, often dramatically, in March 2008.

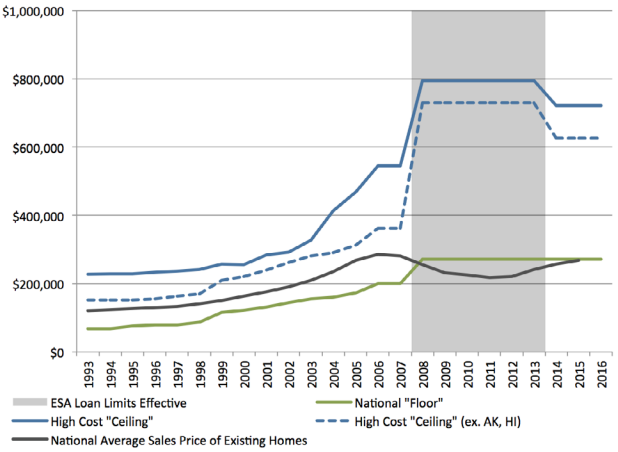
These temporary limits expired at the end of 2008 but were reinstated by the American Recovery and Reinvestment Act of 2009 (ARRA). Continuing resolutions further extended the ESA loan limit standard for FHA (Mortgagee Letters 2009-50; 2010-40; 2011-39; 2012-26). However, the temporary increase in the high cost area "ceiling" for loans acquired by the government-sponsored enterprises was allowed to expire in October 2011, creating the anomalous condition for 27 months of FHA loan limits exceeding those of Fannie Mae and Freddie Mac in many counties.

The temporary FHA loan limits ultimately expired at the end of 2013, at which time loan limits did not revert to their pre-ESA formula but instead change to a new formula described in the Housing and Economic Recovery Act of 2008 (HERA)[4]. HERA maintains the ESA floor but lowers the loan limit from 125 percent of the median house price to 115 percent and lowers the ceiling from 175 percent of the Freddie Mac limit to 150 percent.[5] The lower loan limits were effective for applications for FHA insurance with case numbers assigned on or after January 1, 2014 (Mortgagee Letter 2013-43). Figure 1 shows the recent history of FHA loan limits.

Loan limits in 2014 were also affected by a revision of metropolitan areas by the Office of Management and Budget. Because loan limits for a metropolitan area are defined by the county in that area with the highest median house price, a change in boundaries can affect the loan limits for all counties in that metropolitan area.

Over 600 counties had their loan limits decreased in January 2014. Goodman, Seidman and Zhu (2014) find that the decline in house prices since 2006 was the primary factor in lower loan limits, affecting 389 counties, followed by changes the house price multiplier from 125 percent to 115 percent (157 counties), decline in the loan limit ceiling (73 counties), and changes in metropolitan area boundaries (33 counties).[6]

Figure 1. FHA Loan Limits



Note: National Average Sales Price estimated by applying Case-Shiller National Home Price Index to average sales price of existing single-family homes, condominiums and cooperatives between 2013 and 2015 reported by the National Association of Realtors®, weighted by the number of sales.

The metropolitan areas most impacted by the change include Winchester, VA-WV, Salt Lake City, UT, Worcester, MA, Norwich-New London, CT, and Stockton, CA. In 16 of the 30 most affected census tracts, more than half of borrowers are minority.

The implementation and expiration of the temporary loan limits under ESA creates a natural experiment of the effect of the availability of FHA mortgage insurance on the mortgage market.

Data and Methodology

Detailed information on home mortgage loan originations is available through the Home Mortgage Disclosure Act of 1975 (HMDA). Most mortgage lending institutions are required to submit a loan-application register to be compiled for public use by the Federal Financial Institutions Examination Council (FFIEC). Although reporting is not required of smaller lenders, the HMDA data is estimated to cover 90 to 95 percent of FHA endorsements and between 75 and 85 percent of conventional originations (HUD 2011). The loan-application register lists the loan amount and purpose as well as the occupancy and type of the property securing the mortgage. This study focuses on loan applications[7] and originations of first lien mortgages for

[3] Prior to ESA, the conforming loan limit for the government-sponsored enterprises was determined by adjusting the previous limit by the change in average house prices.

