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Housing Busts and Household Mobility: An Update

- The relationship between household mobility and financial frictions, especially those associated with negative home equity, has attracted greater attention following the recent volatility in the U.S. housing markets.
- The decline in mortgage rates, along with policy interventions to encourage historically low-rate refinancing, likewise recommend a closer look at mortgage interest rate lock-in effects, which are apt to become important once Federal Reserve interest rate policy normalizes.
- This article updates estimates in a 2010 study by the authors of the impact of three financial frictions—negative equity, mortgage interest rate lock-in, and property tax lock-in—on household mobility. The addition of 2009 American Housing Survey data to their sample allows the authors to incorporate the effect of more recent house price declines.
- The new study's findings corroborate the 2010 results: Negative home equity reduces household mobility by 30 percent, and $1,000 of additional mortgage or property tax costs lowers it by 10 to 16 percent.

1. Introduction

A long literature on housing economics has noted that a rise in mortgage rates could "lock-in" an owner to his or her current house, thereby slowing or preventing a permanent move to a new residence if mortgage interest rates rise sufficiently to make the new debt service payment unaffordable (see, for example, Quigley [1987, 2002]). Other financial frictions—such as the one arising from California's Proposition 13 property tax rules, which essentially imply an often large increase in property taxes after a move—would have similar effects on household mobility (Ferreira 2010). Negative equity, by which we mean the current value of the house is less than the outstanding mortgage balance, could also reduce mobility if the owner lacks sufficient liquidity to pay off the full loan balance, which is required for a permanent move and sale of the property if the borrower is to avoid the cost of a default (Stein 1995; Chan 2001; Engelhardt 2003).

These three potential financial frictions are all associated with the sale of the house, so there is a transfer of economic ownership, not just a change of residence. Thus, the type of household mobility that may be impacted by these frictions involves permanent moves in which both physical location and economic ownership change for the previous owner. The housing literature on financial frictions does not have clear implications for temporary moves in which the owner leaves the house for a period of time—perhaps to rent it out—and

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returns at a later date. Overall, mobility reflects permanent and temporary moves, but the appropriate mobility measure depends on the question being addressed. Given our focus on the impact of financial frictions on homeownership transitions, our preferred measure in the analytics reported below reflects only permanent moves as best as possible.

Interest in the relationship between homeowner mobility and financial frictions, especially frictions associated with negative home equity, was piqued for researchers and policymakers by the recent extraordinary boom and bust in U.S. housing markets. With house prices falling 30 percent nationally, the prevalence of negative equity greatly expanded across many markets. More recently, the sharp fall in mortgage interest rates and the various policy interventions to encourage refinancing at historically low rates suggest that we also need to update our knowledge of the impact of mortgage interest rate lock-in effects, as they seem likely to become important after Federal Reserve interest rate policy normalizes.

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Because the studies cited above were dated or based on samples from specific geographic regions or population subgroups, our first paper (Ferreira, Gyourko, and Tracy 2010) used the U.S. Census Bureau's American Housing Survey (AHS) panel from 1985-2007 to provide new and more general estimates for the nation that include all three forms of financial frictions in the same econometric specification. Our paper's three primary results were: 1) owners with negative equity were one-third less likely to move than otherwise observationally equivalent owners without negative equity; 2) for every additional $1,000 in mortgage debt service costs, mobility was about 12 percent lower; and 3) similar increases in property tax costs from Proposition 13 in California also reduced mobility by about 12 percent.

This article updates our previous work in two important ways. It adds data from the most recent AHS for 2009, providing the first evidence from the beginning of the bust in home prices in many markets. It also addresses Schulhofer-Wohl's (2011) criticism of our sample selection procedures used in Ferreira, Gyourko, and Tracy (2010). We demonstrate that those selection procedures are appropriate for studying the effect of negative equity (and the other financial frictions noted) on permanent moves. This update also documents that our previous findings are robust to the inclusion of new data and new measures of permanent mobility, which we discuss more fully below.

Our research is related to an emerging, and potentially very important, literature on labor economics investigating whether reduced mobility among homeowners is impairing adjustment in the labor market that might prevent the unemployment rate from falling as much as it would otherwise (see, for example, Aaronson and Davis [2011], Bricker and Bucks [2011], Donovan and Schnure [2011], Modestino and Dennet [2012], Molloy, Smith, and Woznak [2011], and Valletta [2010]). Because we focus solely on how mobility impacts homeowners, our results do not directly address potential spillovers into the labor market. However, our finding of a large impact of negative equity on owner mobility is consistent with the preliminary conclusion of the labor literature: There are little or no significant impacts on the unemployment rate. As we discuss, most moves are within a labor market area, so there can be a significant decline in such moves with no effect on access to job opportunities in that area.

Much work is needed to more fully understand the linkages between housing and labor markets on this issue. For example, the likelihood that labor markets deteriorate along with housing markets raises the possibility that owners with negative equity are not moving in part because good job opportunities do not exist. Distinguishing between these two potential causes of reduced mobility requires expanding one's theoretical and empirical horizons to better control for labor market conditions, and that is the direction in which we urge future research on this topic to turn.

Finally, reduced homeowner mobility due to financial frictions has economic and social effects beyond its possible ramifications for labor markets. For example, locked-in owners are more likely to be mismatched relative to their desired housing units and local public service bundle (such as school systems and the like). The utility loss just from this mismatch could be significant. Whether owners with negative equity even act like true owners and provide the positive social externalities alleged for homeownership is unknown. Economically, these owner-occupants are "renters." Moreover, immobility associated with any type of friction could alter the nature of any housing recovery by shrinking the potential trade-up market. All of these issues require further study, because the evidence suggests that negative equity in particular is associated with much lower mobility, and we suspect that mortgage interest

rate lock-in will become more important in a future recovery. The starting point for that conclusion is a set of robust estimates of mobility effects attributable to financial frictions. It is to that analysis that we now turn.

2. Financial Frictions and Homeowner Mobility: A Brief Review

High transaction costs of buying and selling a home provide an incentive for people to extend their stay in the house in order to amortize these costs over a longer holding period. Additional financial frictions can arise that exacerbate this effect. For example, Quigley (1987) examines the financial friction from fixed-rate mortgages in an environment of rising mortgage rates. Ferreira (2010) and Wasi and White (2005) study the impact of financial frictions arising from restrictions on the rate of property tax increases in California under Proposition 13. A third financial friction is created when house prices decline sufficiently to push borrowers into negative equity. Chan (2001) and Engelhardt (2003) study the impact of negative equity on household mobility.

In Ferreira, Gyourko, and Tracy (2010), we estimate the impact of all three of these financial frictions on household mobility using a consistent empirical methodology and data

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that span the 1985-2007 period. It is important to keep in mind that each of these frictions applies to the sale of the house, not just to whether the owner continues to live there. Hence, we were interested in how these financial frictions impact permanent moves that require the house to be sold.

The AHS data are well suited to address this issue. The data follow a panel of residences through time rather than a panel of households. They contain information sufficient for measuring each of the three financial frictions as well as other determinants of mobility. A limitation of these data, however, is that when an owner sells a house and relocates, we do not know where he or she moves to or the primary motive for the move.

Recall that Ferreira, Gyourko, and Tracy (2010) estimate large impacts of financial frictions on the permanent mobility of homeowners using the AHS panel. Subsequently, Schulhofer-Wohl (2011) uses our data and estimation code, but expands the definition of a move beyond clearly permanent ones to include any change in residence between adjacent American Housing Surveys. Schulhofer-Wohl is correct in observing that we underreported overall mobility by censoring these transitions. However, that decision was made by design in order to distinguish between permanent and temporary moves, as the underlying theory from earlier research implies that it is only with respect to permanent moves that these potential financial frictions should lead to lower mobility. A temporary move reflects a situation in which an owner-occupied residence is reported as vacant or rented for one or more surveys, with the original owner subsequently returning to the residence. These moves can occur because a homeowner in fact vacates his or her home temporarily or because vacancy status is misreported in the AHS data. Economic ownership does not change in such cases, so the costs associated with the frictions have not yet been incurred.

Nevertheless, Schulhofer-Wohl's (2011) critique led us to develop an improved measure that better exploits the panel structure of the AHS to distinguish between the two types of moves. This raises our reported mobility rates substantially, by more than 25 percent, but it does not materially affect our findings, as reported in Section 3. We do not adopt Schulhofer-Wohl's strategy of counting all transitions from ownership to rental or vacancy status as permanent moves because it dramatically overstates their number. His finding of a zero or a slight positive correlation between homeowner mobility and negative equity is likely due largely to conflating temporary and permanent moves.[1] We show below that over the 1985-99 period in the AHS data, more than 20 percent of Schulhofer-Wohl's moves are temporary in nature, which makes his measure problematic for use in research on lock-in effects. These temporary moves correspond to approximately 50 percent of the additional moves that Schulhofer-Wohl tallied in excess of our new, preferred mobility measure. There is still uncertainty about the economic ownership of the property for the other 50 percent of additional moves.

[1] Schulhofer-Wohl used data and codes from our 2010 study to generate his mobility measure, and he compared his results with our baseline measure of mobility. He then provided his underlying code, just as we did for him. Our discussion of his mobility measure always applies to the first of four such variables from his 2011 paper.

Schulhofer-Wohl's measure of mobility also can be dynamically inconsistent, with moves in one period recoded at a later date as nonmoves as additional waves of AHS data are included in the estimation sample. These issues are especially worrisome if one is trying to understand the impact of the recent housing bust on household mobility, because the errors from conflating temporary and permanent moves are concentrated near the end of the data, and the AHS does not yet have enough post-crisis surveys to allow researchers to distinguish between these types of moves.[2]

While this update highlights how noisy the data from American Housing Surveys are, we know of no superior source to use to investigate this issue. Given that it takes time to resolve uncertainty about whether some transitions are permanent or temporary in nature, there is no variable that perfectly reflects the mobility relevant to analysis of the impact of financial frictions. That includes our improved measure reported in this article. It still understates true mobility rates to the extent that any of the moves that we censor due to uncertainty about whether a change in economic ownership of the property occurred actually reflects permanent moves. Precisely where to draw the line on this measurement issue requires careful consideration of the costs and benefits of overstating versus understating the number of permanent moves. We continue to advocate for a conservative coding strategy that is dynamically consistent over time, but this clearly is not costless. The next sections detail why we came to that conclusion.

3. Additional Data and New Measures of Mobility

3.1 Changes in the Data and Summary Statistics

There are four changes to the data used in this update of Ferreira, Gyourko, and Tracy (2010). The first is the addition of the 2009 AHS sample, which became available after we had published our previous study. The 2009 AHS data allow researchers to begin to examine the impact of the house price declines between 2005 and 2007 on household mobility from 2007 to 2009. This is straightforward, and we present and compare results with and without the new data. It does not result in any meaningful changes in our findings.[3]

The second change involves the use of First American-Core Logic (FACL) repeat-sales house price indexes in lieu of the Federal Housing Finance Administration (FHFA) series when we create instruments to address measurement error in the creation of negative equity variables. Unlike the FHFA series, which are based only on conforming loans, the FACL series include arm's-length purchases made with conforming and nonconforming loans, including subprime, Alt-A, and jumbo mortgages. We believe this provides a more complete picture of what was occurring in terms of local house prices, especially in recent years, but this change also has no material impact on the results.[4]

The third change involves additional cleaning of the panel structure of the AHS data. The American Housing Survey was designed to be used primarily as a series of cross-sections rather than as a panel. For this reason, a variable that we employ to define the panel structure—the purchase year of the house—was not dependent coded.[5] By that, we mean that the interviewer does not have access to the responses for this variable from prior surveys, so there is no way at the time of the interview to ensure consistent coding across surveys. As a result, the purchase year can vary in the data even for the same household. If left uncorrected, this spurious variation in the reported purchase year will induce false household transitions. Ferreira, Gyourko, and Tracy (2010) developed several rules that were used to identify and clean these false household transitions in the data. For this update, we also include hard-coded edits to the purchase year based on an inspection of the data history for each residence, including information on the household head's demographic characteristics. This additional cleaning of the panel structure significantly improves on our earlier rule-based edits.[6]

The fourth and most important change involves the use of an improved measure of mobility, which is the dependent variable in our analysis. This alteration was motivated by Schulhofer-Wohl's (2011) critique of our sample selection procedures. In Ferreira, Gyourko, and Tracy (2010), we deliberately chose a conservative definition of what constituted a move for the reason noted above—namely, theory suggests that financial frictions involving the likes of negative equity or mortgage lock-in should impact mobility for permanent

[2] The distinction between permanent and temporary moves will also be a data issue for researchers using household panel data sets, such as the Panel Survey on Income Dynamics. Exact property address information will be required to reliably distinguish between these two types of moves.

[3] We caution below that this does not necessarily signal that the estimated relationship between mobility and negative equity during this housing market downturn will not change as additional AHS data become available. See the discussion below for more on this topic.

[4] The FACL data used here include the impact of distressed transactions. We have experimented with a series that does not include the data, and it does not change our results.

[5] Ideally, for a residence that is owner-occupied, changes in the purchase year coincide with changes in ownership of the residence.

[6] In the current work, we also follow Schulhofer-Wohl (2011) in setting tenure to missing whenever tenure was imputed by the AHS. There were 2,183 cases in which the reported imputed tenure was reported as owner-occupied and 458 cases reported as rental.

Table 1
Mobility Measures

	1985-2007		
	Percentage Moved	Noncensored	Percentage Censored
MOVE	7.8	61,801	17.3
MOVE-ALL	16.4	68,206	8.8
MOVE1	10.0	63,700	14.8
MOVE2	11.0	64,450	13.8
	1985-2009		
	Percentage Moved	Noncensored	Percentage Censored
MOVE	7.5	66,280	17.7
MOVE-ALL	16.0	73,096	9.2
MOVE1	9.7	68,371	15.1
MOVE2	10.8	69,181	14.1

Source: U.S. Census Bureau, American Housing Survey.

Notes: Percentage moved is computed conditional on being in our final regression sample, which requires no missing data for all regressors pertaining to household and housing unit characteristics. It is the ratio of moves to the sum of moves and nonmoves. Percentage censored is the ratio of censored moves to the sum of moves, nonmoves, and censored moves.

moves. To ensure that we did not mistakenly include temporary moves (or false transitions attributable to any remaining reporting errors in the survey), we restricted our sample to those observations in which it was immediately clear either that the same household resided in the given housing unit across consecutive surveys (in which case, there was no move) or that a different household lived in *and* owned the unit that had been owned by another household in the previous survey (in which case, there was a permanent move because both physical location and economic ownership had changed).

Summary statistics of our original mobility variable, here called MOVE, are reported in the first row of Table 1. This measure is identical to the one used in our 2010 paper. Focusing initially on the top panel, which reports data for the 1985-2007 period covered in that paper, we see that 7.8 percent of the 61,801 housing transitions used in our regression analysis are moves according to this definition.[7] Those 61,801 transitions represent only 82.7 percent of the total number of observations potentially available to us.[8] That is, we treat 17.3 percent of the potential transitions as censored. In 2.4 percent of the cases, the move is censored because the observation is the last in the panel data for a particular residence. The remaining cases involve transitions of the property from ownership to rental or from ownership to vacancy where it is possible that the original owner may still own the property.

In his first and preferred mobility measure, Schulhofer-Wohl (2011) effectively counted as a move all cases in which a unit that had been owned in a given survey and was now being rented or was vacant in the subsequent survey. Using the code he provided, we created this variable in our data. It is labeled MOVE-ALL in the second row of Table 1 because it captures all transitions, whether permanent or transitory in nature. Note the much higher mobility given this definition—16.4 percent of transitions are moves, versus 7.8 percent given the definition in Ferreira, Gyourko, and Tracy (2010).[9] A much smaller fraction of the data is censored using the MOVE-ALL measure, reflecting only the 2.4 percent of cases noted earlier in which the observation is the final one in the data panel for a particular residence.

3.2 Two New Measures of Mobility that Exploit the AHS Panel Structure

Because the conservative coding approach in our 2010 study could result in dropping some permanent moves in a nonrandom way that might affect our key estimates, we develop an improved measure of mobility that uses the AHS panel structure to help mitigate this potential problem. This new variable is labeled MOVE1 in Table 1. By creating it for all cases in which the next survey indicates that the house is vacant or rented, we now look forward across all available surveys to

[7] The reported mobility rate drops from 11.4 percent in our previous work to 7.8 percent in this new estimation sample. This decline reflects the removal of false moves as a result of the additional data cleaning.

[8] There are 74,774 observations on potential transitions between 1985 and 2007 for which we have complete data on all of the control variables as well as instruments used in our regression specification reported below. The estimation sample of 61,801 is nearly identical to our earlier estimation sample of 61,803. This reflects the fact that the extra observations added to the estimation sample because of the cleaning of previously uncaught false transitions in the panel structure nearly balance the number of observations lost because of the deletion of observations with imputed tenure status.

[9] As we show, the MOVE-ALL measure would reflect even higher mobility if it literally did what Schulhofer-Wohl states in his paper (2011, p. 5): "As I explain in the introduction, FGT [Ferreira, Gyourko, and Tracy] drop from the sample all cases where a house is owner-occupied in year t but is vacant or rented in year t+2. I make only one change to FGT's data: I code those cases as moves." Our study does not actually censor all such cases. For example, if the existing owner were to temporarily leave the unit vacant or rent it out and then come back to the unit in a subsequent survey, our data set would not censor the initial observation in that sequence. Our code would recognize that the initial observation in that sequence was not the last one for the given household, and we only allow moves for the last observation on the household. By using the code from our 2010 paper, Schulhofer-Wohl effectively corrects for some temporary moves like this, so that not every case in which a "house is owner-occupied in year t but is vacant or rented in year t+2" is counted as a move in his data.

see if the house again becomes owner-occupied by another household, not just by the previous owner. If it does, we note the year in which the house was purchased. If the purchase year is between the current survey year and the next survey, we code this as a permanent move.

In the example below, the first row reports the American Housing Survey year, the second indicates tenure status (owned or rented), and the third reports the year the home was purchased by its owner.

Example 1

Survey year	2003	2005	2007	2009
Tenure status	Own	Rent	Rent	Own
Year purchased	1997	NA	NA	2004

In this case, the housing unit was owned as of 2003 by someone who purchased it in 1997. The same housing unit is reported as rented in the next two surveys. Then, the 2009 survey reports the unit as again being owned, with the owner having purchased the home in 2004. This tells us there was a permanent move by our prior owner, with the house being sold to a new owner in 2004 and that owner presumably renting it out for a period of time. In our previous coding, situations like this would have resulted in a censored value for our dependent variable in 2003, with the observation being dropped from the analysis. Our new mobility measure, MOVE1, will code this as a move for the 2003 observation.

We also take advantage of a variable in the AHS that records the vacancy status of a unit (*vacancy*) to help resolve some of the cases censored under the rules creating the MOVE mobility indicator. For example, we code MOVE1 as indicating that a move and sale took place if the vacancy variable indicates that the house has been "sold but not yet occupied" (*vacancy* = 5). We code MOVE1 to indicate that the original owner has not moved if the unit is listed as being held for occasional use, seasonal use, or usual residence elsewhere (*vacancy* = 6-11). Each of these instances suggests the presence of multiple homes for the household, so that one should not interpret a transition as a permanent move and sale of the property. We also code MOVE1 to indicate that the unit has not sold if the unit is listed as noncash rent for one or more surveys followed by owner-occupied status with the purchase year outside of the window between survey years. Finally, we code MOVE1 to indicate that a move and sale have not taken place if the unit is vacant for two consecutive surveys and listed as sold but not occupied in the second survey (*vacancy* (t+2) = 5).

Table 1 shows that resolution of previously censored cases in this manner results in 10 percent of our regression sample transitions now being coded as permanent moves. MOVE1 mobility is much higher than MOVE, by 28 percent, but it remains well below that for MOVE-ALL. We discuss the differences across measures more fully below; but first, we introduce another mobility variable, MOVE2.

For MOVE2, we maintain the requirement that we are certain that the household has permanently moved, but relax the restriction that we know that the house has sold in the interval between the relevant surveys. Naturally, this leads to an even higher percentage of transitions being classified as permanent moves, as indicated in this second example.

Example 2

Survey year	2003	2005	2007	2009
Tenure status	Own	Rent	Rent	Own
Year purchased	1997	NA	NA	2008
MOVE1	Censored	NA	NA	
MOVE2	Yes	NA	NA	

In this case, we cannot tell if the owner in 2003 changed residence and sold the property between 2003 and 2005. It is possible that a move and sale did take place and that the new owner decided to rent out the property until 2008, when the property was resold. That new owner then decides to live in the property and reports a purchase year of 2008 in the 2009 AHS. However, it is also possible that the owner in 2003 decided to move and to rent out the property, becoming an absentee landlord. The house is then sold in 2008. Since both situations are consistent with the reported data, this would result in MOVE1 being censored and recorded as missing. However, in MOVE2 we classify this as a move in 2003 because we know that the original owner moved and did not return to the property. Thus, MOVE2 includes cases in which we know there was a permanent move, but cannot resolve the timing of the sale by the original owner. The last row of the top panel of Table 1 shows that the fraction of MOVE2 transitions is 10 percent higher than for MOVE1 (11.0 percent versus 10.0 percent). Still, this more expansive definition does not generate anything close to the level of mobility indicated by MOVE-ALL.

