

# Liquidity Crises in the Mortgage Market

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### Online Appendices

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## A Data

### A.1 Survey of Consumer Finances

The Survey of Consumer Finances (SCF) is a comprehensive survey of household income, wealth, and financial decision-making conducted every three years by the Federal Reserve Board. The most recent survey was conducted in 2016 and contains data from interviews with 6,254 households. The survey design allows us to identify households with mortgages insured by FHA or VA (and thus probably securitized in Ginnie Mae pools) as well as households with mortgages held by non-bank institutions. Three sets of questions are particularly salient:

1. Households with mortgages are asked for the name of the institution that the loan is “with.” The survey answers indicate that households respond to the question by supplying the name of the current loan servicer. Respondents are also asked to identify the type of this institution, and are prompted with the suggestions “a commercial bank, savings and loan or savings bank, a credit union, a mortgage company, a finance or loan company, or something else?” We categorize a lender as a non-bank if the respondent identifies the lender as an institution other than a bank or credit union.
2. Respondents are asked if their mortgage was originated by a different lender than the institution that currently holds it. If so, they are asked for the name and lender-type of the originating institution.
3. Households with mortgages are asked “Is it an FHA mortgage, a VA mortgage, or is it from some other program?” We use the households’ replies to code FHA and VA mortgages.

The tabulations shown in this paper are estimated on the internal version of the data, which allows for slightly more precise identification of FHA and VA loans. In the public version of the data, VA loans are combined with a handful of mentions of other types of guarantee programs, such as “first-time buyer program” or “other federal loan program.”

One potential issue with the SCF is that some borrowers may misreport their type of mortgage or type of lender. For example, in earlier waves of the survey, before the instructions

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were clarified in the 2007 SCF, some households appeared to report mortgages that were guaranteed by Fannie Mae or Freddie Mac as FHA mortgages.<sup>6</sup>

More information on the Survey of Consumer Finances is available at <https://www.federalreserve.gov/econres/scfindex.htm>.

## A.2 Home Mortgage Disclosure Act

The Home Mortgage Disclosure Act (HMDA) was enacted by Congress in 1975 and is implemented by the Consumer Financial Protection Bureau Regulation C. The regulation covers both depository and nondepository lending institutions that (i) do business within metropolitan statistical areas and (ii) exceed minimum thresholds for assets or mortgage lending volume.<sup>7</sup> Under HMDA, lenders are required to disclose to the public detailed information about their home-lending activity each year including the disposition of each application for mortgage credit; the type, purpose, and characteristics of each home mortgage that lenders originate or purchase during the calendar year; the census-tract designations of the properties related to those loans; loan pricing information; personal demographic and other information about loan applicants, including their race or ethnicity and income; and information about loan sales.

The analysis in this paper uses a restricted version of the HMDA data that includes the origination date for each mortgage. Using this additional information, we restrict our calculation of statistics on loan sales to loans originated during the first three quarters of the year. This is because loan sales are recorded in the HMDA data only if the loans are originated and sold in the same calendar year, so loans originated toward the end of the year are less likely to be reported as sold (Bhutta, Laufer, and Ringo, 2017).

## A.3 Mortgage Bankers Association Performance Report

Independent mortgage companies that are approved to do business with Fannie Mae, Freddie Mac, and Ginnie Mae, either as a seller or a servicer, are required to submit the Mortgage Bankers Financial Reporting Form (MBFRF), available at [https://www.fanniemae.com/content/guide\\_form/form-1002-mortgage-bankers-financial-reporting-form](https://www.fanniemae.com/content/guide_form/form-1002-mortgage-bankers-financial-reporting-form), 30 days after the end of each quarter (60 days for the year-end report). The MBFRF contains comprehensive information on companies' income, balance sheets, and exposures. Companies have the option to release their data to the Mortgage Bankers Association for inclusion in aggregate statistics that are reported in the Mortgage Bankers Association Performance Report.

Larger independent mortgage companies make up a disproportionate share of the companies represented in the MBA statistics. Smaller companies typically find it more efficient to sell their originations to larger companies than to become Fannie, Freddie, or Ginnie counterparties themselves. To illustrate this point, Table 1 compares statistics on the distribution of the number of loan originations among companies reporting in the MBA data and

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<sup>6</sup>Bucks and Pence (2008) and Lam and Kaul (2003) note that in 2001 and 1995 SCF waves, respectively, the FHA share of mortgages appears higher than in comparable benchmarks.