[4] HERA was passed subsequent to but also superseded by ESA.

[5] FHA loan limits were also governed by HERA during short lapses in continuing resolutions in early 2009 and late 2011 (Mortgagee Letters 2008-36; 2009-07; 2011-29; 2011-39).

[6] Goodman, Seidman and Zhu include territories of the United States in their tabulations while this study is restricted to states and the District of Columbia.

[7] Applications are limited to those for which the financial institution made a credit decision, including loan originations, denied applications and applications approved but not accepted, but not including applications withdrawn by the applicant and applications closed for incompleteness.

purchase of owner-occupied, site-built, one-to-four unit properties. Up-front mortgage insurance premiums are assumed to be financed into all FHA-insured loans[8]; consequently, loan amounts for FHA originations are discounted by the prevailing insurance premium in order to identify the estimated base loan amount.

Table 1 shows that the changes in loan limits mandated by ESA affected the distribution of FHA endorsements. The share of FHA-insured loan originations with loan amounts above the pre-ESA limit increased from 2.9 percent in 2007 to 10.8 percent in 2008 and the corresponding number of originations increased from 7,300 to 79,400 (Table 1A). The expiration of ESA caused the share of FHA loans above the 2014 loan limits to fall from 4.0 percent to 2.5 percent and the number to fall from 25,200 to 13,500 (Table 1B). Table 1 also shows the share of conventional loans above the 2007 FHA loan limits *increased* slightly from 29.1 percent in 2007 to 31.6 percent in 2008; however, the number of originations fell drastically from 848,900 to 491,200. When the ESA loan limits expired, the share of conventional loans above the 2014 FHA loan limits remained relatively constant at roughly 19 percent.

Loans affected by the policy change are those with loan amounts between loan limit standards. For example, the FHA single-family loan limit in Los Angeles County increased from $362,790 in 2007 to $729,750 in 2008, and then fell to $625,500 in 2014. Loan originations after 2007 with balances less than $362,790 were not affected by the loan limit increase in ESA. Similarly, "jumbo" loans with balances greater $729,750 were never eligible for FHA insurance. However, loans with balances above the pre-ESA loan limit and less than or equal to the ESA loan limit (i.e., between $362,790 and $729,750) were affected by the increase. And loans with balances less than or equal to the ESA loan limits but above the HERA limits (i.e., between $625,500 and $729,750) were affected by the decrease. Figure 2 shows the total number and share of loans in this "intra-limit range" for the implementation (Figure 2A) and expiration of ESA loan limits (Figure 2B).