The bottom panel of Table 1 reports the analogous data for each mobility measure for the full sample that includes the 2009 survey data. Note that mobility is lower for each variable, which indicates that measured mobility declined between the 2007 and 2009 surveys. We exploit this issue in more detail below.

3.3 Trade-Offs across Different Measures of Mobility

Our concern about Schulhofer-Wohl's (2011) empirical strategy for the question we are addressing is that several of the

housing transitions that he considers moves are false positives in the sense that they are temporary or reflect coding errors in the underlying survey. To gauge how serious the potential problem is of conflating these types of moves, we evaluated the likelihood of Type I and Type II coding errors in his mobility measure by coding them in "real time" in the AHS data. That is, we begin by reading in the cleaned panel and selecting observations for 1985 and 1987. We then code MOVE-ALL based on his code for 1985 using data from the 1985 and 1987 surveys. These values for MOVE-ALL are saved and the exercise is repeated using the 1987-89 pair of surveys, the 1989-91 pair, and so on, until 1997-99. We end this exercise in 1999 to ensure that we have enough future surveys to assess whether Schulhofer-Wohl's moves turned out to be permanent or temporary. We call this real-time version of the Schulhofer-Wohl mobility measure MOVE-ALL^R.

It is important to note that the coding of MOVE-ALL^R in this real-time analysis differs from the coding of MOVE-ALL in the estimation sample. Our third example illustrates why.

Example 3:

Survey year	2003	2005	2007
Tenure status	Own	Rent	Own
Year purchased	1997	NA	1997

When the 2003 AHS data are added to the estimation sample, MOVE (and our two other mobility measures), MOVE-ALL, and MOVE-ALL^R for 2003 will all be censored because at that time this is the last observation in the panel for the residence. When the 2005 AHS data are added, MOVE for 2003 will remain censored and MOVE-ALL and MOVE-ALL^R for 2003 will be recoded as a move. However, when the 2007 AHS data are merged into the sample, MOVE for 2003 (as well as MOVE1 and MOVE2) will be recoded from censored to a nonmove, while MOVE-ALL for 2003 will be recoded from a move to a nonmove and MOVE-ALL^R for 2003 will remain coded as a move (since we do not allow the real-time measure to be recoded once it indicates that a move has taken place). The reason for the recoding of MOVE and MOVE-ALL is that when constructing these mobility measures, we sort the data by residence, household (based on a unique household identification number we create), and survey year. Based on the sorted data, a move is only considered for the last observation for that household. As a result, our coding strategy for MOVE (as well as for MOVE1 and MOVE2) only recodes censored observations as either nonmoves or moves and it never recodes noncensored mobility observations. In contrast, the coding for MOVE-ALL can be dynamically inconsistent over time, with moves recoded at a later date as nonmoves. By construction, MOVE-ALL^R maintains dynamic consistency by not recoding a move as a nonmove even when information becomes available indicating that the original owner has returned.

Table 2
Permanent versus Temporary Moves

Cross-Tabulation of MOVE2 with MOVE-ALL^R

		MOVE-ALL^R	
		0	1
MOVE2	0	70,707	3,557
	1	0	8,550
	. (missing)	0	5,050

Percentage of False Positives Resolved over Time

Four years or first subsequent survey	66.0
Six years or second subsequent survey	17.4
Eight years or third subsequent survey	7.7
Ten years or fourth subsequent survey	4.7
Twelve years or fifth subsequent survey	1.9
Fourteen years or sixth subsequent survey	1.2
Sixteen-plus years	1.1

Source: U.S. Census Bureau, American Housing Survey, 1985-2009.

Note: 15.1 percent of false positives are resolved using vacancy status.

The top panel of Table 2 reports cross-tabulations of our MOVE2 indicator, which takes full advantage of the panel to differentiate between permanent and temporary transitions, and MOVE-ALL^R.[10] We use MOVE2 for this analysis since our focus here is whether a move is permanent or not, regardless of when the property was sold. The first column of the table documents that these two mobility variables confirm that there were 70,707 cases in which no move occurred. There are no cases in which our MOVE2 measure considered some transition a move when MOVE-ALL^R did not (that is, there is no evidence of Type II errors); nor is MOVE2 ever censored or missing when MOVE-ALL^R indicates that no move took place.

The table's second column is more interesting because both mobility measures have 8,550 moves, but MOVE-ALL^R has an additional 8,607 moves. Moreover, 41.3 percent (3,557/8,607) of the additional moves in MOVE-ALL^R turn out to be temporary in nature because they reflect Type I errors. That is, using the full panel of surveys up to 2009, we observe the owner return to the unit at some point in the future, or the surveys reflect some other trait that leads us to conclude that there has not been a permanent move.[11]

[10] Here, we use all available transitions from the AHS for owner-occupied residents between twenty-one and fifty-nine years of age over the 1985-99 period and do not restrict the observations to those with nonmissing values for all of the regressors that we use in the final mobility estimation.

Out of all the false positives from MOVE-ALL^R, in two-thirds of the cases the Type I error could be eliminated by looking at only one subsequent American Housing Survey, as shown in the bottom panel of Table 2. To better understand this, presume that we are uncertain about whether a transition in the 1985 data is permanent or temporary. That is, the data clearly show a given owner-occupant in 1985, but a different occupant or a reported vacancy in 1987. In 66 percent of cases, the 1989 survey fully resolves the uncertainty. In these "false positive" cases, we see the same household living and owning the same unit in 1985 and 1989. Another 17.4 percent of the false positives are resolved by the next available survey (that is, after six years have passed), so that more than 83 percent of cases are clarified by 1991 in this example. The remaining cases are clarified by future surveys, with some owners being absent for long periods of time. However, the number of those cases is quite small.[12]

It is also important to note that for 5,050 transitions, MOVE2 is assigned a censored value while MOVE-ALL^R considers them moves. While none of these cases can be definitively identified as permanent moves with the currently available data, some of them undoubtedly are and will be revealed and coded as such over time as additional survey data become available. In practice, this means that MOVE2 still does not include all true permanent moves. This highlights the fact that there is no perfect measure of such mobility as long as the data do not allow for the immediate recognition of whether an economic change in ownership has occurred.

4. Results

4.1 Estimation Methodology

In Ferreira, Gyourko, and Tracy (2010), we showed that each of our financial friction variables, which are based on self-reported values, is subject to substantial measurement error that causes severe attenuation bias in estimated mobility effects.[13] Such measurement error can be mitigated by using an instrumental-variable approach.[14] In the case of house equity variables, we use the purchase price of the house and any house price appreciation implied by the First American-Core Logic repeat-sales house price index for the relevant metropolitan area in order to calculate our instrument for the self-reported measure of negative equity. The instrumental variable for mortgage lock-in is based on the average rate on thirty-year fixed-rate mortgages during the year in which the house was purchased for the self-reported interest rate. The real annual difference in mortgage payments is calculated using the difference between this rate and the prevailing mortgage rate variable. In both cases, our instrument relies on the intuition that aggregate information averages out individual-level measurement error.

The Proposition 13 property tax subsidy variable is constructed from two self-reported variables. To address the likely measurement error, we create an instrument defined as the difference between the growth in the metropolitan area repeat-sales house price index and the maximum allowable growth in the property tax over the same period, all multiplied by the fully assessed property tax on the purchase value of the house. Needless to say, the value of the implied subsidy still is zero for non-California households.

To accommodate our data structure, we use a recursive mixed-process model that expands upon the classic mobility specifications introduced by Hanushek and Quigley (1979) and Venti and Wise (1984), which also served as the foundation for our earlier empirical work. The following four-equation system describes our mobility outcome and our three instrumental variables:

$$
\begin{aligned}
I^*_{mi} &= X_i\beta + \beta_{P13}X_{P13i} + \beta_{FRM}X_{FRMi} + \beta_N I^1_{Ni} + \varepsilon_{1i} \\
X_{P13i} &= X_i\alpha + \alpha_{P13}Z_{P13i} + \alpha_{FRM}Z_{FRMi} + \alpha_N I^2_{Ni} + \varepsilon_{2i} \\
X_{FRMi} &= X_i\gamma + \gamma_{P13}Z_{P13i} + \gamma_{FRM}Z_{FRMi} + \gamma_N I^2_{Ni} + \varepsilon_{3i} \\
I^{*1}_{Ni} &= X_i\delta + \delta_{P13}Z_{P13i} + \delta_{FRM}Z_{FRMi} + \delta_N I^2_{NI} + \varepsilon_{4i}
\end{aligned}
$$

$$
\begin{aligned}
I_{mi} &= 1 \text{ if } I^*_{mi} \geq 0 \\
&\quad\ 0 \text{ otherwise} \\
I^1_{Ni} &= 1 \text{ if } I^{*1}_{Ni} \geq 0 \\
&\quad\ 0 \text{ otherwise}
\end{aligned}
$$

[11] As noted above, the lack of dependent coding for this variable means that some of these cases could be attributable to coding error by the AHS survey taker in the sense that he or she does see or interview the original owner and mistakenly concludes that the unit is not occupied by the same person. The best example of this involves units described as being vacant and held for occasional or seasonal use. This group represents 14 percent of the 3,557 cases. There is a much smaller fraction of units (1.2 percent) for which there is noncash rent and a subsequent sale outside the relevant sample interval. There is an even smaller share of units (0.3 percent) that are vacant across two consecutive surveys, with the second survey listing the housing unit as sold but not yet occupied.

[12] Subsequent to a temporary move, the mean (median) duration of the owner in the residence is 6.1 (5.0) years. In 38 percent of cases, the post-temporary move duration is censored by the end of the data in 2009.

[13] Kain and Quigley (1972) is the seminal work on this issue. More recently, Bayer, Ferreira, and McMillan (2007) observe that self-reported values are less accurate the longer ago the occupant moved in. Hence, wide swings in prices like those seen over our sample period increase the dispersion of self-reported home values. Schwartz (2006) also reports measurement error in interest rates.

[14] See Ashenfelter and Krueger (1994) for a classic reference on how to create an alternative measure of the "treatment" variable of interest, and then to use that measure as the instrumental variable.

$$\begin{bmatrix} \varepsilon_{1i} \\ \varepsilon_{2i} \\ \varepsilon_{3i} \\ \varepsilon_{4i} \end{bmatrix} \sim N(0, \Sigma), \text{ where } \Sigma = \begin{bmatrix} 1 & \sigma_{12} & \sigma_{13} & \sigma_{14} \\ \bullet & \sigma_2^2 & \sigma_{23} & \sigma_{24} \\ \bullet & \bullet & \sigma_3^2 & \sigma_{34} \\ \bullet & \bullet & \bullet & 1 \end{bmatrix},$$

where I_{mi} is our observed mobility indicator, I_{Mi}^{*} a continuous latent index for the propensity to move, I_{Ni}^{1} our negative equity indicator based on the self-reported house value, I_{Ni}^{2} our alternative negative equity indicator based on the metro area house price index, I_{Ni}^{*1} a continuous latent index for whether the borrower is in negative equity, Z_{P13i} our instrument for the annual property tax cost of moving attributable to Proposition 13 for California residents, and Z_{FRMi} our instrument for the annual interest rate cost associated with refinancing for households with a fixed-rate mortgage.

We estimate this system using Roodman's Cmp program in STATA. A description of the program, its implementation, and applications is given in Roodman (2009). For comparison with our earlier findings, we also present results for a single-equation Probit (used in Ferreira, Gyourko, and Tracy [2010]) and a standard linear-probability model.[15]

4.2 Negative Equity

In this section, we first present updated results on the relationship between mobility and negative equity using new data from the 2009 AHS and for the five different mobility variables described above. For the rest of our discussion, we code MOVE-ALL^{R} for the full sample period from 1985 to 2007 or to 2009. Table 3 begins by providing summary statistics on the distribution of self-reported negative equity according to whether there was a move. Table 4 then reports the results of re-estimating the core mobility specification from Ferreira, Gyourko, and Tracy (2010) using the five mobility measures described above as the dependent variable. The top panel of Table 4 reports marginal effects from that specification estimated with the cleaned and edited AHS data from 1985 to 2007. Results for the expanded 1985-2009 AHS data are reported in the bottom panel.

[15] Schulhofer-Wohl (2011) correctly notes that our negative equity indicator was a dichotomous dummy and thus did not have the requisite properties for the IV Probit estimation procedure as carried out in our 2010 study. Consequently, our main results of this update are based on the IV Probit marginal effects from the joint estimation of the four-equation system outlined above. For comparison, we also report estimates from a single-equation IV Probit (used in our previous paper) as well as an IV linear-probability version of the model, with those results reported in the second and third columns of Table 4. Schulhofer-Wohl does not instrument for the measurement error. As our paper showed, there is never any significant correlation between a financial friction and permanent moves unless attenuation bias is dealt with in some fashion.

Table 3
Cross-Tabulations of Negative Equity and Mobility Indicators

	Negative Equity	
Mobility Indicator	No	Yes
MOVE		
No	74.02	2.11
Yes	6.05	0.15
Censored	16.22	1.46
MOVE1		
No	74.51	2.14
Yes	8.04	0.23
Censored	13.74	1.34
MOVE2		
No	74.51	2.14
Yes	8.99	0.28
Censored	12.79	1.29
MOVE-ALL		
No	74.02	2.11
Yes	14.15	0.51
Censored	8.12	1.09
MOVE-ALL^{R}		
No	68.60	1.91
Yes	14.71	0.57
Censored	12.98	1.23

Source: U.S. Census Bureau, American Housing Survey (1985-2009).

Notes: Negative equity is based on self-reported house values. MOVE-ALL^{R} is the real-time calculation of MOVE-ALL over the full sample period in which we do not allow moves to be subsequently recoded as nonmoves. Cell percentages are shown.

Focusing first on the multi-equation Probit marginal effects in column 1, we observe a statistically significant negative relationship between the presence of negative equity and mobility for our original MOVE indicator as well as for our improved MOVE1 indicator. For our earlier sample period from 1985 to 2007, our preferred MOVE1 indicator implies that negative equity is associated with a two-year mobility rate that is 3 percentage points lower, *ceteris paribus*. This is 30 percent of the baseline mobility rate of 10 percent, which is similar to the relative impact reported in Ferreira, Gyourko, and Tracy (2010). The MOVE variable used in our earlier paper generates a slightly larger impact, but it is not statistically or economically different from that for MOVE1. The more expansive definition of permanent mobility reflected in MOVE2 yields a slightly lower marginal effect of 2.8 percentage points, or about one-fourth of the baseline mobility rate. It is different from zero at a 10 percent confidence level for the

Table 4
Empirical Estimates

	1985-2007		
	IV Probit (Multi-Equation)	IV Probit (Single-Equation)	IV Linear Probability
MOVE	-0.043**	-0.050**	-0.062**
N=61,801	(0.012)	(0.014)	(0.017)
MOVE1	-0.030**	-0.047**	-0.056**
N=63,700	(0.014)	(0.016)	(0.019)
MOVE2	-0.028*	-0.047**	-0.043**
N=64,450	(0.015)	(0.020)	(0.020)
MOVE-ALL	0.019	0.029	0.029
N=68,206	(0.021)	(0.024)	(0.024)
MOVE-ALL^R	0.029	0.063**	0.061**
N=64,181	(0.021)	(0.029)	(0.029)
	1985-2009		
MOVE	-0.037**	-0.046**	-0.054**
N=66,280	(0.011)	(0.017)	(0.016)
MOVE1	-0.024*	-0.044**	-0.048**
N=68,371	(0.014)	(0.016)	(0.018)
MOVE2	-0.022	-0.037**	-0.036*
N=69,181	(0.014)	(0.017)	(0.019)
MOVE-ALL	0.027	0.032	0.035
N=73,096	(0.018)	(0.023)	(0.023)
MOVE-ALL^R	0.037*	0.066**	0.066**
N=69,079	(0.020)	(0.027)	(0.027)

Source: U.S. Census Bureau, American Housing Survey.

Notes: Probit marginal effects are average differences. Standard errors are in parentheses. MOVE-ALL^R is the real-time version of MOVE-ALL over the full sample period in which we do not allow moves to be subsequently recoded as nonmoves.

** Statistically significant at the 95 percent confidence level.
* Statistically significant at the 90 percent confidence level.

1985-2007 sample, and we cannot reject the null hypothesis that the effects are the same across all three measures.
A comparison of results across columns in the top panel of Table 4 indicates that implied marginal effects from the multi-equation Probit specification are consistently lower than effects from the single-equation Probit and the linear-probability specifications, although the pattern of findings is quite consistent. In addition, the standard errors are such that we cannot conclude that the levels of the implied effects differ by estimation strategy.

The first column of Table 4's second panel adds in the data from the 2009 survey. We find modestly lower marginal effects here compared with the 1985-2007 results, and negative equity is no longer associated with statistically significant lower mobility for the MOVE2 variable. However, these marginal effects are not significantly different from those of the earlier sample period, so there is no evidence yet that the most recent housing bust has materially changed the relationship between negative equity and owner mobility. That said, one cannot and should not conclude that the relationship will not change over this cycle as more data become available, as cautioned in our original paper. The previous section implies that it takes four to six years for the vast majority of the censored housing transitions to be resolved. Hence, it will be much later in this decade before we can more confidently know how negative equity affected permanent mobility in this latest downturn.

Note that the coefficient on the MOVE-ALL indicator as constructed by Schulhofer-Wohl (2011) suggests a positive correlation between negative equity and mobility. In neither sample period is this statistically different from zero, but the point estimates are positive, not negative. The misclassification of so many temporary moves as permanent ones is likely to be critical here. Recall that theory does not suggest a negative correlation between temporary moves and negative equity. Hence, it should not be surprising to find a weak and imprecise correlation when more than one-fifth of the coded moves may not involve a permanent move and sale of the home.[16]

This intuition that the conflation of temporary and permanent moves is the driving factor behind the difference between our negative equity results and those reported by Schulhofer-Wohl is corroborated by comparing the different estimates associated with MOVE-ALL and MOVE-ALL^R. Recall that the distinction between these two measures is that MOVE-ALL^R retains moves identified by Schulhofer-Wohl that are known ex post to be temporary, whereas MOVE-ALL allows these temporary moves to be recoded as nonmoves. Retaining these temporary moves increases the measured mobility rate from 16.1 percent for MOVE-ALL to 17.8 percent for MOVE-ALL^R. The estimates in Table 4 indicate that the inclusion of these additional temporary moves raises in each case the estimated positive effect of negative equity on mobility.

Of course, the underlying sample used in generating these estimates is the result of censoring all cases in which we cannot tell whether physical location and economic ownership

[16] We also estimated all models with the original FHFA price series used to help determine negative equity. Focusing on the system IV Probit results, we note that MOVE-ALL remains positive but is still statistically insignificant. MOVE continues to be positive and statistically significant. The marginal effects for MOVE1 and MOVE2 decline by around 25 percent for the 1985-2007 sample and around 40 percent for the 1985-2009 sample, and they are no longer statistically significant. This drop in the magnitude of marginal effects likely reflects the inability of the FHFA house price indexes to accurately track the declining prices due to the indexes' narrow focus on houses financed with conforming mortgages.

Table 5

Impact of Other Financial Frictions on Household Mobility

	IV Probit (Multi-Equation)	IV Probit (Single-Equation)	IV Linear Probability
Mobility indicator: MOVE1			
Fixed-rate mortgage lock-in ($1,000)	-0.016**	-0.018*	-0.013
	(0.009)	(0.009)	(0.009)
Proposition 13 property tax lock-in ($1,000)	-0.010**	-0.010**	-0.008**
	(0.005)	(0.004)	(0.004)
Mobility indicator: MOVE2			
Fixed-rate mortgage lock-in ($1,000)	-0.023**	-0.024**	-0.019**
	(0.009)	(0.009)	(0.009)
Proposition 13 property tax lock-in ($1,000)	-0.009*	-0.009*	-0.008**
	(0.005)	(0.005)	(0.004)

Source: U.S. Census Bureau, American Housing Survey, 1985-2009.

Note: Probit marginal effects are average derivatives, with standard errors in parentheses.