<sup>7</sup>See <https://www.fdic.gov/regulations/compliance/manual/5/v-9.1.pdf> for additional details on the criteria that determine which financial institutions are covered by HMDA.

among the more representative set of non-bank mortgage lenders reporting under HMDA. As can be computed from the statistics in the table, companies with more than \$200M in loan originations in 2016 make up 89% of companies reporting in the MBA data, compared with just 56% of companies reporting under HMDA.

A: MBA					
Total Lender Originations (\$)	<200M	200-400M	400-1,000M	>1,000M	Total
Number of Companies Reporting	23	22	59	108	212
Fraction of All Companies	10.8	10.4	27.8	50.9	100
Total Loans Originated (\$000s)	2,552,758	6,341,959	37,866,146	543,767,214	590,528,077
Fraction of total loans (by dollar volume)	0.4	1.1	6.4	92.1	100
Total Loans Originated (#)	12,474	31,333	159,457	2,264,134	2,467,398
Fraction of total loans (by number)	0.5	1.3	6.5	91.8	100

  

B: HMDA					
Total Lender Originations (\$)	<200M	200-400M	400-1,000M	>1,000M	Total
Number of Companies Reporting	439	147	196	215	997
Fraction of All Companies	44.0	14.7	19.7	21.6	100
Total Loans Originated (\$000s)	33,439,508	42,392,595	122,124,072	1,164,704,235	1,362,655,732
Fraction of total loans (by dollar volume)	2.5	3.1	9.0	85.5	100
Total Loans Originated (#)	150,138	177,576	514,304	4,680,120	5,522,383
Fraction of total loans (by number)	2.7	3.2	9.3	84.8	100

Table 1: Comparison of MBA and HMDA data

## A.4 Y-14 data

U.S. bank holding companies (BHCs) and intermediate holding companies with \$50 billion or more in total consolidated assets are required to file quarterly data on various asset classes, capital components, and categories of pre-provision net revenue. The Federal Reserve uses these data to assess the capital adequacy of large bank holding companies and intermediate holding companies, including in supervisory stress test models. More information on these data is available at <https://www.federalreserve.gov/apps/reportforms/reportdetail.aspx?s0oYJ+5BzDZGWnsSjRJKDwRx0b5Kb1hL>. We use data from two schedules in our paper.

The **Y-14Q H.1 corporate loan data schedule** collects loan-level detail on corporate loans and leases, including the warehouse lines of credit and other loans that BHCs extend to non-bank mortgage companies. Respondents are instructed to report corporate loans and leases that are held for sale or held for investment on the last day of the relevant quarter. Respondents are also instructed to include all corporate loans that are at the consolidated bank holding company level, and not just loans held by the banking subsidiaries. Loans with a committed balance less than \$1 million do not need to be reported.

Loans extended to non-bank mortgage lenders (also called “obligors” in the rest of this text) are not explicitly identified in the data, so we identify these non-bank obligors, as described below, by a combination of their tax ID, name, type of credit facility, and line of business. We begin by generating a list of non-bank mortgage originators from the HMDA data from 2013–2016; non-banks are those with the reporting agency listed as the U.S.

Department of Housing and Urban Development. The HMDA data and the Y-14 data list the tax IDs of the relevant entities, so our first screen is whether the tax ID of an obligor in the Y-14 data matches that of a non-bank lender in HMDA. This screen identifies 418 non-bank obligors in the Y-14 data. However, these tax IDs will not match in all cases because of the corporate structure of the non-bank, so we next conducted a “fuzzy match” between the mortgage lender name in HMDA and the obligor name in the Y-14 data. We use the “matchit” command in STATA, which uses a bigram string matching algorithm. We only keep matches with match scores above 0.8 on a scale of 0 to 1. After the fuzzy match, we manually check whether the resulting matches are reasonable. This step identifies an additional 36 non-banks in the Y-14 data. Finally, we select credit lines in the Y-14 data with “credit facility purpose” equal to “mortgage warehousing.” Some of these lines are probably for commercial mortgages rather than residential mortgages. We eliminate at least some of these commercial-mortgage warehouse facilities by dropping all lines of credit that were originated by a BHC division with a name that includes “commercial.” This screen identifies a final 577 non-bank mortgage companies.