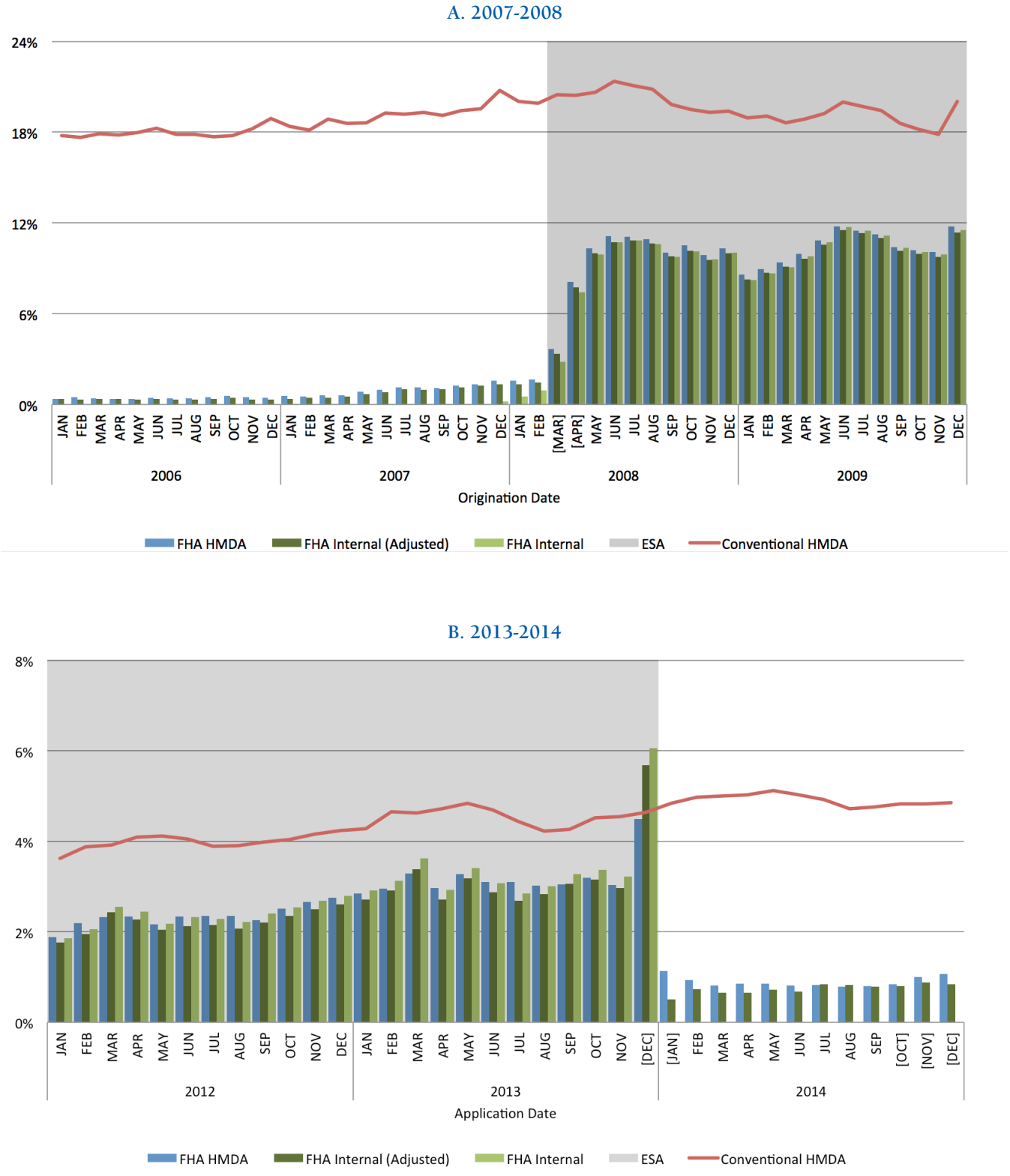
Table 1. Loan Applications and Originations Above FHA Loan Limits (Thousands)

			ESA						HERA
	2006	2007	2008	2009	2010	2011	2012	2013	2014
A. Over 2007 Loan Limits									
Applications	1,502	1,274	832	618	601	566	708	947	1,000
Percent	26%	28%	25%	21%	22%	22%	25%	29%	30%
Originations	1,071	882	608	489	489	461	592	793	853
Percent	25%	27%	24%	21%	23%	23%	26%	30%	31%
Conventional	1,044	849	491	321	321	321	430	603	658
Percent	27%	29%	32%	30%	32%	32%	35%	37%	38%
FHA	3	7	79	119	118	85	91	95	82
Percent	1%	3%	11%	12%	13%	12%	13%	15%	14%
B. Over 2014 Loan Limits									
Applications	774	638	384	261	259	252	313	443	484
Percent	13%	14%	11%	9%	10%	10%	11%	14%	15%
Originations	539	428	271	197	205	200	257	365	405
Percent	13%	13%	11%	8%	10%	10%	11%	14%	15%
Conventional	531	418	237	154	160	163	211	303	343
Percent	14%	14%	15%	14%	16%	16%	17%	19%	20%
FHA	0	1	21	27	28	18	21	25	16
Percent	0%	1%	3%	3%	3%	3%	3%	4%	3%

[8] The upfront mortgage insurance premium was 1.5 percent prior to July 2008. Between July 14 and October 1, the rate varied by loan-to-value ratio and credit score. These risk factors are not reported in HMDA, but the average upfront insurance premium remained roughly 1.5 percent according to internal FHA data. The premium increased to 1.75 percent in October.