** Statistically significant at the 95 percent confidence level.
* Statistically significant at the 90 percent confidence level.

changed. That is roughly half of the excess moves in MOVE-ALL^R relative to MOVE2 based on our real-time analysis of the 1985-99 period. Practically speaking, most of the censored cases in our full data set are from recent waves of the AHS, and Table 2's results suggest that if past patterns persist, the vast majority will be resolved within four to six years. However, it seems likely that at least some of the cases in which the previous owner is coded as no longer living in the unit over multiple surveys, but for which there is still no clear evidence of a sale, actually are permanent moves.[17]

[17] This raises the question of whether we could improve the measure MOVE2 by counting as moves situations in which it seems likely (but not certain) that a permanent move has taken place. Intuition might suggest that the longer the ownership gap observed in which the residence is reported as rental or vacant, the more likely that the previous owner will not return. To check on this possibility, we looked at ownership gaps of different lengths and computed the fraction of cases in which the move turned out to be temporary, conditional on having the information to make this determination. For situations in which the residence was rented or vacant for at least three surveys, the transition turned out to be temporary in 59 percent of the cases in which we could determine the final outcome. If we lengthen the ownership gap to four or more surveys, the percentage of temporary moves actually increases to 62 percent. This pattern continues for ownership gaps of five or more and six or move surveys. Thus, the simple intuition that the longer the current ownership gap, the more likely the move will turn out to be permanent, is not supported in the data. For this reason, we do not think one can improve on MOVE2 by recoding censored transitions as moves given an ownership gap of some specified length. However, it is still useful to understand that the potential fragility of our results (and possibly of previous researchers) arises from the fact that it is difficult to properly measure mobility in a number of cases.

4.3 Fixed-Rate Mortgages and Property Tax Lock-Ins

Updated results on the impact of two additional financial frictions on household mobility are presented in Table 5. The first friction pertains to homeowners with a fixed-rate mortgage. In a rising interest rate environment, if a homeowner with this type of mortgage moves, the monthly cost of an identically sized mortgage can be higher. The second friction pertains to homeowners in California whose property tax increases have been limited over time due to Proposition 13. If the homeowner moves to a similarly valued property, taxes would be set to the fully assessed value of the house. In both cases, we examine the marginal effect of an additional $1,000 annual cost on the likelihood that the household moves. We provide estimates for specifications containing our two improved mobility indicators for the expanded sample period, in which we use the FACL overall house prices to update home values. The data confirm our earlier finding that both frictions give rise to reduced household mobility—10 percent to 16 percent less per $1,000 using our preferred mobility measure MOVE1. In none of the specifications do the data reject the notion that the mobility friction is the same whether it is generated by rising rates for fixed-rate borrowers or higher property taxes for California homeowners.

We suspect that this interest-rate–related lock-in effect will become increasingly important as monetary policy is normalized in the future. To illustrate, we consider the

Table 6
Main Reason for Move: Overall and by Distance of Move

		1985-95				
Reason	1985-2009	All	Same Metropolitan Statistical Area	Same State	Different State	Out of Country
Job-related	12.58	13.23	3.85	21.20	60.53	66.10
Quality-of-life	26.70	23.94	26.67	24.97	8.18	3.39
Personal/family	23.88	20.44	19.73	16.64	10.22	6.78
Financial	21.83	25.55	33.00	20.55	4.25	6.78
Other	11.84	13.18	12.90	13.13	14.94	15.25
All equal	3.17	3.67	3.85	3.51	1.89	1.69

Sources: U.S. Census Bureau, American Housing Survey; authors' calculations.

Note: The sample is restricted to owner-occupied respondents between the ages of twenty-one and fifty-nine.

hypothetical case of a 250 basis point increase in the average thirty-year fixed-rate mortgage interest rate as a result of the normalization of monetary policy. For homeowners in 2009 with a fixed-rate mortgage, this results in a mean (median) annual payment difference of $2,300 ($1,710). According to the Probit marginal effects for MOVE1, this implies a mean (median) reduction in the two-year mobility rate of 3.7 (2.7) percentage points. If we calculate using the estimates for MOVE2, we obtain a reduction in the two-year mobility rate of 5.3 (3.9) percentage points. This suggests that as negative equity (hopefully) diminishes in importance over the coming years, it well may be offset by an increasing fixed-rate-mortgage friction.[18]

5. Spillovers into the Labor Market and Other Implications

Policymakers naturally have been interested in whether reduced mobility among homeowners (from negative equity especially) might be playing a role in what has heretofore been a very sluggish employment recovery. Perhaps being stuck in one's home because of the high costs of curing negative equity prevents a sufficiently large number of people from moving to accept jobs, which affects the measured unemployment rate.

Our analysis is restricted to the housing market because the AHS follows residences rather than households and therefore it is not suited to addressing job mobility. However, the preliminary answer on this question from the initial set of research in labor economics is "no." Since long-distance moves are more likely to be job related, these studies tend to focus on moves across states or counties.[19] The AHS files are also useful for examining the types of moves likely to be impacted by housing market frictions. For example, the AHS asks recent movers (that is, those who moved within the last two years) about the primary reason for their move and, until 1995, the distance of the move. A high percentage of moves—73 percent—are local, while only 13 percent cross a state border. Table 6 provides more detail on the primary reason for moves, both overall and broken down by distance. Most moves are for quality-of-life, personal/family, and financial reasons, and do not appear to be primarily job related. This is especially true for local moves. In contrast, longer-distance moves, particularly across states, tend to be job related. One implication of these data that is consistent with the initial labor market analysis results is that financial frictions affecting household mobility may well be more likely to reduce local moves that need not have significant spillover effects into the labor market. Nevertheless, it is too early to conclude that this is the final word on potential spillovers into the labor market. That conclusion should await a fuller recovery as well as confirming evidence from studies using micro data and modeling individual household behavior.

We emphasize that even if reduced mobility attributable to financial frictions has no spillovers into the labor market, that does not make them economically unimportant. The fewer

[18] This is particularly true for borrowers who received a below-market mortgage rate through a private modification or a Home Affordable Modification Program modification (conditional on the borrower not redefaulting on the modified mortgage). If these low-rate mortgages were either assumable or portable, there would be no associated mobility friction.

[19] Several of these papers (for instance, Aaronson and Davis [2011], Modestino and Dennett [2012], and Molloy, Smith, and Woznak [2011]) also estimate aggregate models of migration rates rather than micro models of whether a household moves. Donovan and Schnure (2011) also pursue an aggregate-level analysis, but theirs is more comprehensive in the sense that it investigates the impact of negative equity within and across counties (and also within and across states).

within-metropolitan-area moves that we see due to negative equity have direct effects on owner economic welfare and potentially important implications for the nature of the housing sector recovery. Being locked into one's current residence because of the high costs of curing negative equity means the household is imperfectly matched in its residence. The welfare losses from being mismatched are not just from having the wrong-sized house (such as not enough bedrooms now that there is an additional child), but also from being in the wrong location. Many families, for instance, may not be able to move to their preferred school district, even if there is no desire to change jobs.

In addition to these welfare consequences are the potential impacts on the scale and intensity of trade-up (and trade-down) purchases. There are vastly more sales of existing homes than new homes in a typical year, so lower transaction levels in the existing stock materially affect the state of the housing market, including the incomes of realtors and others who work in the housing sector and in durable goods sales that coincide with turnover of owned housing, as well as the finances of many state and local governments that rely on transfer taxes.[20]

Finally, it is natural to focus on the potential ramifications of lower mobility due to negative equity, but we should not forget that the mortgage interest rate lock-in effect could become much more important in the future. We find economically meaningful interest rate lock-in effects in past cycles, and the stage is set for them to become empirically relevant. Federal Reserve interest rate policy and other public policies have been successful at encouraging refinancing at historically low rates. When rate policy normalizes, we may find many owners constrained from moving because of the much higher debt service payments they would incur from buying a different home.

[20] Low transaction volumes in housing markets also complicate the appraisal process because of a lack of comparables. This likely leads to conservative appraisals and therefore the need for households to make larger down-payments in order to purchase a home. This creates the possibility of an adverse-feedback effect that can further reduce home sales.

6. Summary and Implications for Future Research

Our inclusion of the most recent American Housing Survey for 2009, which reflects initial data from the recent housing bust, does not materially change previously reported estimates of how negative equity and other financial frictions are correlated with homeowner mobility. Homeowners with negative equity remain about one-third less likely to move than otherwise observationally equivalent owners. However, the uncertainty surrounding changes in economic ownership involving various transitions concentrated in the last few surveys suggests that we cannot really know for sure how the recent housing bust impacted permanent mobility until a few years into the future. Then, the additional survey data will reveal the true nature of many of those transitions.

A critique of the sample selection procedures used in our earlier work (Ferreira, Gyourko, and Tracy 2010), which claims to reverse this result, appears largely due to the incorrect classification of many transitions as moves that are likely to be temporary and not permanent, or simply reflect coding error in the individual surveys. Whether negative equity can be positively associated with temporary moves is a question that we did not attempt to answer then. That said, our improved measure still does not reflect mobility perfectly because of our conservative policy of censoring transitions that cannot be definitively defined as permanent in nature. Hopefully, researchers will develop other data sources or ways to reduce this noise in the AHS panels.

Going forward, it is more important for scholars to tackle the question of whether this correlation is causal in nature. That will require new theoretical and empirical strategies to better control for labor market conditions. As long as labor and housing markets move together (and there is sound reason conceptually and empirically to believe they do), the correlation documented here could be driven predominantly by the lack of good job opportunities to attract potential movers. Until we address this issue, we will not know the true social cost of highly leveraged home purchases that are more likely to lead to negative equity situations.

References

Aaronson, D., and J. Davis. 2011. "How Much Has House Lock Affected Labor Mobility and the Unemployment Rate?" Federal Reserve Bank of Chicago, Chicago Fed Letter no. 290, September.

Ashenfelter, O., and A. B. Krueger. 1994. "Estimates of the Economic Returns to Schooling from a New Sample of Twins." American Economic Review 84, no. 5 (December): 1157-73.

Bayer, P., F. Ferreira, and R. McMillan. 2007. "A Unified Framework for Measuring Preferences for Schools and Neighborhoods." Journal of Political Economy 115, no. 4 (August): 588-638.

Bricker, J., and B. Bucks. 2011. "Negative Home Equity, Economic Insecurity, and Household Mobility: Evidence from the 2007-2009 SCF Panel." Paper presented at the Federal Reserve Bank of St. Louis Applied Micro Economics Conference, St. Louis, Missouri, May 5-6.

Chan, S. 2001. "Spatial Lock-In: Do Falling House Prices Constrain Residential Mobility?" Journal of Urban Economics 49, no. 3 (May): 567-86.

Donovan, C., and C. Schnure. 2011. "Locked in the House: Do Underwater Mortgages Reduce Labor Market Mobility?" Unpublished paper, May 31.

Engelhardt, G. V. 2003. "Nominal Loss Aversion, Housing Equity Constraints, and Household Mobility: Evidence from the United States." Journal of Urban Economics 53, no. 1 (January): 171-95.

Ferreira, F. 2010. "You Can Take It with You: Proposition 13 Tax Benefits, Residential Mobility, and Willingness to Pay for Housing Amenities." Journal of Public Economics 94, nos. 9-10 (October): 661-73.

Ferreira, F., J. Gyourko, and J. Tracy. 2010. "Housing Busts and Household Mobility." Journal of Urban Economics 68, no. 1 (July): 34-45.

Hanushek, E. A., and J. M. Quigley. 1979. "The Dynamics of the Housing Market: A Stock Adjustment Model of Housing Consumption." Journal of Urban Economics 6, no. 1 (January): 90-111.

Kain, J. F., and J. M. Quigley. 1972. "Note on Owner's Estimate of Housing Value." Journal of the American Statistical Association 67, no. 340 (December): 803-6.

Modestino, A. S., and J. Dennett. 2012. "Are American Homeowners Locked into Their Homes? The Impact of Housing Market Conditions on State-to-State Migration." Federal Reserve Bank of Boston Working Paper no. 12-1, February. Available at http://www.bostonfed.org/economic/wp/wp2012/wp1201.pdf.

Molloy, R., C. L. Smith, and A. Woznak. 2011. "Internal Migration in the United States." Journal of Economic Perspectives 25, no. 3 (summer): 173-96.

Quigley, J. M. 1987. "Interest Rate Variations, Mortgage Prepayments, and Household Mobility." Review of Economics and Statistics 69, no. 4 (November): 636-43.

———. 2002. "Homeowner Mobility and Mortgage Interest Rates: New Evidence from the 1990s." Real Estate Economics 30, no. 3 (fall): 345-64.

Roodman, D. 2009. "Estimating Fully Observed Recursive Mixed-Process Models with Cmp." Center for Global Development Working Paper no. 168, April.

Schulhofer-Wohl, S. 2011. "Negative Equity Does Not Reduce Homeowners' Mobility." NBER Working Paper no. 16701, January. Available at http://www.nber.org/papers/w16701.

Schwartz, A. 2006. "Household Refinancing Behavior in Fixed-Rate Mortgages." Unpublished paper, Harvard University, November/December.

Stein, J. C. 1995. "Prices and Trading Volume in the Housing Market: A Model with Down-Payment Effects." Quarterly Journal of Economics 110, no. 2 (May): 379-406.

Valletta, R. G. 2010. "House Lock and Structural Unemployment." Paper presented at the Federal Reserve System Committee on Regional Analysis, New Orleans, Louisiana, November 14-16.

References (Continued)

Venti, S. F., and D. A. Wise. 1984. "Moving and Housing Expenditure: Transaction Costs and Disequilibrium." Journal of Public Economics 23, nos. 1-2 (February-March): 207-43.

Wasi, N., and M. J. White. 2005. "Property Tax Limitations and Mobility: Lock-In Effect of California's Proposition 13." Brookings-Wharton Papers on Urban Affairs 2005, 59-97.

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Key Mechanics of the U.S. Tri-Party Repo Market

- The 2007-09 financial crisis exposed weaknesses in the design of the U.S. tri-party repo market that could rapidly elevate and propagate systemic risk.
- A study of the market identifies the collateral allocation and unwind processes as two key mechanics contributing to the market's fragility and delaying reforms.
- The problems stem from the considerable intervention by dealers to allocate collateral and their reliance on intraday financing to unwind, or settle, expiring repos.
- Streamlining the collateral allocation process and eliminating the time gap associated with the unwinding of repos could reduce market fragility and financial system risk.

1. Introduction

During the financial crisis of 2007-09, particularly around the time of the Bear Stearns and Lehman Brothers failures, it became apparent that weaknesses existed in the design of the U.S. tri-party repo market, used by major broker-dealers to finance their inventories of securities. These design weaknesses had the potential to rapidly elevate and propagate systemic risk.

Following the crisis, an industry-led effort sponsored by the Federal Reserve Bank of New York was undertaken to improve the tri-party repo market's infrastructure, with the main goal of lowering systemic risk. This article describes some key mechanics of the market—in particular, the collateral allocation process and the "unwind" process—that have contributed to the market's fragility and delayed the reforms.

A repurchase agreement, or "repo," is effectively a collateralized loan. A well-functioning tri-party repo market depends on the ability to efficiently allocate a dealer's securities—the collateral in the transaction—to the various repos that finance those securities. In the United States, collateral allocation currently involves considerable intervention by dealers, which slows the entire process. Collateral allocation is also complicated by the need for coordination between the Fixed Income Clearing Corporation (FICC), which clears some interdealer repos, and the clearing bank, which facilitates the settlement of tri-party repos. The

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length of time necessary to allocate collateral in the tri-party repo market has been a significant obstacle to market reform.

Another impediment to reform is the unwind process, the settlement of expiring repos that occurs before new repos can be settled. The unwind creates a need for intraday funding to tide dealers over in the period between when they return cash to investors and when they get new cash from the settlement of new repos. In the tri-party repo market, this intraday financing is provided by the clearing banks. The dealers' reliance on intraday credit is one of the three weaknesses of the market highlighted in a Federal Reserve Bank of New York white paper on infrastructure reform. Such reliance creates potentially perverse dynamics that increase market fragility and financial system risk.

The next section offers a brief overview of the U.S. repo market and some of its important segments. In Section 3, we describe the market in more detail and summarize the concerns surrounding it. Section 4 reviews the mechanics of tri-party repo transactions; Section 5 concludes.

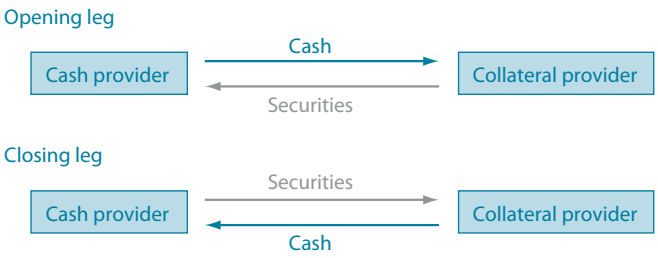
2. The U.S. Repo Market

A repo is the sale of a security, or a portfolio of securities, combined with an agreement to repurchase the security or portfolio on a specified future date at a prearranged price. Aside from some legal distinctions concerning bankruptcy treatment,[1] a repo is similar to a collateralized loan. Exhibit 1 shows a basic repo transaction. For the opening leg of the repo, an institution with cash to invest, the cash provider, purchases securities from an institution looking to borrow cash, the collateral provider.

The market value of the securities purchased typically exceeds the value of the cash. The difference is called the "haircut." For example, if a cash loan of $95 is backed by collateral that has a market value of $100, then the haircut is 5 percent. For the closing leg of the repo, which occurs at the term of the repo, the collateral provider repurchases the securities for $95 plus an amount corresponding to the interest rate on the transaction.

In most segments of the U.S. repo market, at least one of the counterparties is a securities dealer.[2] Dealers use the repo market to finance their inventories of securities, among other purposes. In some cases, the collateral provider is a client of the dealer that wants to borrow cash. On these repos, the dealer is the cash provider. Repos involve a variety of other cash providers, including money market funds (MMFs), asset managers, securities lending agents, and investors looking to obtain specific securities as collateral in order to hedge or speculate based on changes in the market values of those securities.

Exhibit 1
A Typical Repo Transaction



We now describe different segments of the U.S. repo market in more detail.

2.1 The Bilateral Repo Market

When the repo market was first developed, all transactions were bilateral. In the bilateral market, a repo is typically settled when the collateral provider receives the cash and delivers the securities to the cash provider. The transfer is usually simultaneous, so this type of repo is sometimes called "delivery versus payment," or DvP. For example, for a repo collateralized by Treasury securities, the collateral provider could instruct its custodian bank to deliver the appropriate securities to the cash provider's custodian bank through the Fedwire Securities Service.[3]

Bilateral repos have some operational complexities. They typically require the cash provider to be able to 1) keep track of the securities collateral it receives, 2) make sure that this collateral is adequate and valued correctly, and 3) ensure that the proper margin has been applied. All of this requires significant operational expertise and systems, especially for large investors that do many repos with a variety of counterparties.

To avoid this complicated process, a collateral provider could offer to hold the securities, but segregate them for the benefit of the cash providers. Such repos are called "hold in custody," but they are no longer popular for two reasons. First, the cash investor may find it difficult to obtain its securities should the collateral provider default. Second, these repos involve the potential for fraud. These complexities are alleviated in the tri-party repo market, which we describe later.

The bilateral repo market has two main segments, one in which dealers borrow cash and another in which dealers lend cash. We describe each in more detail.

[1] See Duffie and Skeel (2012).

[2] The terms "dealer" and "securities dealer" are used interchangeably.

[3] The Fedwire Securities Service is operated by the Federal Reserve System.

The Bilateral Market in Which Dealers Borrow Cash

Some DvP repos are collateralized by a security that is in particular demand. For example, the cash provider might want the security for delivery against a short sale or to cure a delivery failure. These sought-after securities are typically called "special," and often include the most recently issued ("on-the-run") Treasury securities. Investors are often willing to accept a lower interest rate on a repo collateralized by a special security.

Repos involving specific securities are typically bilateral. The cash providers in this segment of the market are usually hedge funds and dealers. When both counterparties are dealers, the repo does not provide net funding to the dealer community in the aggregate, but redistributes the available cash and specific securities among dealers. Copeland, Martin, and Walker (2010) estimate the size of this segment of the repo market at almost $1 trillion as of May 2012. Gorton and Metrick (2012) provide information about haircuts in the interdealer bilateral market.

The Bilateral Market in Which Dealers Lend Cash

In another segment of the bilateral market, dealers finance their clients' assets or lend cash to each other. Financing a client's assets is particularly convenient if the dealer holds these same assets in custody, because the dealer can simply assert a lien on the securities that collateralize the repo. The securities obtained by the dealer in this process can then be rehypothecated in other repo transactions, if the collateral provider allows it. Copeland, Martin, and Walker (2010) estimate the size of this segment of the repo market at almost $2 trillion as of May 2012.[4] They also provide information about haircuts that dealers require for financing their clients' assets.