We augment the Y-14 data with data from HMDA, where available, on the number, dollar amount, and type of mortgages that each non-bank originated each quarter. We also obtain information on each non-bank’s Ginnie Mae servicing portfolio by performing a similar fuzzy match between the Y-14 obligor name and the names of Ginnie Mae’s issuers/servicers. This fuzzy match adds information from 156 Ginnie Mae issuers/servicers to our data. The HMDA and Ginnie Mae data give us some rough proxies for the assets, size, and business models of the non-bank lenders.

We also use data from the **Y-14Q Schedule I (MSR valuation schedule)** in the paper. This schedule collects information on the number and dollar value of mortgages serviced by the bank, the value of the associated mortgage servicing rights, the banks’ estimates of changes in the MSR valuations in a variety of stress scenarios, and the banks’ costs incurred in servicing mortgages. Servicing costs are broken out by type of servicing contract (Fannie Mae or Freddie Mac; FHA; VA; non-agency) and the delinquency status of the loan.

## B The economics of vertically disintegrated markets

Existing theories found in the economics literature on transactions costs, contracting, industrial organization, and economic networks provide limited insight into competitive outcomes in vertically disintegrated markets in which agents can act strategically when entering into contractual agreements among themselves; are influenced by the actions of others to whom they are only indirectly connected; and make unobservable quality choices that impact outcomes, locally as well as globally. In his famous essay on the nature of the firm, Coase (1937) describes why and how economic activity divides between firms and markets. He argues that firms exist to reduce the costs of transacting through markets. Building on Coase’s seminal ideas, Williamson won a Nobel prize for his development of the transaction cost theory of integration (see Williamson, 1971, 1975, 1979). A key element of this theory is that market contracts are inherently incomplete and this limitation of explicit contracts may be especially severe when complexity or uncertainty make it difficult to specify contractual safeguards, or when parties cannot walk away without incurring substantial costs. Transaction cost theory

therefore argues that vertical integration can be an effective response when these features are present. A related rationale for integration is that it might mitigate potential holdups by suppliers (see Joskow, 2005; Williamson, 2010).

The property rights theories of vertical integration (see Grossman and Hart, 1986; Hart and Moore, 1990; Hart, 1995) have focused on how integration changes the incentives to make specific investments and find that ownership strengthens a party's bargaining position. However, incentive theories (see Holmström and Milgrom, 1994; Holmström, 1999) have also shown that under certain conditions, asset ownership by the agent (e.g., non-integration) can be complementary to providing high-powered financial incentives.

The related literature in organizational economics has focused more directly on the determination of horizontal market structures due to firm-level costs or strategic interaction among firms (see Stigler, 1951). In addition to the trade-off between efficient horizontal scale and vertical market power, Stigler's theory adds the additional idea that formal market institutions are required to support disintegrated trade. Bresnahan and Levin (2013) also argue that transaction costs for vertically disintegrated markets usually depend on market institutions that facilitate search and matching as well as institutions that facilitate contractual and pricing arrangements. Thus, this literature appears to conclude that vertically disintegrated market structures, particularly in industries with frequent arms-length exchange, require market institutions to set standards for products and contracts, establish mechanisms for matching buyers and sellers, and disseminate supply and demand information to function well.