In April 2010, the premium was rose to 2.25 percent then fell to 1 percent a few months later. The upfront premium was reset to 1.75 percent on April 9, 2012, which was the rate through 2013 and 2014.

Figure 2. Share of Loan Originations in Intra-Limit Range



[]=Month excluded from analysis

There are two reasons why the FHA-insured origination volume in the intra-limit range before or after ESA is not zero. First, HMDA data does not distinguish single-family homes from properties with two- to four-units, which have a higher FHA loan limit. Second, HMDA data rounds loan amounts to the nearest thousand dollars. According to internal FHA data, the intra-limit range share of FHA endorsements of single-family properties is approximately zero in years when ESA was not in effect. Adjusting by rounding the loan amount and including two-to-four unit properties closely resembles the volumes found in the HMDA data.

Following how FHA adopted changes in loan limits, the effect of the implementation of ESA loan limits is modeled using the origination date while the effect of their expiration is modeled using the application date (Mortgagee Letters 2008-06; 2013-43). Specifically, the analysis of the enactment of ESA loan limits uses loans with a date of origination between January 2006 and December 2009. The analysis of the expiration of ESA limits uses loans with a date of application between January 2012 and September 2014. The last three months of 2014 are excluded because applications late in the year may not be acted on and therefore reported until the following calendar year and the HMDA data for 2015 has not been released. For example, over 60 percent of loan applications submitted between October and December in 2013 were not acted upon and therefore disclosed until 2014.

In addition, the month that loan limit changes were announced is excluded from the analysis. There is evidence that some borrowers, for example, rushed to apply for FHA mortgage insurance in December 2013 before the expiration of the ESA loan limits (see Figure 3B).The spike in applications shows that the decline in FHA loan limits was unexpected after several years of continuing resolutions that preserved the ESA formula. In addition, pulling demand forward may depress applications in the following month, which is therefore also excluded. These patterns bolster the argument that the changes in loan limits represent a discontinuity in policy necessary for the natural experiment research design, but short-term sorting around the effective date of the new loan limits obscures the long-term trend. Removing the transition period results in a more conservative estimate of the effect of the change in loan limits.

We use a research design in which monthly mortgage originations with loan amounts in the intra-limit range are compared before and after ESA loan limits were effective, controlling for applications, the loan origination rate outside the intra-limit range, and a general time trend. The total number of mortgage originations with loan amounts in the intra-limit range in time t is modeled as

$$ORIG_t = \alpha + \beta_1 APP_t + \beta_2\left(\widetilde{ORIG}_t / \widetilde{APP}_t\right) + \gamma_1 Time_t + \gamma_2 Month_t + \delta ESA_t + \varepsilon_t$$

where

$\boldsymbol{APP_t}$ is the number in hundreds of mortgage applications with loan amounts in the intra-limit range,

$\widetilde{\boldsymbol{ORIG_t}}$ is the number of mortgage originations with loan amounts in the exo-limit range (i.e., outside the intra-limit range),

$\widetilde{\boldsymbol{APP_t}}$ is the number in hundreds of mortgage applications with loan amounts in the exo-limit range,

$\boldsymbol{Time_t}$ is a linear time trend centered on the month that ESA loan limits went into effect or expired (e.g., 3/5/2008=-1, 3/6/2008=0, 3/7/2008=1, etc.),

$\boldsymbol{Month_t}$ is a series of binary variables indicating month of application/origination, and

$\boldsymbol{ESA_t}$ is a binary indicator of whether the ESA loan limit formula was in effect

The coefficient of interest (δ) measures the effect of the temporary ESA loan limits. Including the number of applications accounts for changes in demand for loan amounts in the intra-limit range over time. The origination rate in the exo-limit range controls for general changes in the supply of mortgage credit. Monthly fixed effects account for seasonality and the trend for secular changes in the market.