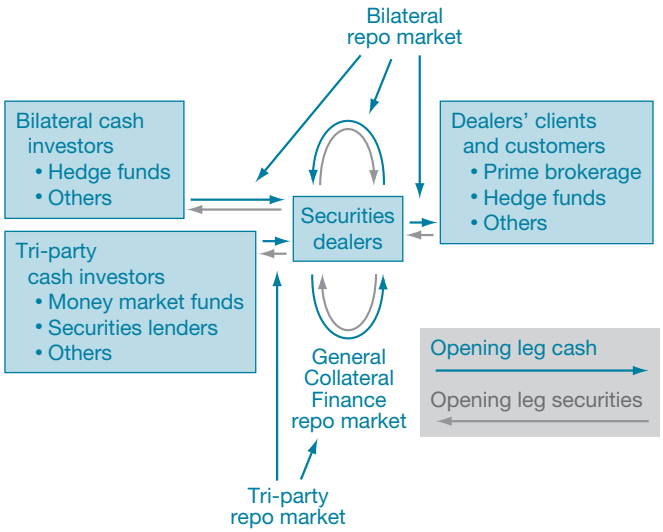
2.2 The Tri-Party Repo Market

In the tri-party repo market, a third party, called a clearing bank, facilitates repo settlement. In the United States, two clearing banks handle tri-party repos: Bank of New York Mellon (BNYM) and JP Morgan Chase (JPMC). These clearing banks settle repo transactions on their own balance sheets. Maintaining cash and securities accounts for dealers and cash providers, the clearing banks settle the opening leg of a tri-party repo by transferring securities from the dealer's securities account to the cash investor's securities account, and by transferring cash from the investor's cash account to the dealer's cash account. Movements in the opposite direction occur on the closing leg of the repo (Exhibit 2).[5]

In addition to offering settlement and custodial services, clearing banks provide collateral management services, such as daily revaluation of assets, daily remargining of collateral, and allocation of the borrower's collateral to its lenders in accordance with the lenders' eligibility and risk management constraints. As explained by Garbade (2006), clearing banks also ensure that the collateral will be available to cash providers if a dealer defaults.

The tri-party repo market has two main segments, described in more detail below.

Exhibit 2
The U.S. Repo Market



Tri-Party Repos Funded by Nondealers

Cash providers in this segment of the market are primarily MMFs, securities lenders, and other institutional cash providers, such as mutual funds, corporate treasurers, and state and local government treasurers. These investors seek interest income at short maturities. For some investors, overnight repos serve as a secured alternative to bank deposits. Together, MMFs and securities lenders account for over half of tri-party repo lending (Copeland, Martin, and Walker 2010).

[4] Note that adding up the size of the two segments of the bilateral repo market would double count interdealer activity, since one dealer is borrowing and another is lending. The available data do not allow us to separate that activity.

[5] The mechanics of tri-party repo transactions are described in Section 4.

Table 1

Composition and Concentration of Tri-Party Repo Collateral
June 11, 2012

Asset Group	Collateral Value (Billions of Dollars)	Share of Total (Percent)	Concentration by Top Three Dealers (Percent)
Fedwire-eligible collateral			
U.S. Treasuries, excluding Strips	578.24	32.1	30.2
U.S. Treasury Strips	47.17	2.6	49.6
Agency debentures and strips	106.99	5.9	36.6
Agency mortgage-backed securities	680.82	37.8	30.9
Agency collateralized mortgage obligations (CMOs)	126.04	7.0	43.9
Non-Fedwire-eligible collateral			
Asset-backed securities, investment- and noninvestment-grade	35.33	2.0	45.5
CMO private-label, investment- and noninvestment-grade	34.13	1.9	47.2
Corporates, investment- and noninvestment-grade	63.81	3.5	31.6
Equities	80.85	4.5	39.8
Money market instruments	25.17	1.4	60.8
Other	22.01	1.2	
Total	1,628.04		

Source: Tri-Party Repo Infrastructure Reform Task Force (http://www.newyorkfed.org/tripartyrepo/margin_data.html).

Notes: "Other" includes collateralized debt obligations, international securities, municipality debt, and whole loans.
The underlying data include a total of 7,104 deals and 10,282 collateral allocations.

Dealers use the tri-party repo market mainly to obtain large-scale, short-term financing for their securities inventories at a low cost. They typically use only one of the two clearing banks to settle their tri-party repos. Large cash providers maintain accounts at both clearing banks in order to transact with dealers at each of them.

The tri-party repo market is a general collateral (GC) market, meaning that an investor may care about the class of collateral it receives but not about the specific securities.[6] The market is the largest source of secured funding for U.S. dealers. As shown in Table 1, U.S. Treasury securities and various U.S. government agency obligations (mortgage-backed securities [MBS], debentures, and collateralized mortgage obligations) accounted for approximately 85 percent of U.S. tri-party repo collateral in June 2012. The total amount of financing provided in the U.S. tri-party repo market then—about $1.8 trillion—was down from a precrisis peak of about $2.8 trillion.

[6] This is in contrast to the market for special securities. Tri-party repo cash providers typically are not interested in specific securities. In addition, as described in Section 4, the clearing bank's collateral allocation process does not facilitate the allocation of specific securities to a repo. For these reasons, special securities are not financed in the tri-party repo market.

The GCF Repo Market

The GCF (General Collateral Finance) repo market is a blind-brokered interdealer market, meaning that dealers involved in the transactions do not know each other's identity. GCF trades are arranged by interdealer brokers that preserve the participant's anonymity. Only securities that settle on the Fedwire Securities Service can serve as collateral for a GCF repo transaction. GCF repo trades are settled on the books of the clearing bank using the tri-party repo infrastructure and thus are an integral part of tri-party repo settlement.[7]

The GCF market has several functions for dealers. Some use the market for a substantial share of their inventory financing, on an ongoing basis. Dealers can also use GCF repos to fine-tune their financing at the end of the day, lending cash if they have secured more financing than they need or borrowing cash if they are short. Dealers also use GCF repos for collateral upgrades, borrowing cash against agencies' MBS collateral and reinvesting the cash against Treasury securities. They may choose to do this because it is easier to finance Treasury securities than agency MBS outside of the GCF market or because they need to make a pledge to a central counterparty that accepts only Treasuries as collateral. (The data in Table 1 do not include the GCF market

[7] Fleming and Garbade (2003) provide an overview of the GCF market.

Table 2
Distribution of Investor Haircuts on Tri-Party Repos
June 11, 2012

	Cash Investor Margin Levels		
Asset Group	10th Percentile	Median	90th Percentile
Fedwire-eligible collateral			
U.S. Treasuries, excluding Strips	2.0	2.0	2.0
U.S. Treasury Strips	2.0	2.0	2.0
Agency debentures and Strips	2.0	2.0	5.0
Agency mortgage-backed securities	2.0	2.0	3.0
Agency collateralized mortgage obligations (CMOs)	2.0	3.0	5.0
Non-Fedwire-eligible collateral			
Asset-backed securities, investment- and noninvestment-grade	3.0	7.0	15.0
CMO private-label, investment- and noninvestment-grade	2.0	8.0	15.0
Corporates, investment- and noninvestment-grade	2.0	5.0	15.0
Equities	5.0	8.0	15.0
Money market instruments	2.0	5.0	5.0

Source: Tri-Party Repo Infrastructure Reform Task Force (http://www.newyorkfed.org/tripartyrepo/margin_data.html).

Notes: Figures are percentages. The underlying data, which are common to those underlying Table 1, include a total of 7,104 deals and 10,282 collateral allocations.

because the market does not provide net financing to the dealer community in the aggregate. Instead, the market allows dealers to redistribute cash among themselves.[8])

3. Tri-Party Repo Transactions

Because a repo is effectively a collateralized loan, the key terms are the same for both: borrower and lender, maturity date, cash loan amount, interest rate,[9] collateral eligibility, margin schedules, and the treatment of the contract in the event of either party's failure. For tri-party repos, the time to maturity, or tenor, is commonly one day. Many such "overnight" repos, however, are "rolled" for a number of successive days. A "term" repo has a tenor of more than one day.

To establish a tri-party trading relationship, a cash provider and a cash borrower execute a master repo agreement (MRA) that stipulates the key elements of their prospective tri-party repos, such as how a repo may be terminated and how margins will be maintained. The MRA also outlines the conditions under which the collateral backing the repo can be replaced by other collateral. The borrower and lender each have, in addition, clearing agreements with a tri-party clearing bank, either JPMC or BNYM. Like repos, clearing agreements are exempt from bankruptcy stays, which allows these agreements to terminate in the event of bankruptcy, giving the collateral holder the immediate right to use or dispose of the collateral.[10] Finally, a custodial undertaking agreement (CUA), executed by the two MRA signatories as well as the clearing bank, establishes the clearing bank as the tri-party agent for this lender-borrower relationship and documents the lender's collateral eligibility criteria.[11]

An annex to the custodial agreement stipulates the haircuts applicable to each class of collateral that the investor will accept. Hence, the haircut is not negotiated on a trade-by-trade basis. The haircut may depend on a number of factors, including the historical price volatility for the asset type, the loan term, and the identity of the dealer.[12]

[8] The Federal Reserve Bank of New York and the Depository Trust and Clearing Corporation provide data on the GCF market. See http://www.newyorkfed.org/tripartyrepo/margin_data.html and http://www.dtcc.com/products/fi/gcfindex/, respectively.

[9] The interest rate is quoted on a standard money market basis. For example, in U.S. dollars, the "actual/360" money market convention implies that a loan of $100 for three days at an interest rate of 2 percent is repaid with interest of $100 x 0.02 x 3/360.

[10] Clearing agreements are "securities contracts," exempt from automatic stays, preferences, and other bankruptcy rules. See Duffie and Skeel (2012).

[11] The annexes of the CUA contain schedules that define the eligible collateral for a particular type of repo as well as the haircut for each collateral type. Section 4.2 provides more detail.

[12] Copeland, Martin, and Walker (2010) explain that haircuts depend on the dealer.

Table 2 provides summary statistics for the cross-sectional distribution of overnight haircuts set in the U.S. tri-party repo market in May 2011.[13] The median haircut applied to U.S. Treasuries was 2 percent, while the median haircuts on corporate bonds and equities were 5 percent and 8 percent, respectively, reflecting their generally higher volatility or lower liquidity compared with Treasuries. The annex to the custodial agreement may also specify concentration limits, such as no more than 40 percent agency securities and no more than 25 percent corporate bonds.

Once these various contracts are in place, dealers can engage in tri-party repo transactions with cash providers. They negotiate the interest rate, the type of eligible collateral, the tenor, and the size of each repo. Typically, a dealer's repo traders call investors in the morning to arrange new repos. Industry participants report that 80 to 90 percent of tri-party repo funding is arranged before 10:00 a.m. In some cases, such as for a large fund complex, a deal is negotiated in the morning but the allocation to specific funds within the complex is not indicated until later in the day. Some trades, however, are arranged later in the day. For example, MMFs that accept redemptions from their investors until late in the afternoon would not know the amount of cash they will invest until that time.

Dealers and investors have incentives to maintain the quality of their relationships, so they try to accommodate each other's needs when possible. This may occur if an investor experiences some unexpected changes in available cash. For example, a dealer may allow some classes of investors, such as MMFs, to deviate by up to 10 percent from the originally agreed-upon deal size. If a dealer lacks sufficient amounts of eligible securities, it will typically post cash collateral, which is generally acceptable. In this case, however, the dealer pays interest on this component of the repo without borrowing any net amount of cash. Each day, a clearing bank settles the opening legs of new repos as well as the closing legs of any repos to be settled on that day, acting as agent for both the borrower and lender. As we explain in Section 4, the dealer and its clearing bank have some discretion with regard to the specific packages of collateral to allocate to each repo deal, subject to meeting the deal's collateral requirements. The clearing bank is heavily involved in the collateral allocation process and in the transfer of cash and securities between the accounts of the borrower and lender.

[13] Monthly data back to May 2010 are available at http://www.newyorkfed.org/tripartyrepo/margin_data.html.

3.1 The Role of the Clearing Banks as Intraday Investors

The financial strains experienced by several dealers, including Bear Stearns and Lehman Brothers, during the financial crisis of 2007-09 highlighted the fact that the two tri-party clearing banks are not only agents, but also the largest creditors in the tri-party repo market on each business day. This daytime exposure is associated with the unwind of repos, a process by which the clearing banks send cash back to investors and collateral back to dealers, regardless of whether a repo is expiring.[14]

Between the time of the unwind and the time at which new trades are settled near the end of the business day, dealers must finance the securities that serve as repo collateral. During this transition period, the clearing banks provide financing to dealers, collateralized by the dealers' securities.[15] This provision of intraday credit creates multiple risks.

The exposure of a clearing bank to a single dealer can routinely exceed $100 billion (Federal Reserve Bank of New York 2010). In the event that a dealer fails, its clearing bank could, in an unexpected situation, discover that the market value of the collateral provided by the dealer is insufficient to cover the amount owed to the clearing bank. The stability of the clearing bank could also be threatened if it decides instead to hold the collateral on its own balance sheet, thereby increasing its leverage.

The financial strains experienced by several dealers, including Bear Stearns and Lehman Brothers, during the financial crisis of 2007-09 highlighted the fact that the two tri-party clearing banks are not only agents, but also the largest creditors in the tri-party repo market on each business day.

The vulnerability of a clearing bank to a troubled dealer is intensified by "wrong-way" risk, meaning that, in a crisis situation, the failure of a dealer may be correlated with a

[14] The unwind process is described in more detail in Section 4.

[15] Clearing banks may apply a haircut to the intraday repo financing of dealer inventories. United States Bankruptcy Court (2010, pp. 1095-1102) documents that one clearing bank increased haircuts abruptly during the crisis to a level that, in some cases, exceeded those charged by cash providers.

sudden reduction in the market value of some securities that collateralize the dealer's tri-party repos. Moreover, an attempt by a clearing bank to lower its exposure to a failed dealer through a sudden "fire sale" of the collateral could itself reduce the value of that collateral, thus exacerbating the losses to the clearing bank and to other market participants that hold positions in the same or similar assets. This danger buttresses the importance of the Primary Dealer Credit Facility (PDCF), introduced by the Federal Reserve Bank of New York during the financial crisis (Adrian, Burke, and McAndrews 2009). The PDCF provided an alternative source of financing for collateral that might otherwise have been liquidated in a fire sale; such a liquidation could have potentially destabilized the markets and eroded the capital of these asset holders.

As explained by Duffie (2010), the exposure of tri-party clearing banks to securities dealers also represents a potential danger to any dealer whose credit quality becomes suspect. A clearing bank refusing to unwind the repos of such a dealer could suddenly and fatally restrict that dealer's ability to finance itself. Section 4 explains how the daily morning "handoff" of dealer exposure from cash providers to the clearing bank creates an incentive for the clearing bank to pull away from granting credit to a dealer in the event of concerns over that dealer's credit quality. In the case of Lehman Brothers, such instances are documented by Anton R. Valukas in his report as bankruptcy examiner (United States Bankruptcy Court 2010) and by the report of the Financial Crisis Inquiry Commission (2011).

Concerns over the failure of a large dealer arise in part from the stress likely to spread to other financial markets, as was the case with the run on MMFs following the failure of Lehman Brothers. This run was triggered when the Reserve Primary Fund announced large losses on its investments in Lehman commercial paper. From September 9 to September 30, 2008, institutional investors withdrew approximately $450 billion (about one-third of their assets) from "prime" MMFs.[16] Significantly greater redemptions would likely have occurred had the U.S. Treasury not quickly guaranteed the performance of money market funds, an action that it has pledged not to take in the future (McCabe 2010).

4. Key Market Mechanics

Two key processes in the U.S. tri-party repo market contributed to its fragility during the financial crisis of 2007-09 and have delayed the current market reforms. The first is the afternoon collateral allocation process. The redesign of this process has proved more complicated than expected by the industry task force charged with the reform, and has therefore become a focus. The second is the morning unwind, the process by which clearing banks return cash to lenders' cash accounts and the collateralizing assets to dealers' securities accounts.

4.1 The Afternoon Collateral Allocation Process

In the afternoon, new repo deals must be settled.[17] This process, which occurs on the books of the clearing bank, consists of transfers of cash from the clearing accounts of the investors to those of the dealers, and transfers of securities from the clearing accounts of the dealers to those of the cash providers. The dealer's objective is to allocate its collateral to lenders in a way that is efficient from the viewpoint of financing costs and collateral usage, while meeting each lender's criteria for acceptable portfolios of collateral. This can present a relatively high-dimensional and complex mathematical programming problem because of the number of deals available to each dealer as well as the number and types of constraints on collateral imposed by individual cash providers. The allocation process is the responsibility of the dealer's clearing bank, although in many cases a dealer may become involved. This section provides a general overview of the allocation process in a typical U.S. tri-party repo setting.

Two key processes in the U.S. tri-party repo market contributed to its fragility during the financial crisis of 2007-09 and have delayed the current market reforms.

The Dealer's Problem

A large dealer might have tri-party repo relationships with, say, twenty or more significant cash providers. Each relationship can involve many different deals on a given day. For example, the tri-party repo relationship between a dealer and an asset manager responsible for a mutual fund complex could involve cash loans to the dealer from each of a number of mutual funds

[16] The data are provided in Duffie (2010).

[17] In addition, following the unwind process, term and rolling repos must also be rewound.

in the complex. Even a particular mutual fund may lend cash to the dealer through more than one tri-party repo deal on a given day. Each deal represents, in effect, a loan of cash for a given term, collateralized by a portfolio of securities meeting requirements that are stipulated in the tri-party agreement negotiated in advance by the cash investor and the dealer. The interest rate on the loan depends on the types of securities identified as eligible collateral.

Each cash investor has a "rule set" governing the portfolio of collateral that is acceptable under its repo agreement. The rule set is a collection of restrictions on the acceptable types of collateral (defined by issuer type, issuer name, security identifier [such as CUSIP], maturity, credit quality, currency, and many other properties) as well as concentration limits across types of securities. A basic rule set simply specifies the acceptable types of collateral and the associated haircuts.

A large dealer might have tri-party repo relationships with, say, twenty or more significant cash providers. Each relationship can involve many different deals on a given day.

Indeed, for U.S. Treasuries, agency debt, and agency MBS, which constitute the majority of the U.S. tri-party repo market, deals are often arranged with a specific security type in mind. The rule set is part of the CUA signed by the cash investor, the collateral provider, and the clearing bank.

Typical rule sets have evolved, becoming more complicated over time, especially for repos that may be backed by equities or non-Fedwire–eligible collateral.[18] For example, a rule set might specify "Only U.S. Treasuries, agency securities, and investment-grade, U.S.-dollar corporate bonds are acceptable. No more than 30 percent of the portfolio may be corporate bonds." The language of a tri-party repo master agreement is, of course, more precise than this description, which we offer only for illustration.

Timing

In the current market infrastructure, the collateral allocation process takes several hours, extending from about 3:00 p.m. to 6:00 p.m. or, for some dealers, to 6:30 p.m. The lateness of the allocation process is due to a number of factors.

[18] Fedwire-eligible collateral is collateral settled on the Fedwire Securities Service.

Some of a dealer's Fedwire-eligible securities, primarily U.S. Treasury and agency securities, are not available in its "box," the set of securities to which it holds title, until the Fedwire Securities Service's 3:30 p.m. close for interbank transactions. The visibility of their holdings of Fedwire-eligible securities is limited prior to 3:30 p.m., so dealers prefer to begin allocating these securities to tri-party deals no earlier than this time.

Most dealers also trade in the GCF repo market. A dealer may choose—or, depending on its available securities, need—to wait for its GCF trades to settle before completing some of its tri-party repo allocations. Settlement of GCF repos can last until 4:30 p.m. or, on certain days, until 5:00 p.m. The length of this settlement period can lead to significant additional delays in the completion of the tri-party collateral allocation process.

Equities can be allocated to repos from the accounts that dealers hold at the Depository Trust Company (DTC). As with the handoff of GCF repo collateral, the receipt of DTC-eligible collateral may need to occur before some tri-party repo deals can be settled. Currently, DTC-eligible collateral becomes available as late as 4:30 p.m., although dealers may obtain partial delivery before that time if all DTC liens against the collateral have been released.

Although the tri-party collateral allocation process can begin before all DTC-eligible collateral is available and before all GCF repos are settled, it usually cannot be completed until these other steps have themselves been completed. In addition to delays caused by the timing of the handoffs of collateral involving Fedwire, DTC, and the FICC, the collateral allocation process itself takes considerable time because many dealers choose to "manually" intervene in this process, for reasons that will be discussed.

Mechanics of the Allocation Process

The allocation process for each dealer has two basic steps. In the first, the dealer's allocation decision problem is solved, manually or with the assistance of mathematical programming software. The solution is a set of portfolios of securities, one for each repo. The second step is the transfer of title to these securities out of the dealer's box and into the collateral accounts that cash providers hold at the clearing bank. This transfer of title is made against transfers of cash from the cash providers' accounts (at the clearing bank) into the borrowing dealer's cash account (at the clearing bank).

To facilitate the first step, the clearing banks make their collateral allocation systems available to the dealers. A common algorithm orders the repo deals, typically from least to most

Collateral Allocation Algorithms

For purposes of software input, a cash provider's rule set is converted into a combination of mathematical restrictions. For example, a concentration limit can be specified in terms of a linear inequality constraint of the form

$$C(k, n): b(1, k, n)x(1, n) + b(2, k, n)x(2, n) + \ldots + b(m, k, n)x(m, n) \leq c(k, n),$$

where $x(i,n)$ is the market value of security number i allocated to deal n, $b(i,k,n)$ is the contribution of security i to constraint k of deal n, and $c(k,n)$ is the constraint maximum, such as the allowable market value of securities that may be allocated under the k-th constraint of deal n.