A more recent literature has focused on the importance of network linkages between intermediaries and financial institutions in explaining systemic risk in financial markets similar to the vertically disintegrated mortgage market (see, for example, Allen and Gale, 2000; Allen, Babus, and Carletti, 2012; Cabrales, Gottardi, and Vega-Redondo, 2017; Glasserman and Young, 2015; Acemoglu, Ozdaglar, and Tahbaz-Salehi, 2015; Elliott, Golub, and Jackson, 2014; Babus, 2016; Di Maggio and Tahbaz-Salehi, 2014). These studies show that financial networks may create resilience against shocks in a market via diversification and insurance, but may also generate contagion and systemic vulnerabilities by allowing shocks to propagate and amplify. Stanton, Walden, and Wallace (2017) develop a theoretical model of a network of intermediaries in the private label mortgage market which gives rise to heterogeneous financial norms and systemic vulnerabilities. They show, in markets of this type, that the optimal behavior of intermediaries regarding their attitude toward risk, the quality of the projects that they undertake, and the intermediaries they choose to interact with, is affected by the behavior of their counterparties. These strategic network effects influence the financial strength and systemic vulnerability of individual intermediaries, as well as aggregate market outcomes. Stanton, Walden, and Wallace (2014) establish empirically that network effects existed in the pre-crisis vertically disintegrated U.S. private-label residential-mortgage market, and Stanton et al. (2017) find that endogenous network effects were important determinants of ex post observable systemic vulnerabilities in that market.

## C Structured Investment Vehicles (SIVs) pre-crisis

SIV/ABCP Conduit Program Name	Holding Company Name	<i>Inside Mortgage</i>		Status
		<i>Finance</i> Rank 2006	Origination 2006 (\$ Billion)	
Mountain Funding Trust	Accredited Home Lenders	36	15.70	CH 11 2008
Broadhollow Funding, LLC	American Home Mortgage	13	58.90	CH 11 2007
Main Street Warehouse Funding Trust	Ameriquest Mortgage	16	27.80	Closed 2008
Bishop's Gate Residential Mortgage Trust	Cendant Mortgage*	18	41.26	Sold 2005
Park Granada, LLC	Countrywide	1	462.50	Sold 2008
Park Sienna, LLC	Countrywide	1		
Harwood Street Funding I, LLC	CTX Mortgage	34	13.47	Closed 2008
Harwood Street Funding II, LLC	CTX Mortgage	34		
KKR Atlantic Funding Trust	Deutsche Bank Trust Company Americas**	25	29.00	CH 11 2009
Funding, LLC (Series A)	EMC Mortgage	11	72.43	Closed 2009
Master Funding, LLC (Series B)	EMC Mortgage	11		
MINT I, LLC	GMAC Mortgage	8	74.60	CH 11 2012
Witmer Funding, LLC	GMAC Mortgage	8		
North Lake Capital Funding	Indy Mac	7	89.95	Sold 2007
Luminent Star Funding Statutory Trust I	LaSalle Bank***	18	38.31	Sold 2007
Wind Master Trust	Lehman Brothers****	38	14.00	CH 11 2008
Wind Master Trust	Lehman Brothers*****	20	34.30	Sold 2009
Strand Capital, LLC	Long Beach Mortgage*****	4	195.70	Sold WAMU
Auburn Funding, LLC	Nationstar Mortgage	NA	3.74	Sold 2006
Von Karman Funding Corp., LLC	New Century Financial	12	59.8	CH 11 2007
St. Andrew Funding Trust	New Century Financial	12		
MINT II, LLC	Residential Capital	9	96.75	CH 11 2012
Three Pillars Funding LLC	Suntrust	15	56.45	Going Concern
Ocala Funding, LLC	Taylor Bean Whitaker Mort.	30	24.80	CH 11 2011
Thornburg Mortgage Capital Resources, LLC	Thornburg Mortgage		.29	CH 11 2009
Total lenders with SIVs (\$ Billion)			1,409.46	
Total U.S. origination (\$ Billion)			2,980.00	
SIV lenders as percentage of total			47.30%	

\*PHH Mortgage; \*\*MortgageIT; \*\*\*ABN AMRO; \*\*\*\*BNC Mortgage; \*\*\*\*\*Aurora Loan Services; \*\*\*\*\*WAMU

Table 2: Columns one and two reports the pre-crisis universe of off-balance Structured Investment Vehicles (SIVs) that were used to fund mortgage originations by their parent holding company and were funded by Extendable Asset Backed Commercial Paper issued by their parent holding company. Columns three and four reports the 2006 values for the overall market ranking of the parent and the parent's total mortgage origination in billions of dollars. Finally, column five provides information on the status of the parent company as of 2017. Sources: Mortgage origination data were obtained from *Inside Mortgage Finance* and HMDA. SIV data were obtained from quarterly SIV statements reported to Moody's Investor Services. The status of the parent was obtained from various regulatory and corporate filings.

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