After estimating the effect on the overall mortgage market, the specific impacts on FHA-insured and conventional mortgage originations are also estimated using a seemingly unrelated regression (SUR) model[9], which allows errors to be correlated across equations. The system of equations can be represented as

$$FHA_t = \alpha + \beta_1^F APP_t + \beta_2^F\left(\widetilde{FHA}_t / \widetilde{APP}_t\right) + \gamma_1^F Time_t + \gamma_2^F Month_t + \delta^F ESA_t + \varepsilon_t^F$$

$$CONV_t = \alpha + \beta_1^C APP_t + \beta_2^C\left(\widetilde{CONV}_t / \widetilde{APP}_t\right) + \gamma_1^C Time_t + \gamma_2^C Month_t + \delta^C ESA_t + \varepsilon_t^C$$

[9] A Breusch-Pagan test presented in the findings confirms that residuals across the two models are not independent. Unfortunately, the *sureg* command in Stata currently does not allow for correlation in error terms both across and within models, such as correlation within a county across loan amount ranges. However, the results are robust to alternative specifications of the error terms, including fixed effects models and ordinary least squares clustered by county.

where we assume

$$E\left[\varepsilon_{t_1}^{F}\varepsilon_{t_2}^{F} \mid X\right] = 0$$

but allow

$$E\left[\varepsilon_{t_1}^{F}\varepsilon_{t_2}^{C} \mid X\right] = \sigma^{FC}$$

A second SUR model is estimated in which FHA-insured loan originations are included as an explanatory variable of conventional loan originations. Including FHA_t in the model of $CONV_t$ should moderate the estimated impact of ESA_t because it is not the change in FHA loan limits that affects conventional originations but the change in FHA endorsements directly.

Findings

Table 2 presents the results of estimating the impact of the enactment of higher loan limits under ESA. The first column shows the estimated effect on the overall number of mortgage originations with loan amounts in the intra-limit range. Overall, the model is statistically significant. Further, Breusch-Godfrey and Durbin[10] tests did not find evidence of autocorrelation in the error terms.

The volume of originations is affected by the demand for mortgage credit: there are roughly 72 additional mortgages made in this loan range for every 100 applications, all else equal. However, it should be noted that the number of applications was falling precipitously over this period, contributing to a decline in new mortgages. Originations in the intra-limit range are also affected by broader trends in the supply of mortgage credit: a 10 percentage point increase in the exo-limit range origination rate (originations per hundred applications with loan amounts outside the intra-limit range) leads to 82 additional loan originations in the intra-limit range. In addition to these factors, there is also a time trend indicating nearly 100 fewer loan originations in the intra-limit range per month. Most importantly, the ESA indicator shows that the increase in loan limits that went into effect at the beginning of March 2008 increased the number of loan originations newly eligible for FHA insurance by 1,698 per month. All of these variables are statistically significant at the 1 percent level.

The second column of Table 2 shows the results of the first SUR model that includes estimates of both FHA and conventional loan originations. Both models are statistically significant and the Breusch-Pagan test confirms a statistically significant negative correlation in the error terms across models. In the model of FHA originations, the exo-limit range origination rate is statistically significant at the 1 percent level, although the effect is more modest than in the model of all originations, as expected. The estimated effect of ESA loan limits is negative, contrary to expectation, but not statistically significant.

In the model of conventional loan originations, both the intra-limit applications and exo-limit range origination rate are

Table 2. Estimated Impact of Enactment of ESA Loan Limits

	(1)		(2)				(3)	
	All		FHA		Conventional		Conventional	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Applications (00s)	71.66***	1.99	4.01	3.23	71.75***	4.17	75.95***	3.25
Exo-Limit Origination Rate (%)	823.79***	65.11	435.41***	45.43	269.23***	60.49	-1.22	66.68
Linear Time Trend	-99.87***	28.57	-53.70	43.92	12.01	55.48	-21.24	42.64
ESA Loan Limits	1697.10***	482.20	-459.65	933.49	1019.59	1189.89	518.07	933.38
FHA Originations	.		.		.		-0.55***	0.13
Month Fixed Effects	Yes		Yes		Yes		Yes	
N	46		46		46		46	
F	1732.6***		52.7***		591.4***		960.7***	
RMSE	623.8		1288.5		1624.7		1267.3	
Breusch-Pagan χ^2	.		29.54***				2.74*	

Statistically significant at the ***0.01 level **0.05 level *0.10 level.
FHA component of SUR model presented in Column 3 is not shown.