For instance, if the cash loan size of deal n is $100 million and if the k-th constraint on this deal specifies that no more than 30 percent of the collateral (after haircuts) may be investment-grade corporate bonds, and if the associated haircut implies multiplication by a factor of 1.05, then $c(k,n)$ = $31.5 million and $b(i,k)$ = 1 if the i-th security in the dealer's "box" is a corporate bond; otherwise, $b(i,k)$ = 0.

Constraints that rule out securities of a particular type, such as speculatively rated corporate bonds, can be specified by a constraint of the form "$x(i,n) = 0$" for any security i of the excluded type.

Rules can be combined via "logical and" and "logical or" operations. For example, a rule set could require:

$$[C(1, n) \ AND \ C(2, n) \ AND \ C(3, n)] \ OR \ [C(1, n) \ AND \ C(4, n)],$$

meaning that the allocation to the n-th deal must meet all of the restrictions $C(1,n)$, $C(2,n)$, and $C(3,n)$—or, alternatively, can be satisfied by meeting restrictions $C(1,n)$ and $C(4,n)$.

There can also be cross-deal concentration limits associated with groups of deals from the same dealer client. Of course, there are also cross-deal constraints associated with the dealer's total available amounts of each security, which can be specified in the form

$$x(i, 1) + \ldots + x(i, N) \leq v(i),$$

where N is the total number of deals to be populated with collateral and $v(i)$ is the total market value of security i in the dealer's "box" available for allocation. Of course, there is also a nonnegativity restriction on $x(i,n)$ for all i and n.

This mathematical description of the problem constraints does not necessarily explain the software or methods actually used by clearing banks; rather, it is used here to illustrate the underlying nature of the problem.

For a given dealer, a simple allocation algorithm could begin by determining preliminary allocations, deal by deal, taking some particular dealer-specified ordering of deals (or "deal sort"), such as "largest deal first." The dealer may also rank the available collateral in the order that it wishes to have the collateral allocated, with the most desired ranked first. Dealers often prefer to conserve their most liquid securities, such as U.S. Treasuries, by first allocating relatively illiquid ones.

For example, a simple algorithm would allocate securities, type by type, with the highest-ranked security allocated first, to deals in the given deal order, until the available quantity of the given type of security is exhausted or until each deal has the maximum amount of that security consistent with its concentration limits. This iterative algorithm is not an explicit optimization, beyond the desired effects of security rankings and deal order.

An explicit optimization algorithm could, for instance, maximize the total quantity of financing from deals that can be collateralized with the available pool of securities. Alternatively, the algorithm could be designed to minimize the dealer's net interest expense for financing the dealer's securities (the "cost of carry") or to minimize the use of margin (that is, other things equal, show preference to deals with lower average haircuts). Various forms of optimization criteria could be tried, allowing the dealer to select the preferred allocation among the resulting outputs.

If an allocation algorithm is unable to populate all of the deals with the initially available pool of dealer collateral, the dealer may then "upgrade" the collateral pool. For example, in order to achieve a feasible allocation, the dealer could upgrade the basket of available securities by adding some U.S. Treasuries, which are typically accepted in most deals. A dealer may even complete a collateral package with cash. The dealer's upgrade schedule can be priority ranked, with the most desired collateral to be allocated ranked first.

If, even with upgrades, the amount and mix of collateral are insufficient to cover all deals, some rationing algorithm must be used, unless the dealer is able to renegotiate some trades. A dealer could have sufficient amounts of financing, but nevertheless fail on some deals because of insufficient collateral. In such a case, the dealer could prioritize specific clients, or give preference to older deals or those that could be collateralized with securities from markets that have already closed.

restrictive in their collateral concentration limits, and ranks the collateral, typically from lowest to highest quality. The repo deals are then allocated collateral, one by one, with assets in rank order. Some dealers, particularly small ones, use this algorithm to allocate their entire tri-party repo books.

Some dealers feel they can achieve a better collateral allocation with a "script," each step of which uses the ranking-based algorithm described above but applied only to a restricted set of deals and a restricted set of collateral. For example, one step could be to allocate a dealer's Treasury

collateral to deals that accept only Treasuries. By using this approach, dealers can better control the allocation process. This method has the benefit of not requiring a CUSIP-level specification of the allocation of securities. (The box provides additional details on collateral allocation algorithms.)

The collateral allocation systems used by the clearing banks do not have filters that are sufficiently granular to meet some cash providers' collateral requirements. For example, some investors may accept residential MBS but not commercial MBS. If the clearing bank's system is unable to distinguish between these two types of mortgage-backed securities, the collateral allocation process may require a dealer's manual intervention. Similarly, a clearing bank's system for distinguishing between the credit ratings of corporate bonds may not be sufficiently granular to accommodate the rules

The collateral allocation systems used by the clearing banks do not have filters that are sufficiently granular to meet some cash providers' collateral requirements.

applied by some cash providers. In such instances, dealers must manually allocate collateral to some of their deals at the CUSIP level, specifying exactly which collateral to allocate to each repo.

Another motive for a dealer to override its clearing bank's automated collateral allocation mechanism and manually intervene is the belief by the dealer that it can achieve a more efficient allocation of its collateral. Ideally, the allocation process maximizes the amount of financing that can be obtained from a given pool of collateral, or minimizes the dealer's all-in net cost of financing, including the effect of haircuts. The use of the clearing banks' automated allocation systems, and the avoidance of "manual overrides," is therefore promoted by the sophistication of the optimization algorithms used in these systems.

4.2. The Morning Unwind

Under market arrangements in place during the crisis, each morning between 8:00 and 8:30, the clearing banks would unwind all tri-party repo trades, including term and rolling repos not maturing that day.[19] Recall from Section 3 that the return of cash to investors creates a need for dealers to find another source of financing until the day's trades and other outstanding trades are settled in the evening. This financing is provided by the clearing banks, which extend intraday secured credit to the dealers in the form of repos to finance essentially all of their securities until the lenders' funds settle in the evening.

The clearing banks apply a risk management concept known as net free equity (NFE) to ensure that the market value of the dealer's securities held at the clearing bank, including the effect of haircuts, exceeds the value of the intraday loans provided to the dealer. Dealers may also keep securities that are not financed through tri-party repos in their accounts at the clearing bank, increasing their NFE.

A complete unwind of all repos, and not merely those maturing, is an operationally simple process. An alternative would be a process by which dealers could substitute collateral (including cash) into repo deals without unwinding them, in order to extract a needed security, possibly at multiple points in the business day. Through-the-day collateral substitution is prevalent in European tri-party repo markets. By contrast, the U.S. clearing banks have offered some automated collateral substitution capabilities to U.S. tri-party repo market participants only since June 2011.

Unwinds are at the discretion of the clearing bank. This significant fact was not well understood by some market participants prior to the financial crisis. In the event that a clearing bank becomes concerned about a dealer's credit quality—fearing, for example, that the dealer might declare bankruptcy during the coming day—the clearing agreement between a dealer and a tri-party clearing bank normally gives the clearing bank the right to protect itself by not unwinding. This would leave the original tri-party cash providers exposed to the dealer, but still holding the dealer's collateral.

A clearing bank's failure to unwind a dealer's tri-party repos would almost certainly force that dealer into default because the dealer would not be able to deliver promised securities. Moreover, investors would likely refuse to continue funding the dealer. Cash providers would then have possession of the securities backing the repos and could be forced to liquidate some or all of them.

A special concern is that U.S. money market mutual funds accept as repo collateral some types of securities that they are not permitted, under Rule 2a-7 of the Investment Company Act, to hold on their balance sheets. For example, an MMF may not be able to hold a ten-year Treasury note, given the regulatory maximum maturity of thirteen months for an MMF's assets.

[19] On August 22, 2011, the unwind moved to 3:30 p.m. As of the end of 2011, one clearing bank does not systematically unwind the term repos of some investors.

5. Conclusion

This article reviews some key mechanics that played a role in the systemic weaknesses of the U.S. tri-party repo market revealed during the financial crisis of 2007-09. These weaknesses have proved an obstacle to industry reform efforts, which started in September 2009 and are currently incomplete.

The collateral allocation process in the tri-party repo market currently requires a considerable amount of time, partly because of the desire of some dealers to intervene in this process. In addition, the need to settle in the GCF market before the rest of the tri-party repo market only extends the length of the process. Settling in the GCF market also requires coordination between the Fixed Income Clearing Corporation and the clearing banks as well as communication between their systems. A similar form of coordination is required with the Depository Trust Company. The time required to allocate collateral makes it difficult to settle new and expiring repos simultaneously and thus to reduce the dealers' reliance on credit from their clearing banks. This factor has been an obstacle to ongoing reforms of the tri-party repo market.

The daily time gap between the unwind and rewind of repos drives much of the demand for intraday credit from the clearing banks, contributing to the fragility of the market in several ways. First, the gap between unwind and rewind means that there is a twice-daily transfer of exposure from a dealer's investors to its clearing bank, and then from its clearing bank back to its investors. This handoff can create a perverse dynamic if the dealer comes under stress, as both the cash investor and the clearing bank may want to be the first to reduce exposure to the dealer.

Moreover, if a dealer declares bankruptcy during part of the day, its clearing bank could be weakened. This could create spillovers to other dealers that use this clearing bank for their tri-party activity, because investors may fear exposure to the clearing bank. It could also lead cash providers whose cash accounts are at the clearing bank to demand their cash on short notice, further exposing the clearing bank or promoting a fire sale of some collateral.

Finally, a dealer failure could disrupt the clearing bank's ability to function and thus undermine its ability to conduct other important payment, clearing, and settlement activities. This could not only destabilize the tri-party repo market, but also serve as a channel for transmitting systemic risk more broadly throughout U.S. and even global financial markets.

In principle, a collateral allocation process that allows for the simultaneous settlement of new and expiring repos would eliminate the gap between unwind and rewind, reducing the dealers' need for intraday credit. The clearing banks could design a collateral allocation system that achieves the various optimization objectives desired by dealers, thereby removing the incentive for them to manually intervene in the process. The resulting collateral allocation process would also need to be transparent to investors, allowing them to evaluate their own settlement risks.

The U.S. tri-party repo market is one of the most important components of the financial system. Improving the collateral allocation process and eliminating the time gap between the unwind and rewind of collateral would help reduce the fragility of the market and the amount of risk in the financial system.

Darrell Duffie has potential conflicts of interest that may be reviewed on his webpage (www.stanford.edu/~duffie/). Among these, he is a member of the board of directors of Moody's Corporation and has been retained as a consultant by the estate of Lehman Brothers Holdings Inc. on matters potentially related to the subject of this article.

References

Adrian, T., C. Burke, and J. McAndrews. 2009. "The Federal Reserve's Primary Dealer Credit Facility." Federal Reserve Bank of New York Current Issues in Economics and Finance 15, no. 4 (August).

Copeland, A., I. Davis, E. LeSueur, and A. Martin. 2012. "Mapping and Sizing the U.S. Repo Market." Federal Reserve Bank of New York *Liberty Street Economics* blog, June 25. Available at http://libertystreeteconomics.newyorkfed.org/2012/06/mapping-and-sizing-the-us-repo-market.html.

Copeland, A., A. Martin, and M. W. Walker. 2010. "The Tri-Party Repo Market before the 2010 Reforms." Federal Reserve Bank of New York Staff Reports, no. 477, November.

Duffie, D. 2010. How Big Banks Fail and What to Do about It. Princeton, N.J.: Princeton University Press.

Duffie, D. Forthcoming. "Replumbing Our Financial System: Uneven Progress." International Journal of Central Banking. Available at http://darrellduffie.com/uploads/working/DuffieReplumbingJuly2012.pdf.

Duffie, D., and D. Skeel. 2012. "A Dialogue on the Costs and Benefits of Automatic Stays for Derivatives and Repurchase Agreements." In Kenneth E. Scott and John B. Taylor, eds., Bankruptcy Not Bailout: A Special Chapter 14. Palo Alto, Calif.: Hoover Institution Press.

Federal Reserve Bank of New York. 2010. "Tri-Party Repo Infrastructure Reform." White paper, May 17. Available at http://www.newyorkfed.org/banking/nyfrb_triparty_whitepaper.pdf.

Financial Crisis Inquiry Commission. 2011. "The Financial Crisis Inquiry Report: Final Report of the National Commission on the Causes of the Financial and Economic Crisis in the United States." January. Available at http://www.gpo.gov/fdsys/pkg/GPO-FCIC/pdf/GPO-FCIC.pdf.

Fleming, M., and K. D. Garbade. 2003. "The Repurchase Agreement Refined: GCF Repo®." Federal Reserve Bank of New York Current Issues in Economics and Finance 9, no. 6 (June).

Garbade, K. D. 2006. "The Evolution of Repo Contracting Conventions in the 1980s." Federal Reserve Bank of New York Economic Policy Review 12, no. 1 (May): 27-42.

Gorton, G., and A. Metrick. 2012. "Securitized Banking and the Run on Repo." Journal of Financial Economics 104, no. 3 (June): 425-51.

Hördahl, P., and M. R. King. 2008. "Developments in Repo Markets during the Financial Turmoil." BIS Quarterly Review, December: 37-53. Available at http://www.bis.org/publ/qtrpdf/r_qt0812e.pdf.

McCabe, P. E. 2010. "The Cross Section of Money Market Fund Risks and Financial Crises." Board of Governors of the Federal Reserve System Finance and Economics Discussion Series no. 2010-51, September.

United States Bankruptcy Court, Southern District of New York. 2010. In re Lehman Brothers Holdings, Inc., et al., Debtors. "Report of Anton R. Valukas, Examiner." Chapter 11, Case no. 08-13555 (JMP), March 11.

Adam Ashcraft, Allan Malz, and Zoltan Pozsar

The Federal Reserve's Term Asset-Backed Securities Loan Facility

- The securitization markets for consumer and business ABS and CMBS came to a near-complete halt in the fall of 2008, when investors stopped participating in these markets.
- ABS markets supply a substantial share of credit to consumers and small businesses, so their disruption threatened to exacerbate the downturn in the economy.
- On November 25, 2008, the Federal Reserve announced the creation of the TALF program to address the funding liquidity problem in securitization markets.
- Under the program, the Federal Reserve extended term loans collateralized by securities to buyers of certain high-quality ABS and CMBS, with the intent of reopening the new-issue ABS market.
- Through the TALF program, the Federal Reserve was able to prevent the shutdown of lending to consumers and small businesses, while limiting the public sector's risk.

1. Introduction

In the fall of 2008, investors stopped participating in securitization markets. They fled not only the residential mortgage-backed securities that triggered the financial crisis, but also consumer and business asset-backed securities (ABS), which had a long track record of strong performance, and commercial mortgage-backed securities (CMBS).

The rapid disintermediation of money market funds following the collapse of Lehman Brothers had a dramatic impact on the investor base for structured credit, which included short-term funding from money funds through repurchase agreements and asset-backed commercial paper (ABCP) issuance. With no buyers and plenty of distressed sellers, the price of structured credit bonds quickly incorporated large liquidity premiums, which significantly increased the cost of new issues and, consequently, the cost of originating new loans. The unprecedented widening of structured credit spreads rendered new issuance uneconomical, and the shutdown in term funding markets for issuers contributed to a contraction in credit that threatened to exacerbate the downturn in the economy.

Programs such as the U.S. Treasury's guarantee of money funds and the Federal Reserve's Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility (AMLF) supported the orderly liquidation of prime money market fund

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positions. However, it was the Term Asset-Backed Securities Loan Facility (TALF) and Commercial Paper Funding Facility (CPFF) that helped stabilize funding markets for issuers. TALF extended term loans, collateralized by the securities, to buyers of certain high-quality asset-backed securities and commercial mortgage-backed securities.

Without support by the public sector, it could have taken considerable time for a market-clearing price of leverage to reemerge, and that likely would have initially occurred only at financing rates and other terms that would have made funding costs prohibitive for well-underwritten structured credit. TALF endeavored to fill the balance sheet vacuum left in the wake of the withdrawal of levered ABS investors and to short-circuit the seemingly endless cycle of ABS spread-widening, by providing term asset-backed funding otherwise unavailable to investors. By reopening the new-issue ABS market, the regular flow of assets from loan originators to loan warehouses and to new-issue ABS and finally ABS investors would be restored, ultimately supporting the provision of credit to consumers and small businesses.

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An important liquidity effect of the shutdown of securitization markets was the disappearance of price observations. In the absence of benchmark securitization transactions and secondary-market trading, lenders had poor information about their cost of funding. By promoting the new issue and trading of structured credit, TALF aimed to reduce uncertainty to issuers about their funding costs, making it more attractive to originate new loans.

TALF loans could be secured by certain newly issued ABS and CMBS as well as by certain previously issued, or "legacy," CMBS. The legacy CMBS program was intended to support new-issue CMBS by facilitating trading and price discovery, while also reducing liquidity premiums. Secondary-market spreads constitute hurdle rates for new issuance, since potential investors have the choice of buying bonds in the secondary market rather than the new-issue market. These spreads were wide enough in late 2008 to make ultimate loan rates uneconomical. Even after accounting for investors' distaste for the low underwriting standards associated with late-vintage CMBS deals, secondary-market spreads were an impediment to making the economics of new issuance work. To the extent that the market was expressing aversion to legacy CMBS assets as opposed to the CMBS asset class as a whole, the legacy program could address this by funding leveraged investors' purchases of even the safest bonds from otherwise toxic CMBS deals. Tighter legacy CMBS would reduce the cost of new loans by reducing investors' opportunity costs.

In an environment of impaired funding liquidity, many investors wished to have drastically lower leverage, but were unwilling to sell assets at distressed prices. Some potential investors would be hindered from buying new securitization bonds if they could not first reduce the size of their balance sheets, and they could not do so without a levered bid for the assets. The legacy program was also intended to reverse the depletion of capital caused by market illiquidity for institutions holding these bonds, thus directly reducing their leverage and better positioning them to issue new commercial real estate loans.

TALF played a significant role in the policy response to the financial crisis. This article suggests that TALF made an important contribution to preventing the securitization markets from shutting down entirely and abruptly. The program appears to have done so through its intended effects on market and funding liquidity, which in turn restored pricing levels that were compatible with continued credit intermediation through the securitization channel, albeit at lower volumes. While TALF was successful in reviving securitization markets where liquidity was the fundamental problem, it did not prevent a significant collapse in the amount of credit intermediation. The collapse in credit provided by both banks and nonbank investors through securitization has declined dramatically, owing in part to lower demand for credit and in part to a reduction in the supply of credit by lenders, each related to the severe economic downturn.

Because of its unusual features compared with the Federal Reserve's other emergency liquidity programs, TALF touches on a number of interrelated research and policy issues in economics and finance, including the scope of the central bank's lender-of-last-resort function, the monetary policy transmission mechanism, the nature of liquidity, and the risk management of complex products. While this article cannot address them all, it does at least call attention to the wide range of issues that the TALF experience has raised.

Our study proceeds as follows. We begin by reviewing the crisis events to which the TALF responded. We then describe the thinking behind the design of the facility. Finally, we attempt to measure the extent to which the program succeeded.

2. Background to the Collapse

Securitization involves the sale of a pool of loans or receivables, generally referred to as *collateral*, to a bankruptcy-remote trust, which issues bonds called asset-backed securities, or ABS. If the loans are mortgages secured by residential or commercial real estate, the securities are called residential mortgage-backed securities, or RMBS, or commercial mortgage-backed securities, or CMBS.[1] The process generally involves tranching, which allocates principal and/or losses from the collateral in a certain order to those bonds, with those receiving principal first and losses last being the most senior. In the development of securitization markets, the fineness of ABS tranching increased and the investor base for ABS shifted from traditional buy-and-hold investors (such as pensions) to investors relying on short-term borrowing (such as structured investment vehicles, or SIVs).

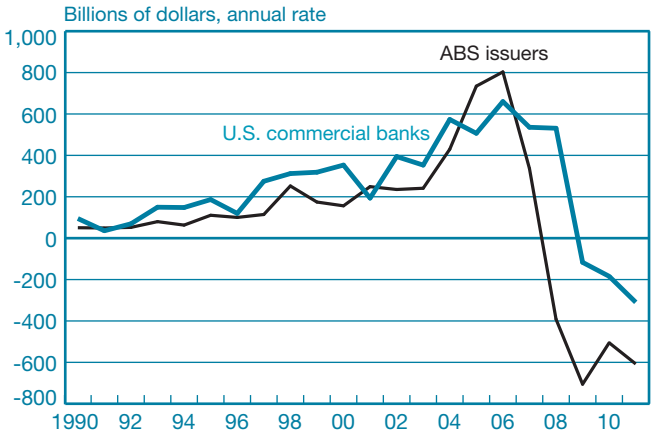
In this sketch of the securitization markets' evolution up until the crisis, we highlight two key features: 1) in aggregate financial intermediation, the share of nonbanks, which rely more heavily than banks on ABS for funding, grew, and 2) to finance purchases of ABS, investors increasingly relied on short-term funding markets, which were disrupted following the collapse of Lehman.

2.1 Nonbanks Have Become an Important Part of the Origination of Credit

Over the prior quarter-century, securitization has played an increasing role in credit intermediation. Chart 1 plots credit intermediation by commercial banks and ABS issuers. These data on net issuance of securitized credit products include residential mortgages as well as consumer and small-business debt and commercial mortgages. The chart illustrates that, from near zero in 1984, ABS issuance reached levels on a par

[1] The term ABS generally refers to bonds backed by both mortgage and nonmortgage loans and receivables, but is sometimes used more narrowly to mean only bonds backed by nonmortgage loans. In this article, we generally use the term ABS in this narrower sense and write "ABS and CMBS" to indicate bonds backed by both nonmortgage loans and commercial-mortgage loans. But to reduce redundancy, we sometimes use the term "ABS" in its more generic sense.

Chart 1
Net Credit Intermediation by Commercial Banks and Issuers of Asset-Backed Securities (ABS)



Source: Federal Reserve Statistical Release Z.1, "Flow of Funds Accounts of the United States."

with bank lending by the beginning of the last decade. When the recent credit crunch hit, ABS issuance dropped much more rapidly than bank lending. New issuance disappeared, and net issuance, which excludes amortization and repayment of outstanding bonds, turned negative in 2008.

The types of institutions that supplied consumers and small businesses with credit have changed since the 1980s. Banks became less and less important intermediaries of auto loans, student loans, and equipment loans—to name the largest categories—and were displaced by finance companies[2] as the main originators of these types of credit. There are also several other niche loan types, such as auto dealer floorplan loans and franchise loans, which finance dealer inventories or the purchase of a franchise. In these categories as well, finance companies have taken over from banks as the main lenders.

Among the primary providers of different types of credit just prior to the financial crisis, auto finance companies and the captive finance arms of foreign auto manufacturers topped banks in terms of the total volume of auto loans, leases, and dealer floorplan loans. Nonbank lenders dwarfed banks in the volume of student loans originated. The captive finance arms of big-ticket equipment manufacturers had overtaken banks in the issuance of equipment loans, leases, and diversified floorplan loans. Equipment finance companies had become

[2] Finance companies are nonbank credit intermediaries. Like banks, finance companies lend; however, unlike banks, they are not funded with deposits, but in wholesale funding markets. Furthermore, finance companies' funding sources are not insured by the Federal Deposit Insurance Corporation (FDIC) and their rollover risks are not backed by the Federal Reserve's discount window. Examples of finance companies include Ford Motor Credit, AmeriCredit, and (prior to its conversion to a bank holding company) American Express.

niche lenders to small- and medium-sized enterprises seeking funding for purchases of small- to mid-ticket equipment.

In addition to small "monoline" finance companies, several large finance companies also operated diversified finance businesses, including diversified floorplan lending; aircraft finance; franchise loans; debtor-in-possession financing; middle-market lending; and student, equipment, consumer, and credit card loans. In contrast, while some nonbank finance companies have been in the credit card lending business, large banks have dominated this segment.

The types of institutions that supplied consumers and small businesses with credit have changed since the 1980s. Banks became less and less important intermediaries of auto loans, student loans, and equipment loans—to name the largest categories—and were displaced by finance companies as the main originators of these types of credit.

2.2 Nonbanks Rely on Securitization for Funding

Funding for these nonbank lending activities came mainly through wholesale channels, including unsecured corporate debt, bank loans, and term ABS. Different loan types and lenders depended on these wholesale funding sources to varying degrees. In general, an investment-grade finance company has access to diversified funding sources, while a noninvestment-grade finance company generally has access only to secured forms of funding.

While term ABS was not the only source of funding that financed nonbank credit intermediation, it was the single largest form of funding for the finance company universe as a whole. Just prior to the financial crisis, in 2007, annual issuance of nonmortgage credit funded through the term ABS market reached about $250 billion.[3] Of this total, $90 billion was for credit card loans (originated mainly by banks), $70 billion was for auto loans and leases, $50 billion was for student loans, and nearly $10 billion was for equipment loans and leases. The non-credit-card categories were originated mainly by finance companies.

Throughout the securitization boom of 2003-07, the annual volume of nonmortgage ABS remained relatively stable at roughly $230 billion, in sharp contrast to residential mortgages, where annual origination volumes *doubled* over the same period. This suggests that, unlike the mortgage market, the nonmortgage ABS market did not experience rapid volume growth driven by a collapse in underwriting standards over the period. A key reason for the maintenance of standards was that nonmortgage ABS were issued on an originate-to-fund basis, where issuers generally retain a first-loss piece in the deal. Thus for finance companies, the primary motivation behind securitization was funding, not arbitrage, risk transfer, or capital relief.

During the securitization boom, commercial real estate (CRE) lending also became materially dependent on securitization. Commercial mortgages had traditionally been issued by banks, insurance companies, and wealthy households. Then, in the mid-1980s, real estate investment trusts, which were introduced in 1960, began to take on a significant share of commercial property investing. Securitization of commercial mortgages through CMBS was introduced in the mid-1980s and was first used extensively in the early 1990s by the Resolution Trust Company as a means of liquidating the CRE assets of failed savings and loan associations. CMBS assumed an increasing share of the intermediation of CRE credit over the next two decades, accounting for more than 25 percent at the peak in 2007 (Chart 2).

For finance companies, the primary motivation behind securitization was funding, not arbitrage, risk transfer, or capital relief.

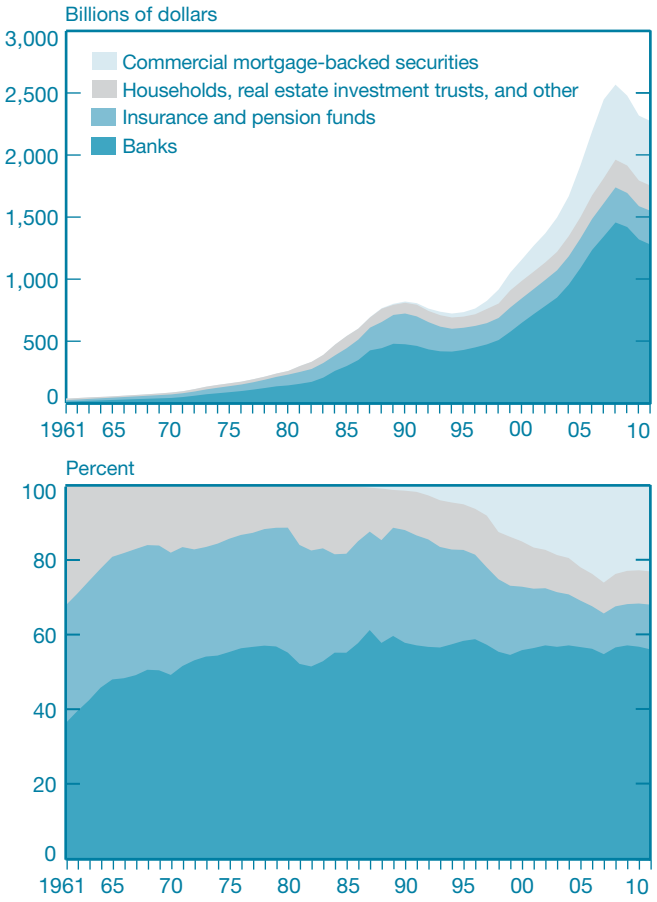
Unlike the forms of credit underlying consumer and commercial ABS, CMBS is an originate-to-distribute business, where loans are originated by banks that use securitization as a way to arbitrage differences in prices between whole loan and bond markets. Like the market for residential lending, there was a credit cycle in commercial real estate, driven by deterioration in underwriting standards. In particular, CMBS investors accepted higher leverage ratios and the use of estimated future (rather than current) rental income to determine appropriate leverage, which therefore became more

[3] Figures cited here and in the following paragraph are drawn from the *Asset-Backed Alert* issuance database.

Chart 2

Sources of Commercial Mortgage Lending

Amount and Share of Commercial Real Estate Funding Outstanding



Source: Federal Reserve Statistical Release Z.1, "Flow of Funds Accounts of the United States, Table L.220."

Note: Share of total commercial mortgage assets, NSA.

common in the mortgage loans backing CMBS. As in the RMBS market, the historically important role of due diligence by junior tranche investors was increasingly short-circuited by the sale of junior tranches into collateralized debt obligations, which facilitated greater leverage and minimal "skin in the game."

However, while underwriting standards deteriorated, there was less overbuilding of commercial real estate prior to 2007, compared with residential real estate and with earlier commercial real estate cycles. The vulnerability of the CRE sector to financial distress was therefore somewhat less acute than that of residential real estate.

2.3 Many Term ABS Investors Employed Maturity Mismatch

The investor base of ABS has undergone a profound change and expansion since the 1980s. While the initial ABS deals of the mid-1980s were sold mainly to real-money investors such as insurance companies and pension funds, ABS deals issued twenty years later at the onset of the crisis also relied on a diverse set of nonbank levered ABS investors. These new investors were drawn into the market through the increasing importance and acceptance of complex vehicles (SIVs and ABCP conduits), instruments (prime money market mutual funds), and transactions (tri-party repo and securities lending)

A significant part of the investor base for term ABS prior to the financial crisis engaged in maturity mismatch, with SIVs accounting for 8 to 15 percent, securities lenders for 15 to 25 percent, and money market mutual funds for 8 to 10 percent.

that facilitated the use of short-term funding to leverage the relatively low yields of long-term high-quality assets. As shown in Table 1, a significant part of the investor base for term ABS prior to the financial crisis engaged in maturity mismatch, with SIVs accounting for 8 to 15 percent, securities lenders for 15 to 25 percent, and money market mutual funds for 8 to 10 percent.

In the residential and commercial real estate markets, banks and broker-dealers using their balance sheets for warehouse lending were important indirect "investors." Anticipating that they would be in the "moving" but not the "storage" business, banks and investment banks not only accumulated billions of dollars of mortgage loans intended for securitization, but also provided financing for the warehouses of third-party originators.

Since all of these ABS investors conducted maturity transformation, they were exposed to rollover risk and spread-widening. The rapid deterioration of subprime mortgages triggered such a rollover event. In response, there was a run on funding for all complex vehicles such as SIVs and ABCP conduits, given limited transparency about their individual subprime exposures. Until the fall of 2008, these vehicles had

Table 1
Traditional and 2009 Asset-Backed-Security (ABS) Investor Composition

Pre-crisis Consumer ABS Investor Composition

Investor Type	Share of Market (Percent)
Securities lenders	15-25
Asset managers	15-20
Money market mutual funds	8-10
Insurance companies	10-20
Bank portfolios	10-15
Structured investment vehicles	8-15
Sovereign wealth funds	8
Pension funds	8
Corporate accounts	5
Hedge funds	2-5

2009 Consumer ABS Investor Composition

Investor Type	Share of Market (Percent)
Asset managers	42
Hedge funds/private equity	32
Insurance companies	11
Pension funds	7
Bank portfolios	4
Other	3
Corporate accounts	1

Sources: Pre-crisis shares—Federal Reserve Bank of New York; Barclays; Citigroup; J.P. Morgan Chase; Bank of America/Merrill Lynch; 2009 shares—Federal Reserve Bank of New York; Citigroup.

been absorbed by their parents, avoiding large forced sales of ABS. In the process, the vehicles were put into runoff mode—that is, they stopped purchasing new-issue ABS. The disappearance of this bid from the ABS market, which represented at least 50 percent of investor demand, was reflected in a 100-basis-point widening in new-issue ABS spreads between September 2007 and August 2008. The widening in ABS spreads was initially welcomed by real money accounts (traditional ABS investors such as insurance companies, pension funds, and money market funds), which could once again get their hands on new-issue ABS at relatively rich spreads and were not outbid by levered investors. Demand from real-money investors sustained the new-issue ABS market until the Lehman bankruptcy.

2.4 Lehman's Collapse Severely Reduced Investor Demand for Securitization

The bankruptcy of Lehman Brothers caused a cardiac arrest in the financial system, including a complete freeze-up in ABS issuance. Levered investors who relied on funding through repurchase agreements ("repo lines") and securities lending arrangements were the main link between the seizure in ABS issuance and Lehman's bankruptcy. Following the Lehman event, these repo lenders, like all financial institutions, became extremely protective of their balance sheets and sought aggressively to raise cash. Those who relied on short-term funding suddenly faced far more stringent credit terms on

With loan warehouses full and securitization markets closed, some finance companies were close to the point where they would have to decline otherwise creditworthy consumers seeking credit because they could not secure refinancing from banks or capital markets.

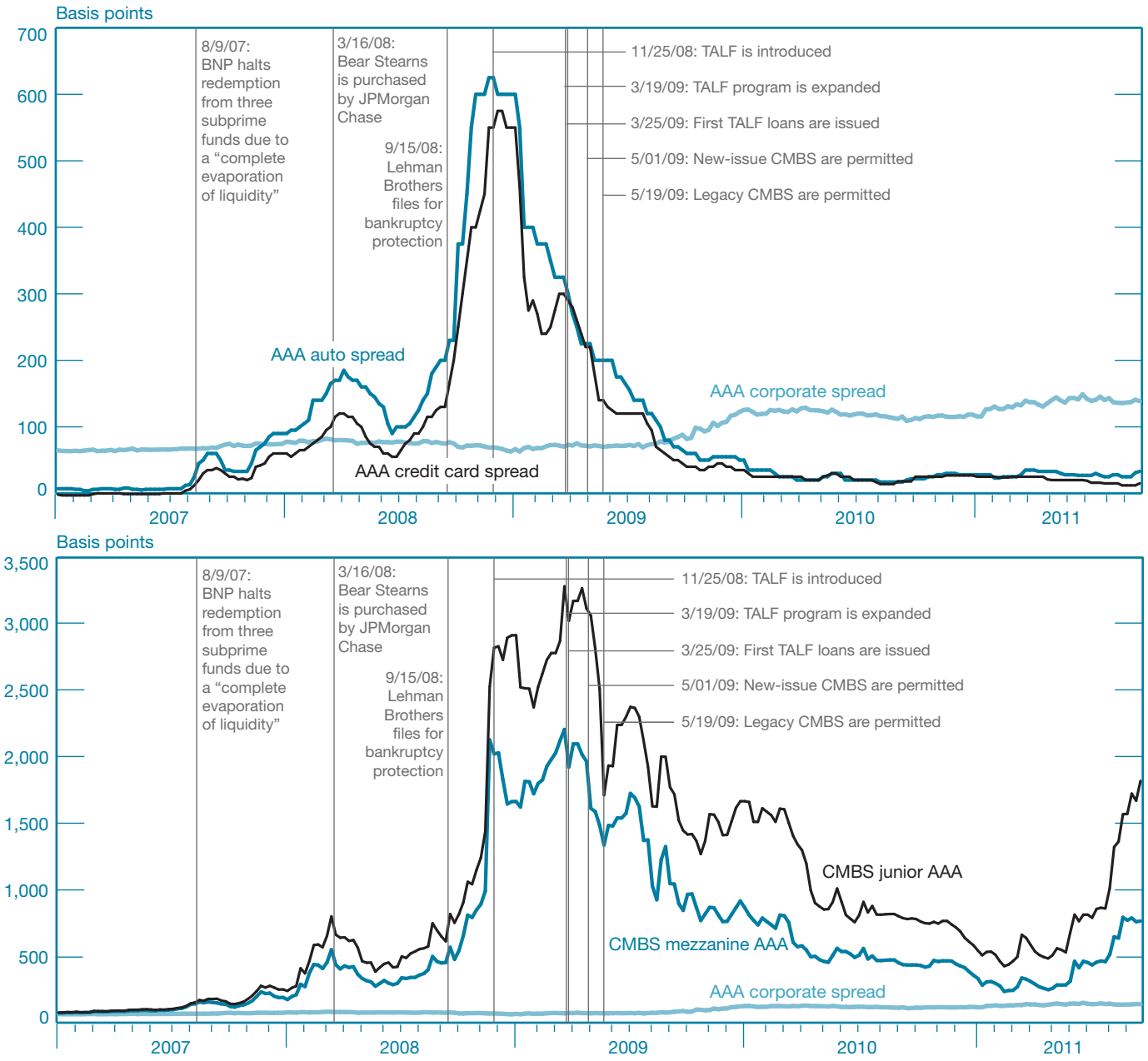
pledged high-quality assets. The inability of levered investors to continue funding on stricter terms led to the surrender and liquidation of collateral, pushing spreads across several types of ABS wider by several hundred basis points (Chart 3, top panel). The decline in prices associated with these liquidations put further pressure on margins, which led to further liquidations.

Unlike the run on term ABS, investors' aversion to the CMBS asset class increased steadily from 2007 and reached staggering proportions in late 2008. It reflected anxiety over a possible rapid increase in commercial mortgage loan defaults driven by the decline in credit standards and high leverage of many properties in CMBS loan pools as well as the potential for a severe economic downturn. Following the bankruptcy of Lehman, which was driven by concerns about the credit quality of its CRE loan warehouse, CMBS prices were also driven lower by liquidity-driven selling and the desire to sell early in what increasingly looked like an asset "fire sale." Spreads for bonds with extremely high credit enhancement, which had been near 20 basis points in 2006, reached approximately 1,500 basis points immediately following the Lehman bankruptcy.

The rapid widening of securitization spreads kept even real money accounts—money market and fixed-income mutual funds—from the new-issue market, as they had to mark their

Chart 3

Consumer Asset-Backed-Security and Commercial-Mortgage-Backed-Security (CMBS) Spreads



Sources: JPMorgan Chase; Bloomberg Financial L.P.

recent purchases to the wider spreads, forcing them to report diminishing net asset values and exposing them to greater risk of redemptions. Unsure about potential fire sales stemming from the forced liquidation of levered accounts, real money accounts stopped buying new-issue ABS altogether, clogging a crucial channel of credit to the real economy and an important source of funding for finance companies and credit card programs.

The introduction of the Commercial Paper Funding Facility (CPFF) by the Federal Reserve and the Term Liquidity Guarantee Program (TLGP) by the FDIC supported continued issuance of highly rated short-term debt and of unsecured

long-term debt by banks. However, these programs did not address the needs of nonbank finance companies whose funding relied predominantly on term ABS. While these finance companies were mainly noninvestment grade, they were also specialist lenders, operating in niches (auto loans and leases, for example) no other lender would have been able to enter or ramp up at short notice.

The lack of funding for these finance companies threatened the real economy with a seizure in the flow of credit. A look under the hood at the shadow banking system's securitization funding infrastructure suggested that this threat could materialize with only a short lag following Lehman's demise. With securitization markets frozen, finance companies had no outlet for loans that had accumulated in their loan warehouses, and banks were unwilling to expand these warehouse lines because of their own balance sheet concerns. With loan warehouses full and securitization markets closed, some finance companies were close to the point where they would have to decline otherwise creditworthy consumers seeking credit because they could not secure refinancing from banks or capital markets. Given the importance of consumer and small-business spending in the economy, and the fact that finance companies were more important providers of certain types of credit than banks, support of securitization markets became of paramount importance from a macroeconomic stability perspective.

Table 2
Events in the TALF Program

November 25, 2008	Initial program announcement
March 19, 2009	First new-issue asset-backed-security (ABS) subscription
March 19, 2009	Expansion to equipment, servicing advance, fleet lease, nonauto floorplan
March 19, 2009	Joint U.S. Treasury/Federal Reserve announcement of expansion of TALF to up to $1 trillion and plans to study inclusion of legacy commercial mortgage-backed securities (CMBS) and residential mortgage-backed securities
May 1, 2009	Expansion to new-issue CMBS and insurance premium receivables
May 1, 2009	Announcement of five-year TALF loans, carry cap
May 16, 2009	First new-issue CMBS subscription
May 19, 2009	Expansion to legacy CMBS
July 16, 2009	First legacy CMBS subscription
November 3, 2009	First ABS subscription applying Fed credit risk assessment
November 17, 2009	First TALF-eligible new-issue CMBS deal
March 4, 2010	Last ABS subscription date
March 19, 2010	Last legacy CMBS subscription date
June 18, 2010	Last new-issue CMBS subscription date
July 20, 2010	Reduction of TARP capital in TALF LLC

Source: http://www.newyorkfed.org/markets/talf_announcements.html.

3. The Design of the TALF Program

TALF was intended to mitigate the impact of the rapid decline of term funding liquidity for nonbank issuers of ABS and CMBS and to avert a collapse of new issuance through the injection into the financial system of balance sheet capacity for high-quality ABS and CMBS. Policymakers were concerned that in the absence of action to maintain issuance, the supply of credit to consumers and mortgage borrowers would freeze up. The Federal Reserve aimed to head off this event by offering loans to finance purchases of ABS and CMBS, collateralized by the securities.

The Fed's work on potential programs to support the ABS market began in immediate response to the cessation of ABS issuance, the exit of AAA investors, and the drastic widening of secondary-market spreads. By mid-November 2008, a small number of viable approaches had been identified and discussed. Created under the authority of Section 13(3) of the Federal Reserve Act, the TALF program and its initial terms and conditions were announced on November 25, 2008. Under the TALF, the Federal Reserve Bank of New York was authorized to make loans totaling up to $200 billion to investors in eligible ABS. The U.S. Treasury committed $20 billion of Troubled Asset Relief Program (TARP) funds as credit protection to the Federal Reserve.