[10] The estimated Durbin-Watson statistic is 1.585.

statistically significant at the 1 percent level, but also smaller than in the model of all originations. The estimated effect of ESA loan limits on conventional originations is positive, also contrary to expectation, but again not statistically significant. When the number of FHA originations in the intra-limit range is included in the SUR model, the estimated effect of ESA loan limits on conventional originations declines but remains not statistically significant. On the other hand, the estimated direct effect of FHA originations is statistically significant at the 1 percent level and indicates 55 fewer conventional loan originations for every 100 additional FHA loans. Including FHA originations also reduces the degree of correlation in error terms across models.

Table 3 presents the results of estimating the impact of the expiration of the higher loan limits. The first column shows the estimated effect on the overall number of mortgage originations with loan amounts in the intra-limit range. The model is statistically significant without evidence of autocorrelation in the error terms.[11] The volume of originations is again responsive to the demand for mortgage credit, with 87 additional mortgages for every 100 applications, and reflects general trends in the supply of mortgage credit, with a 10 percentage point increase in the exo-limit range origination rate associated with 17 additional originations in the intra-limit range. A negative time trend persists, indicating 12 fewer loan originations per month. The estimated effect of the ESA loan limits is negative, meaning loan originations in the intra-limit range *increased* after the expiration of the higher loan limits, but the coefficient is not statistically significant.

The second column of Table 3 shows the results of the first SUR model that includes estimates of both FHA and conventional loan originations. Both models are statistically significant and the Breusch-Pagan test confirms a statistically significant correlation in the error terms across models. In the model of FHA originations, the positive effects of intra-limit applications and exo-limit origination rate as well as a negative time trend are all statistically significant at the 1 percent level. Most importantly, the estimated effect of ESA loan limits on FHA originations is also statistically significant at the 1 percent level and indicates 694 additional FHA loans per month under the ESA loan limit formula compared to after its expiration, all else equal.

In the model of conventional loan originations, the effect of intra-limit applications remains statistically significant at the 1 percent level but the exo-limit origination rate is not statistically significant. A *positive* time trend is statistically significant. The estimated effect of ESA loan limits on conventional originations is also statistically significant and indicates 671 *fewer* conventional loan originations per month under the ESA loan limit regime. Note that the magnitude of the positive effect of loan limits under ESA on FHA originations is similar to the magnitude of the negative effect on conventional originations.

Table 3. Estimated Impact of Expiration of ESA Loan Limits

	(1)		(2)				(3)	
	All		FHA		Conventional		Conventional	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Applications (00s)	87.36***	1.84	11.66***	3.26	65.21***	3.26	76.00***	1.52
Exo-Limit Origination Rate (%)	167.02***	34.24	62.90***	17.32	31.21	21.27	-36.61***	11.53
Linear Time Trend	-11.87**	4.45	-39.63***	6.18	38.65***	8.40	10.50**	4.12
ESA Loan Limits	-70.81	48.26	693.42***	78.93	-671.05***	83.51	-19.79	63.05
FHA Originations	.		.		.		-0.91***	0.07
Month Fixed Effects	Yes		Yes		Yes		Yes	
N	31		31		31		31	
F	3679.0***		76.8***		905.2***		5605.4***	
RMSE	47.5		121.3		121.7		48.9	
Breusch-Pagan χ^2	.		26.32***				0.03	

Statistically significant at the ***0.01 level **0.05 level *0.10 level.
FHA component of SUR model presented in Column 3 is not shown.