Even before the TALF program was officially announced, staff work on its implementation had already commenced. Over the next four months, Fed staff set up the complex operational apparatus of the program, drafted the Master Loan and Security Agreement (MLSA), and refined the terms and conditions based on extensive consultations with market participants. The first TALF subscription followed these intense efforts on March 17, 2009. (Key events in the program's life are listed in Table 2.)

Normally, the monetary authorities would have approached the funding liquidity problem in securitization markets by reducing the cost of funding for depository institutions. But this was not a viable course of action in October 2008 because short-term interest rates were already near zero. More important, depository institutions, like other financial

institutions with significant exposure to residential and commercial real estate, were eager to reduce, not expand, their balance sheets and thus were in no position to fully take up the slack caused by the collapse of ABCP conduits and SIVs and by the repo markets' rejection of asset- and mortgage-backed collateral.

The most direct alternative approach would have been to extend discount window access to nonbank loan originators. But although it would have had the virtue of requiring haircuts given by the lender, such a program would have been operationally demanding for the Federal Reserve's District banks to carry out. In particular, direct lending would have required the Fed to accurately assess both the overall financial condition of nonbank lenders, of which it had little knowledge, and the risk of the whole loan pools. In contrast, requiring a lender to sell loans to a trust that issues term ABS would use the existing securitization mechanisms, oblige the issuer to face discipline from third parties other than the Fed (investors and the credit rating agencies), and put the Fed as lender in a better position in the event of issuer bankruptcy.[4] Consequently, the TALF program was designed to provide term liquidity to issuers through securitization rather than direct loans.

TALF was intended to mitigate the impact of the rapid decline of term funding liquidity for nonbank issuers of ABS and CMBS and to avert a collapse of new issuance through the injection into the financial system of balance sheet capacity for high-quality ABS and CMBS.

Private scrutiny not only of loan pools but also of securitization liabilities was desirable in view of the long term to maturity of TALF loans and the dispersion of new-issue spreads and credit quality for a given rating across ABS sectors. To render effective market discipline of securitization liabilities as well as loan pools, the TALF program relied on the purchase of new-issue ABS by private investors rather than directly by the Federal Reserve. The program avoided undercutting market mechanisms for allocating credit to borrowers by relying on private structuring and pricing of new securitizations. Moreover, if the public sector became the term ABS buyer of last resort, this would do nothing to restart the market and would complicate its ability to ultimately exit from the program. In contrast, under the CPFF, the Fed lent not to third-party investors but to issuers, using the commercial paper they issued as collateral. But these were short-term (ninety-day) loans to high-quality issuers with little dispersion in spreads for a given rating.

Relying on private investors in new-issue ABS and CMBS and enabling at least some deals to come to market would also provide benchmark pricing to the market. Even a small number of transactions would inform market participants about where securitization liabilities would tend to price. This would reduce market and funding liquidity risk by diminishing uncertainty about the funding cost of the underlying loans and the feasibility of a securitization exit, easing a key constraint on willingness to lend to creditworthy borrowers. Lower liquidity risk would also reduce the large liquidity premium component of secondary-market spreads.

The TALF program was structured with private investors taking a first-loss position and the public sector taking a tail-risk position. To avoid undercutting market mechanisms of risk monitoring and due diligence regarding the creditworthiness of the loans, the program imposed haircuts on the TALF loans by lending an amount against the bonds that was materially smaller than the value of the bonds taken as collateral. With a first-loss position, investors have skin in the game, incentivizing them to screen collateral for credit quality. Otherwise, they have an incentive to adversely select collateral—that is, pledge the lowest-quality eligible collateral.

The TALF program was structured with private investors taking a first-loss position and the public sector taking a tail-risk position.

TALF could conceivably have been structured with the public sector sharing both risk and upside with the private sector.[5] But high secondary-market spreads made the economics of such a program difficult. Yields of 20 percent on short average-life legacy fixed-rate conduit CMBS presented an insuperably high hurdle rate to attracting potential investors to three-year auto loan ABS. For investors to be willing to place capital at risk by purchasing term ABS with a coupon of 3 to 5 percent, it was necessary to provide them with a significant

[4] In another example of the Fed using capital market discipline over borrowers to minimize the risks of its crisis policy tools, when it expanded counterparties in March 2008 by extending discount window access to primary dealers through the Primary Dealer Credit Facility, the Fed accepted only securities, and not whole loans, as collateral.

[5] The U.S. Treasury's Legacy Securities PPIP program employed a more complicated form of risk sharing with both public-sector-supplied leverage and an equity stake. However, that program involved less than a dozen private investors.

amount of leverage. Public sector funding would thus have a greater impact if deployed in a senior rather than junior position within the capital structure.

Collateralized margin lending by the Federal Reserve to new-issue ABS investors emerged clearly as a program form that would implement three necessary elements: use of securitization, sale of term ABS to third parties, and provision of leverage. The challenge was to fill in the details in a way that provided adequate funding liquidity to issuers as well as adequate returns to investors, while limiting the public sector's risk to an acceptable level.

3.1 Overview of the TALF Program

The basic features of the TALF program can be categorized under two headings: program structure and risk management. The basic structure of the program specified the following:

- TALF made term loans to eligible borrowers collateralized by eligible securities.
- Eligible securities were defined as those in certain "asset classes," such as auto loans or commercial real estate, among other qualifications.
- TALF was a standing (rather than auction) facility with monthly subscription dates.
- A broad range of ABS types, but only those types, were eligible collateral:
    - newly issued ABS backed by credit card, auto, small-business, dealer floorplan, equipment, and student loans, and by insurance premium and residential mortgage servicing advance receivables;
    - newly issued CMBS secured by fixed-rate commercial real estate loans; and
    - structurally senior legacy CMBS secured by fixed-rate commercial real estate loans.
- TALF loans had maturities of three or five years.
- TALF made fixed-rate or floating-rate loans. Fixed rates were set prior to each subscription for each eligible collateral type, basis, and loan maturity as a spread over an index. The level of the index, but not the spread, varied by subscription month.
- TALF agents, most of which are also primary dealers, acted as agents for all TALF loans, responsible, among other functions, for crediting or debiting borrowers' accounts for loan proceeds, for making interest and loan repayments, and for delivering and receiving collateral.

The market, credit, and compliance risks of the program to the public sector were managed through these program features:

- To be eligible collateral for a TALF loan, ABS had to be of high credit quality, as evidenced both by AAA ratings and a Federal Reserve risk assessment.
- A haircut, the amount by which the loan proceeds are lower than the value of collateral, was applied to each item of collateral accepted against a TALF loan, ensuring that investors would bear the first loss. Loans were not subject to remargining; that is, the haircut would not be altered during the life of the loan.
- TALF loans were nonrecourse—meaning that, should the borrower fail to repay, the Federal Reserve would keep the collateral. But if proceeds from the sale of the collateral were insufficient to repay the loan, there is no further recourse to other assets of the borrower.
- If a TALF loan were not repaid and the proceeds could not be recouped through sale of the collateral, the U.S. Treasury would bear the next loss, after the borrower's haircut, up to a specified amount, beyond which the Federal Reserve would bear any further losses.
- Risk- and revenue-sharing between the Fed and the U.S. Treasury, and administration of any collateral retained by the facility because of nonrepayment of the loans, were implemented through a special-purpose vehicle called TALF LLC.
- TALF borrowers were to be U.S. persons or companies, and they could not have a material interest in the collateral.

The program is described in great detail in the terms and conditions, frequently asked questions, MLSA, and other documents posted on the New York Fed's website.[6] While TALF loan subscriptions have ended for all asset classes, the program remains in operation, administering payments of principal and interest as well as overseeing TALF LLC.

3.2 The Importance to Issuers of Placing the Senior Bonds

The TALF program was limited to providing funding liquidity for AAA-rated bonds. Since AAA bonds form the bulk of the liabilities of most securitizations, reducing the liquidity premium in AAA-rated ABS and CMBS yields would be the most effective means of reducing issuers' cost of originating loans.

[6] See http://www.newyorkfed.org/markets/talf.html.

To illustrate how crucial the senior bonds are, we use a simple example of a two-tranche ABS. The example will also help explain the risk management of the program later on. We need to specify its key elements: the assets in the collateral pool and the liability structure. We assume the pool is a granular (highly diversified and with little exposure to any single borrower) and static set of identical one-year loans or mortgages paying a fixed rate of 9.5 percent. If a loan defaults, recovery is zero.[7]

Assume that the liabilities consist of just two tranches of securities: One is an equity or first-loss tranche, held by the originator of the underlying loans and amounting to 12.5 percent of the securitization liabilities. The other is a senior bond with a maturity of one year and an annual fixed-rate coupon of 4 percent. It has an attachment point or credit enhancement of 12.5 percent, since the equity tranche bears the first 12.5 percent of losses.[8] The bond has a first-priority claim on principal and interest. The equity tranche earns the residual, if any, of principal and interest on the underlying loans once the senior tranche has been paid off in full and suffers credit write-downs prior to the bonds. We assume that there are no underwriting and management fees.

The granularity assumption permits us to apply the single-factor credit risk model, in which defaults are driven by a systematic ("market" or economy-wide) factor and idiosyncratic random shocks that are specific to the individual loan. We assume each loan has an unconditional probability of default—the default probability one would estimate knowing nothing about the state of the economy—of π = 3.5 percent per annum. The default correlation—the extent to which loan defaults coincide—is set by β, a parameter that drives the relative strength of systematic and idiosyncratic shocks in determining defaults. When β is high, systematic shocks dominate, the creditworthiness of the loans is highly dependent on overall economic conditions, and default correlation is high. We assume β = 0.35. The expected equity return is then 18.5 percent, which we assume is the issuer's hurdle rate for engaging in the business of originating loans and then securitizing the pools.[9]

To show how a large increase in senior bonds' liquidity premiums affects the economic viability of securitization, we carry out a comparative statics exercise in which we drastically increase the required senior yield, then compute how the underlying loan rate would have to adjust to maintain an equity return of 18.5 percent, given the increased cost of term funding.

Increasing the required bond yield by 650 basis points to 10.5 percent, a widening comparable to that in the fall of 2008, even with no change in the expected default rate, reduces the equity return to a loss of nearly 27 percent. By comparison, that impact on the equity return is about the same as a tripling of the expected default rate. In order for one to restore the equity return to the hurdle rate, the "breakeven" loan rate would have to nearly double from 9.5 to 15 percent. An increase in loan rates of this magnitude would have substantially limited consumers' and businesses' demand for credit.

Following the Lehman bankruptcy, of course, all of the parameters investors focused on were moving: Default rates were expected or feared to be rising, and required rates of return were increasing. Thus, the example is a relatively benign case. But it suggests that spreads on AAA bonds would have a disproportionate effect on the overall economics of securitization. That is, providing funding that reduced the liquidity premium component of AAA spreads could restore the economic viability of the securitization channel.

It was not obvious at the time the TALF was created that reducing AAA bond yields, and thus the breakeven loan rate, would suffice to keep originators from reducing credit supply.

It was not obvious at the time the TALF was created that reducing AAA bond yields, and thus the breakeven loan rate, would suffice to keep originators from reducing credit supply. Apart from the funding costs of the loans, originators planning to securitize loans faced two additional balance sheet constraints. First, issuers had historically sold term subordinated (sub-AAA) ABS in addition to the senior bonds. The market for these subordinated tranches disappeared during the post-Lehman panic, so lenders would have to fund the rest of the capital structure on balance sheet. It was unclear

[7] The granularity assumption is reasonable for some asset classes that are typically financed through ABS, such as auto loans, but less so for other asset classes, such as credit cards, for which the collateral pool is usually a revolving pool of loans. As these loans are paid off or discharged after default, they are replaced by new loans. It is a poor representation of CMBS, in which many, if not all, the mortgages in the collateral pool are typically large relative to the total size of the pool; accordingly, a small but surprising cluster of defaults can be a threat even to relatively senior bonds.

[8] The boundary between two securitization tranches, expressed as a percentage of the total liabilities, is called the *attachment point* of the more senior tranche and the *detachment point* of the more junior tranche.

[9] The single-factor model was introduced by Vasicek (1991). The model enables us to compute the probability distribution of collateral losses, as a fraction of the pool, for any parameter pair π and β. Each collateral loss leads to an associated bond and equity return. The expected bond and equity returns can then be computed as the average return, weighted by the probabilities of the associated collateral losses.

if they had adequate capital or alternative funding sources to do so at a cost that would permit them to continue lending. Second, given the dire economic outlook, the amount of credit enhancement an issuer had to provide to achieve a AAA term ABS rating had increased significantly, reducing the share of the lower-cost AAA proceeds in the securitization liability mix. A significant uncertainty of program design was thus whether issuers could continue supplying credit while facing this reduction in their ability to fund new loans even if the AAA bonds could be sold, or whether the market would eventually rediscover its appetite for subordinate bonds. In the event, it was not until early 2010 that issuers were able to regularly issue subordinate bonds.

3.3 The TALF Loan

While it was clear that the right design of the program would be margin lending to investors by the Federal Reserve, investors had little appetite during the crisis for the typical repo contract. TALF credit extensions therefore took the form of long-term nonrecourse loans secured by eligible collateral, not subject to mark-to-market or remargining requirements.

The Nonrecourse Provision

Broker-dealer repo would typically be at maturities from overnight to ninety days, would require both initial margin and daily marking-to-market, and might involve recourse to the borrower or to the borrower's other positions with the same dealer. For a levered investment fund, recourse would in effect grant the lender a call on the fund's remaining net asset value at loan maturity. At maturity, a repo lender could decline to refinance those positions or increase haircuts, subjecting the borrower to refinancing risk. With remargining or recourse, a transitory but sharp price decline could force a levered fund to close out its position at a loss. These funding risks were fresh in potential investors' minds following the collapse of Lehman, when broker-dealers increased haircuts and forced widespread unwinding of positions amid extreme volatility.

While recourse and remargining are significant risk mitigants for a secured lender, they would have been potentially expensive for the borrower given the recent volatility in term ABS markets. Not only would these features have reduced the investor base, but they would have prompted investors to demand higher returns to compensate for refinancing risk, which ultimately would have reduced program efficacy. A meaningful recourse provision was in any event impractical without a regime (which the Federal Reserve lacks the ability and resources to institute) to verify borrower financial condition.

The TALF borrower was also not required to cross-collateralize its total liability to the Federal Reserve with all the ABS pledged and thus had the option of putting one bond but not another. While such cross-collateralization might have provided some risk mitigation, it was deemed too easy for borrowers to circumvent by setting up multiple borrowers as well as impractical given the low level of TALF-eligible issuance.

TALF Loan Term to Maturity

The loan term was a key design element of the TALF program. Levered investors were eager to avoid the refinancing risk associated with funding longer-dated collateral with a shorter-dated loan. Most TALF collateral was eligible only for a three-year loan term, but longer-dated collateral (such as ABS secured by student loans, loans guaranteed by the U.S. Small Business Administration [SBA], or commercial real estate loans) was eligible for a five-year loan term.

Bonds issued by revolving master trusts, common for credit card ABS, do not amortize and are intended to be refinanced at maturity, so a trust's revolving period and the bond maturities can be adapted to a three-year TALF loan term. The maturities of bonds issued by amortizing trusts are more tightly connected to the amortization of the underlying collateral. The maturities of the longest senior tranches of most amortizing trusts are close to three years. Five-year loans were introduced in order to promote lending in the SBA loan, student loan, and CRE sectors, in which securities have longer maturities (seven to ten years, fifteen years, and ten years, respectively). While the TALF loan term was shorter than the bond maturities, investors could reasonably assume that market conditions would have normalized by the time the TALF loan matured, permitting them to either finance their positions in the private market or unwind them in an orderly way.

Haircuts

The advance rate, or loan amount, was determined by the market value of the ABS and the haircut applied. Haircuts varied by asset class and the bond's average life (see Table 3 for details on haircuts and Table 4 for prepayment assumptions). The average life of a security is the average timing of principal repayment, which in turn depends on assumptions about prepayment for ABS, since they are amortizing securities. In

Table 3

TALF Haircuts by Asset Class

Percent

		ABS Weighted Average Life (Years)						
Sector	Subsector	0<1	1<2	2<3	3<4	4<5	5<6	6<7
Auto	Prime retail lease	10	11	12	13	14		
Auto	Prime retail loan	6	7	8	9	10		
Auto	Subprime retail loan	9	10	11	12	13		
Auto	Motorcycle/other RV	7	8	9	10	11		
Auto	Commercial and government fleets	9	10	11	12	13		
Auto	Rental fleets	12	13	14	15	16		
Credit card	Prime	5	5	6	7	8		
Credit card	Subprime	6	7	8	9	10		
Equipment	Loans and leases	5	6	7	8	9		
Floorplan	Auto	12	13	14	15	16		
Floorplan	Nonauto	11	12	13	14	15		
Premium finance	Property and casualty	5	6	7	8	9		
Servicing advances	Residential mortgages	12	13	14	15	16		
Small business	SBA loans	5	5	5	5	5	6	6
Student loan	Private	8	9	10	11	12	13	14
Student loan	Government-guaranteed	5	5	5	5	5	6	6
CMBS	New-issue	15	15	15	15	15	16	17
CMBS	Legacy	15	15	15	15	15	17	17

Source: Federal Reserve Bank of New York: http://www.newyorkfed.org/markets/talf.html.

Notes: For asset-backed securities (ABS) benefiting from a government guarantee with average lives of five years and beyond, haircuts increase by 1 percentage point for every two additional years (or portion thereof) of average life at or beyond five years. For all other ABS with average lives of five years and beyond, haircuts increase by 1 percentage point for each additional year (or portion thereof) of average life at or beyond five years. For newly issued and legacy commercial mortgage-backed securities (CMBS) with average lives beyond five years, collateral haircuts increase by 1 percentage point of par for each additional year of average life. No CMBS may have an average life of more than ten years.

order to prevent issuers from gaming TALF haircuts by asserting high prepayment rates and thus short average lives for the securities they wished to pledge, the program set standardized prepayment assumptions by asset class. This permitted the issuer to calculate the TALF average life of each security and investors to know the haircut on a TALF loan.

The haircut was measured as a percent of value for new-issue ABS and CMBS and as a percent of par for legacy CMBS. A haircut measured as a fraction of par instead of price implies a market-value haircut that is higher for lower-value collateral, adding an additional protection against adverse selection in the legacy program.

An investor could present new-issue, TALF-eligible collateral either at issue, when the price is typically at par, or at any subsequent subscription. Underwriters of TALF-eligible ABS generally set the pricing date close to the TALF subscription date. Otherwise, between the issue and subscription dates, investors would have to seek alternative financing and face the risk of securing lower TALF loan proceeds if the bond price dropped. In the event, secondary-market TALF-eligible ABS have generally been presented at a premium to par, as spreads have narrowed since issue.

While the value of a new-issue ABS or CMBS bond for purposes of determining the loan amount was based on its price on the subscription date, the value of a legacy CMBS was based on the minimum of the investor's acquisition price and the price on subscription date, exposing the TALF investor to market risk in the period between the transaction date and the subscription date.

Table 4
TALF Prepayment Assumptions

Sector	Subsector	Prepayment Assumption
Auto	Prime retail lease	75 percent of prepayment curve
Auto	Prime retail loan	1.3 percent ABS
Auto	Subprime	1.5 percent ABS
Auto	Motorcycle/other RV	1.5 percent ABS
Auto	Commercial and government fleets	100 percent of prepayment curve
Commercial mortgage	—	0 percent CPR
Equipment	Loans and leases	8 percent CPR
Small business	SBA 7a	14 percent CPR
Small business	SBA 504	5 percent CPR
Student loan	Student loan private	4 percent CPR
Student loan	Student loan FFELP	4 percent CPR
Student loan	Student loan consolidation	50 percent of CLR curve

Source: Federal Reserve Bank of New York: http://www.newyorkfed.org/markets/talf.html.

Notes: CPR is conditional payment rate; it represents the proportion of the principal of a pool of loans that is assumed to be paid off prematurely in each period. ABS is absolute prepayment speed; it represents the percentage of the original number of loans that prepay during a given period.

TALF Loan Interest Rate

The TALF loan rate was set as a spread, fixed over the life of the program but varying by asset class and loan term, over an index (Table 5). The index for fixed-rate loans was the Libor swap rate, generally with a maturity equal to that of the TALF loan. For most asset classes, the index for floating-rate loans was the one-month Libor rate, but for some the index was the prime rate or target federal funds rate. The indexes were chosen to correspond to bond pricing conventions at issue, thus minimizing the role of interest rate risk in the borrower's put-option decision. For example, new-issue CMBS are typically priced relative to the swap curve, so the five-year TALF loan rate was the five-year swap rate on the subscription date plus 100 basis points. A five-year loan against SBA Pool Certificate collateral, in contrast, was set at a spread of 75 basis points over the target federal funds rate, which is highly correlated with the prime rate originators use to price loans to borrowers (since the prime rate is generally 300 basis points above the target federal funds rate).