[11] The estimated Durbin-Watson statistic is 2.01

In fact, the third column confirms the substitution effect. Including the number of intra-limit range FHA originations sharply reduces the estimated effect of ESA loan limits, which is also no longer statistically significant. Meanwhile, the estimated direct effect of FHA originations is statistically significant at the 1 percent level and indicates 9 fewer conventional originations for every 10 additional FHA originations. In fact, the 95 percent confidence interval includes 1, indicating a possible one-for-one substitution cannot be rejected. Including FHA originations also eliminates the statistically significant correlation between models of FHA and conventional originations.

Conclusion

The housing crisis created a vicious cycle in which falling house prices led to financial distress in the conventional mortgage market, which restricted mortgage lending, further exacerbating the declines in house prices. The government guarantee provided through FHA mortgage insurance helped stabilize the mortgage market. Although most of the increase in FHA's market share occurred below the pre-ESA loan limits, the increase in the maximum loan amount eligible for FHA insurance was in keeping with FHA's counter-cyclical role. FHA was able to help increase loan originations without substantially displacing conventional lending. We find that the introduction of higher loan limits under ESA increased the overall number of loan originations newly eligible for FHA financing by nearly 1,700 per month. The direct effect on the specific number of FHA and conventional loan originations is less clear, although every two FHA endorsements appears to have displaced roughly one conventional loan in 2008 and 2009. According to Moody's Analytics, homes sales would have fallen an additional 2.4 million and prices depressed by nearly another 20 percent if FHA had stopped insuring loans in October 2010. "Arguably the most important policy response to the housing crash has been the dramatic expansion of Federal Housing Administration lending" (Zandi and deRitis 2010).

The conventional market had sufficiently recovered by 2014 such that FHA could lower loan limits without harming the overall mortgage market. Conventional lending replaced FHA-insured lending in that market segment nearly one-for-one and the overall volume of affected loan originations did not change significantly.

However, caution is still warranted for calling for faster or greater retrenchment. First, reducing FHA business before it had a chance to recapitalize would create an inter-temporal form of adverse selection, wherein FHA is most concentrated in the worst performing years of the housing cycle. The Office of Management and Budget projects that forward loans endorsed between fiscal years 2007 and 2009 will ultimately cost FHA nearly $23 billion (OMB 2016). From 2009 until 2015, FHA's capital ratio[12] was below the two percent required by the National Affordable Housing Act of 1990. More recent books of business are needed to replenish FHA's capital reserves and in order to weather the next crisis.

Second, the findings are based on a relatively small, unusual segment of FHA's portfolio. The estimated local area treatment effects may not be completely generalizable to lower loan amounts that constitute the bulk of FHA endorsements. Moreover, it is difficult to disentangle the impact of change in FHA loan limits from concurrent changes in the loan limits for Fannie Mae and Freddie Mac as well as the overall turbulence in the mortgage market over this period.

Relative pricing also affects the level of substitution. FHA insurance is typically more expensive than conventional mortgage credit offered to qualified consumers. And FHA premiums have been raised multiple times, with the annual premium rising from 0.55 percent in early 2010 to up to 1.35 percent by mid-2013 (see Mortgagee Letters 2008-22; 2010-02; 2010-28; 2011-10; 2012-04; 2013-04). However, the degree of substitution in 2014 suggests that the cost of FHA insurance to consumers was still lower than offered in the conventional market. Otherwise, borrowers would have already shifted towards conventional mortgage credit prior to the expiration of FHA loan limits. Indeed, Moody's Analytics finds that FHA was less expensive at the start of 2015 than conventional loans financed through the government-sponsored enterprises for borrowers with credit scores under 680 and a downpayment of five percent or less (Zandi and deRitis 2015).

Prematurely forcing FHA out of parts of the market by lowering loan limits may harm homebuyers and homeowners by restricting mortgage credit as well as taxpayers by interrupting the process of rebuilding reserves sufficient to withstand the next housing crisis. On the other hand, a recovering conventional mortgage lending industry shows evidence of supporting an increasing share of the market as FHA scales down from the counter-cyclical position it assumed at the height of the housing crisis.

[12] FHA's capital ratio is defined as the economic value as a share of insurance in-force.

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