Table 5
TALF Loan Rates

Collateral Type	TALF Loan Rate
Fixed-rate	
Fixed-rate asset-backed securities (ABS)	
< One year average life	One-year Libor swap rate + 100 basis points (bps)
>= One year average life	Two-year Libor swap rate + 100 bps
>= Two years average life	Three-year Libor swap rate + 100 bps
SBA Development Company participation certificates	
Three-year TALF loan	Three-year Libor swap rate + 50 bps
Five-year TALF loan	Five-year Libor swap rate + 50 bps
Commercial mortgage-backed securities	
Three-year TALF loan	Three-year Libor swap rate + 100 bps
Five-year TALF loan	Five-year Libor swap rate + 100 bps
Floating-rate	
Floating-rate ABS	One-month Libor + 100 bps
FFELP loans	One-month Libor + 50 bps
SBA pool certificates	Federal funds target + 75 bps
Private student loan	Max (100 bps, prime rate − 175 bps)

Source: Federal Reserve Bank of New York: http://www.newyorkfed.org/markets/talf.html.

Note: Libor is London inter-bank offered rate.

3.4 TALF-Eligible Asset Classes

TALF contained three subprograms, distinguished by the type of collateral supported: new-issue nonmortgage ABS, new-issue CMBS, and legacy CMBS. The program avoided undercutting market mechanisms for allocating credit to different sectors of the economy by defining eligible collateral broadly within these general classes of underlying loans. Other asset classes, such as nonagency residential mortgages, were considered, but it was ultimately concluded that the TALF program structure was not applicable and would not revive lending in those sectors. (Eligible asset classes are summarized in Table 6.)

Table 6
Overview of TALF-Eligible Collateral

Asset Class	Description	Origination Date	Issue
Auto, credit card receivables, student loans, small business	Auto loans include retail loans and leases relating to cars, light trucks, motorcycles, and other recreational vehicles; commercial and government fleet leases; and commercial loans secured by vehicles and the related fleet leases and subleases of such vehicles to rental car companies.	After October 1, 2007	[a]
	Credit card receivables include both consumer and corporate credit card receivables.	NA	[a, b]
	Student loans include federally guaranteed student loans (including consolidation loans) and private student loans.	After May 1, 2007	NA
	Small business loans include loans, debentures, or pools originated under the SBA's 7a and 504 programs, provided they are fully guaranteed as to principal and interest by the full faith and credit of the U.S. government.	After January 1, 2008	After January 1, 2008
Mortgage servicing advances, business equipment, vehicle fleet, floorplan	Mortgage servicing advances are receivables created by principal and interest, tax and insurance, and corporate advances made by Fannie Mae– or Freddie Mac–approved residential mortgage servicers.	After January 1, 2007	NA
	Equipment loans include retail loans and leases relating to business equipment. Vehicle fleet includes commercial and government fleets and commercial loans secured by vehicles and the related fleet leases and subleases of such vehicles to rental car companies.	After October 1, 2007	[a]
	Floorplan loans include revolving lines of credit to finance dealer inventories.	NA	[a, b]
Insurance premium finance, new-issue CMBS, legacy CMBS	Insurance premium finance includes loans originated for the purpose of paying premiums on property and casualty insurance originated on or after January 1, 2009.	January 1, 2009	[a, b]
	New-issue CMBS are commercial mortgage-backed securities issued on or after January 1, 2009.	After January 1, 2009	After January 1, 2009
	Legacy CMBS include structurally senior fixed-rate conduit commercial mortgage-backed securities.	NA	Before January 1, 2009

Source: Federal Reserve Bank of New York: http://www.newyorkfed.org/markets/talf.html.

[a]Asset-backed securities (ABS) must have an average life of five years or less.

[b]Must refinance maturing ABS through 2010:Q1 or be new master trust with originations after January 1, 2009. Eligible premium finance ABS may also be issued out of an existing or newly established master trust in which all or substantially all of the underlying exposures were originated on or after January 1, 2009.

New-Issue ABS and CMBS

The first subscription of the new-issue ABS program was held in March 2009 and the last in March 2010. The ABS program provided loans to investors against eligible new-issue ABS collateral, limited to AAA-rated tranches secured by consumer or small-business loans. The underlying nonmortgage credit exposures were as follows (see Table 6 for more specific requirements for each asset class):

- retail auto loans;
- commercial, rental car company, and government fleet leases;
- business equipment loans and leases;
- floorplan loans, by which, for example, auto dealers finance inventories;
- federally guaranteed and private student loans;
- credit card receivables;
- insurance premium finance loans, by which businesses finance lump-sum insurance premium payments;
- small-business loans, fully guaranteed as to principal and interest by the U.S. government, originated under the SBA's 7(a) ("Pool Certificates") and 504 ("Development Company Participation Certificates") programs; and
- servicing advance receivables, which arise from residential mortgage servicing advances.

The first subscription of the new-issue CMBS program was held in June 2009 and the last in June 2010. The program provided loans to investors against AAA tranches of eligible new-issue CMBS. To be eligible, the CMBS were required to be privately issued and structurally senior, to bear a fixed interest rate, and to be secured by first-lien, fixed-rate amortizing commercial real estate loans. In the event, only one TALF-eligible new-issue CMBS was issued.

TALF-eligible, new-issue ABS and CMBS had to have been issued on or after January 1, 2009; have AAA credit ratings from two eligible nationally recognized statistical rating organizations (NRSROs); and have no lower rating from any NRSRO.[10] The AAA rating had to be attained on the strength of the securitization collateral and structure itself, rather than through a financial guarantee or "wrap" provided by an insurance company or other third party.

Legacy CMBS

The first legacy CMBS subscription was held in July 2009 and the last in March 2010. The legacy CMBS program provided loans to investors against structurally senior, AAA fixed-rate conduit CMBS issued *before* January 1, 2009 (hence the term "legacy"). Since the purchase price factored into the determination of the loan amount, borrowers had to have purchased the legacy CMBS in recent secondary-market transactions between unaffiliated parties, executed on an arm's-length basis at prevailing market prices.

3.5 Eligible TALF Borrowers

Any U.S. company that owned eligible collateral could borrow from the TALF through an account relationship with a TALF agent. Eligible borrowers included firms organized in the United States, but excluded firms controlled or managed by an entity owned by a foreign government.[11] TALF borrowers ceded all governance rights under an ABS, including voting, consent, or waiver rights, to the New York Fed.

In order to prevent conflicts of interest that could lead to collateral being presented at inflated prices, borrowers could not borrow against ABS if they had a material economic interest in the securitization's underlying collateral pool.[12] For the same reason, as noted above, a borrower against legacy CMBS had to acquire the CMBS through an arm's-length transaction.

TALF agents were primary dealers or designated broker-dealers, operating under the New York Fed's TALF Master Loan Security Agreement to carry out specified administrative, payments processing, and compliance responsibilities. These agents were tasked with processing TALF applications; disbursing loan proceeds, as well as principal and interest generated by the collateral, to TALF borrowers; and remitting TALF loan principal and interest to the New York Fed. Borrowers worked through a TALF agent during the loan application process and throughout the life of their TALF loan, if they received one. TALF agents were required to ensure that no conflicts of interest existed in any party's participation in TALF and to demonstrate that they knew a potential borrower and could vouch for its reputation. They also were required to subject applicants to a "Know Your Customer" program based on provisions of the Patriot Act.

3.6 TALF Operations

Apart from the TALF agents, a number of other private entities helped administer the TALF program:

- Bank of New York Mellon, the program custodian, was responsible for holding collateral, collecting and distributing payments and administrative fees, verifying

[10] Eligible credit rating agencies for ABS included Moody's, Fitch, and Standard and Poor's. For new-issue and legacy CMBS, eligible credit rating agencies also included Realpoint and DBRS. Beginning with the February 2010 subscription, DBRS was an eligible credit rating agency for nonmortgage ABS. SBA Pool Certificates or Development Company Participation Certificates had an issuance cutoff date of January 1, 2008, and were exempt from the ratings requirements.

[11] A precise definition is contained in the "Eligible Borrowers" section of the General Terms and Conditions, available at http://www.newyorkfed.org/markets/talf_terms.html: "An entity is a U.S. company if it is (1) a business entity or institution that is organized under the laws of the United States or a political subdivision or territory thereof (U.S.-organized) and conducts significant operations or activities in the United States, including any U.S.-organized subsidiary of such an entity; (2) a U.S. branch or agency of a foreign bank (other than a foreign central bank) that maintains reserves with a Federal Reserve Bank; (3) a U.S. insured depository institution; or (4) an investment fund that is U.S.-organized and managed by an investment manager that has its principal place of business in the United States. An entity that satisfies any one of the requirements above is a U.S. company regardless of whether it is controlled by, or managed by, a company that is not U.S.-organized. Notwithstanding the foregoing, a U.S. company excludes any entity, other than those described in clauses (2) and (3) above, that is controlled by a foreign government or is managed by an investment manager, other than those described in clauses (2) and (3) above, that is controlled by a foreign government."

[12] As stated in the "Eligible Collateral" section of the General Terms and Conditions, "ABS will not be eligible collateral for a particular borrower if that borrower, or any of its affiliates, is the manufacturer, producer or seller of any products, or the provider of any services, the sale, provision, or lease of which is financed by the loans or leases in the pool supporting that ABS unless the loans or leases relating to such products or services constitute no more than 10% of the aggregate principal balance of the loans and leases in the pool supporting such ABS as of the issuance date of such ABS. For purposes of this requirement, products include financial products such as insurance, and services include education. In the case of leases, the term 'aggregate principal balance' refers to the securitization value of the leases in the pool."

the data provided by the TALF agents, and validating the pricing and ratings submitted for pledged securities.

- Collateral monitors provided data and modeling services used in risk assessments and also validated pricing and ratings.[13]

The New York Fed held separate monthly TALF loan subscription and settlement dates for non-CMBS ABS and for new-issue and legacy CMBS.[14] On each subscription date, it set interest rates for each type of loan, and TALF agents submitted loan request packages to the New York Fed that included:

- the requested loan amount ($10 million minimum);
- the maturity date of the loan;
- the type of interest rate (fixed or floating), corresponding to the type of collateral offered;
- filing documents, including the prospective uses and offering documents of the securities to be pledged;
- proof of purchase for the ABS and CMBS being offered as collateral;
- the CUSIPs of the securities; and
- an attestation from an accounting firm stating that the proposed collateral meets TALF's eligibility criteria, or a signed, agreed-upon procedures report from a nationally recognized accounting firm (for newly issued CMBS).

The New York Fed reserved the right to reject any request for a loan, in whole or in part, at its discretion. It also assessed an administrative fee of 10 basis points of the loan amount for nonmortgage-backed ABS collateral and 20 basis points for CMBS collateral.

The borrower (through its agent) had to deliver eligible loan collateral and administrative fees to the custodian on the TALF loan's settlement date. If the New York Fed deemed the collateral eligible, it determined the loan amount based on the haircut for the asset class, the security's average life computed under the TALF prepayment speed, and its price.

Cash Flow Waterfall

In the typical case, in which the TALF borrower does not surrender the collateral, the custodian uses cash flows from the collateral in order to make all loan principal and interest payments on behalf of the TALF borrower. The residual is delivered to the borrower through the TALF agent. The custodian holds the collateral throughout the life of the loan.

[13] Trepp (as of June 2009) and BlackRock (as of January 2010) were collateral monitors for CMBS. PIMCO (as of July 2010) was collateral monitor for the program as a whole.

[14] The first CMBS subscription (June 2009) was for new-issue CMBS only.

In general, the remittance of principal on eligible collateral is used immediately to reduce the principal amount of the TALF loan in proportion to the loan's original haircut. In other words, if the original haircut was 10 percent, 90 percent of any remittance of principal is immediately repaid to the New York Fed. This allocation of principal prevents the leverage of the TALF transaction from changing over time. Requiring deleveraging would have made the program less effective by significantly reducing investor returns and penalizing amortizing asset classes relative to asset classes with bullet structures.

For nonmortgage ABS collateral priced at a premium to par, the borrower makes an additional principal payment calculated to adjust for the expected reversion of market value toward par value as the ABS matures. The above-par payment is calculated at the inception of the TALF loan. This payment simply amortizes the premium on the bond over its expected average life.

A "carry cap" ensured that the borrower will not receive any upside from the transaction until the loan is repaid in full. It limited cash flow during the term of the TALF loan to a maximum equal to the haircut capital invested by the borrower—an important mechanism used to mitigate adverse selection.

A "carry cap" ensured that the borrower will not receive any upside from the transaction until the loan is repaid in full. It limited cash flow during the term of the TALF loan to a maximum equal to the haircut capital invested by the borrower—an important mechanism used to mitigate adverse selection. For five-year TALF loans, the excess of interest and any other distributions (excluding principal distributions) on the ABS in excess of TALF loan interest payable (the "net carry") was to be remitted to the TALF borrower only up to 25 percent per annum of the original haircut amount in the first three loan years, 10 percent in the fourth year, and 5 percent in the fifth year; the remainder of the net carry repays TALF loan principal. If, for example, the TALF loan amount against collateral priced at par was $94, and the haircut was $6, any net carry in excess of $1.50 during the first year of the loan would be applied toward reduction of the TALF loan. For a three-year TALF loan, net carry was to be remitted to the borrower each year only up to 30 percent per

annum of the original haircut amount, with the remainder applied to loan principal.

Exercise of the Put Option and TALF LLC

As TALF loans are nonrecourse, borrowers effectively own a put option on the collateral; they can surrender the collateral in exchange for extinguishing the loan. In this case, borrowers would surrender their collateral through a TALF agent, which would submit a collateral surrender form to the New York Fed.

A number of conditions must be fulfilled in order for the TALF borrower to optimally exercise the put. The ABS cannot have been fully paid down, and there must be credit impairment or loss of market value of the bond in excess of the haircut—that is, the outstanding loan amount must exceed the value of the collateral. An additional condition must prevail for the put to be optimally exercised prior to the TALF loan maturity: The interest on the TALF loan must exceed the interest paid by the ABS—in other words, the borrower has negative carry. If the borrower does not repay the loan and instead surrenders the collateral, the Treasury and Federal Reserve ultimately bear the risk of loss and have no right to pursue the borrower in the courts, even if the value of the bonds is less than the loan amount.

The New York Fed created TALF LLC, a special-purpose vehicle, to purchase and manage any assets surrendered by TALF borrowers. It was initially funded by a $100 million drawing on the U.S. Treasury's $20 billion commitment. Just under $16 million of these funds is set aside to defray administrative expenses in the event a TALF borrower exercises the put.

TALF LLC also holds the accumulated interest from TALF loans in excess of the interest earned by the New York Fed. The Fed retains a portion of TALF loan interest equal to its cost of funds—the overnight indexed swap (OIS) rate plus 25 basis points. The accumulated excess interest from TALF loans and the Treasury funding are invested to earn interest income.

The funds in TALF LLC are used for ongoing administrative expenses, which are small relative to the flows into the LLC, and would be the first funds used if collateral were purchased from a TALF borrower exercising a put. If the New York Fed were to receive notice of collateral surrender, it would sell the collateral at par to TALF LLC, which would then fund the purchase of the collateral in the following way:

- It would first draw on the funds in TALF LLC (approximately $757 million as of July 20, 2011). Although TALF borrowers with more than one loan outstanding do not cross-collateralize the loans, the accumulated interest from all TALF loans protects the public sector against losses on any of the loans.
- If these funds were exhausted, TALF LLC would borrow from the U.S. Treasury against its $20 billion commitment.[15]
- Once the $20 billion TARP loan commitment is fully funded, TALF LLC would ask the New York Fed, which committed up to $180 billion for this purpose, for a loan, which would be senior to the $20 billion Treasury loan.

If surrendered collateral is liquidated, the order in which loan repayments and the proceeds from possible asset sales from TALF LLC are distributed is defined in a credit agreement among the Treasury, the New York Fed, and TALF LLC requiring them to:

- pay general TALF program administrative expenses,
- repay the $16 million Treasury loan made to TALF LLC to cover administrative expenses,
- repay outstanding principal on any New York Fed senior loans,
- fund the cash collateral account,
- repay outstanding principal on any Treasury loans,
- repay New York Fed loan interest,
- repay Treasury loan interest,
- repay any other obligations that may arise that have not been specified by the agencies, and
- distribute to the Treasury and the New York Fed (in shares of 90 percent and 10 percent, respectively) any remainder after the above requirements are satisfied.

4. Limiting Risk to the Public Sector to an Acceptable Level

The terms of the TALF loan contract—the long terms to maturity and nonrecourse leverage without margin calls—were generous to investors and therefore required parameters on collateral, haircuts, and loan rates that limited risk to the public sector to an acceptable level. One way to define the public sector's risk appetite is that the program should be constructed in such a way that a loss occurs only in an economic downturn so severe that avoiding such losses is a subordinate goal to economic recovery.

[15] In July 2010, this commitment was reduced to $4.3 billion, or approximately 10 percent of the $43 billion in TALF loans outstanding at that time. See http://www.federalreserve.gov/newsevents/press/monetary/20100720a.htm.

The major risks to the program and to public funds fall into three broad categories: operational risk, fraud risk, and market and credit risks. Although we focus here on market and credit risks, much effort was made to identify operational, fraud, and compliance risks and to design mitigants against them.

As TALF loans are without recourse to the borrower, the market and credit risks borne by the lender depend entirely on the risks of the bonds used as collateral. If, at the maturity of the TALF loan, the value of the bonds is less than the loan amount, the borrower has an incentive to abandon the collateral and not repay the loan. The borrower is therefore said to be "long a put" on the collateral struck at the loan amount.

Credit risk is the risk that a bond will suffer a write-down or impairment as a result of defaults and low recoveries on the underlying loans. Credit risk is thus measured as a loss of par value, but may be realized prior to maturity by writing down both the value of the assets in the trust and the value of the liabilities that are affected by the asset loss. Market risk is the risk that changes in market prices—interest rates and credit spreads—will reduce the value of the bond prior to maturity, even if the bond ultimately is repaid at par. The public sector faced market risk from fluctuations in the value of its collateral and from mark-to-market losses on any collateral put by TALF borrowers in lieu of TALF loan repayment.

Mark-to-market losses may occur because the market anticipates or is more wary of credit losses, but unless those losses are actually realized and result in write-downs, the bond's value will recover over its remaining life. Credit write-downs cannot be recovered once they are realized, but mark-to-market losses can be recovered until the position is sold.

Market risk introduces the possibility that collateral might be "put to the Fed" even in the absence of severe credit losses. If the mark-to-market losses occur within the term of the TALF loan, while public funds would ultimately be recovered, there would be a transitory but nonetheless real portfolio value loss, as one asset, the TALF loan, is replaced with a bond of lower value. If large credit losses do not materialize, and the bond price recovers before eventually being sold, there is ultimately no long-term loss to the public sector.

The key mitigants to credit and market risks are:

- terms and conditions regarding collateral eligibility,
- credit enhancement provided by the issuer,
- haircuts,
- borrower payments, and
- risk review of collateral.

4.1 Risk Mitigation from Program Terms and Conditions

Program terms and conditions defined eligible collateral for TALF loans. Eligibility was limited to certain asset classes and, within each sector, to structurally senior, AAA-rated bonds. Eligible new-issue collateral was generally limited to nonmortgage ABS asset classes with a strong performance history. New-issue CMBS were eligible provided certain further criteria were met, such as collateral pools excluding large loans and floating-rate or second-lien mortgages as well as pooling and servicing agreements containing certain protections for the senior bonds. These additional terms and conditions for CMBS avoided a number of features that had contributed to poor underwriting standards and poor performance prior to the financial crisis.

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Not eligible were ABS asset classes with historically poor performance (for example, timeshares, aircraft leasing, and manufactured housing) that were not central to the goal of averting a deeper recession. Nonagency RMBS and securitizations of corporate loans were excluded, in part because of risk considerations, but also because the TALF program's approach of providing funding liquidity for senior bonds would not address the problems facing those sectors.

Among legacy securities, only structurally senior CMBS were made eligible for TALF.

Ratings of nonmortgage ABS have held up well relative to those in other structured credit asset classes. A recent study indicates that the three-year cumulative loss rate for original AAA-rated ABS is only 8 basis points.[16] Downgrades have recently outpaced upgrades for the first time since 2003, but primarily in the student loan sector, driven by negative carry from auction-rate securities and by regulatory and other fundamental changes in the private student loan business.

There are several reasons for the better ABS performance relative to CMBS and RMBS. Loan originators generally retain significant unhedged first-loss positions. Mortgage loans may be used speculatively, since they are based on real estate assets that can appreciate in value and have high refinancing risk at maturity. ABS credit enhancement is recalibrated based on observed delinquency more frequently, as the securities generally have shorter maturities. Underwriting standards for consumer and commercial loans did not deteriorate as much as those for real estate loans in the years leading up to the financial crisis. Major consumer ABS sectors are generally structured to withstand severe unemployment stress. The risk of a breakdown of the historical relationship between unemployment and loan performance introduces some systematic risk, but the idiosyncratic issuer funding or solvency risk is more significant.

The terms and conditions also called for a AAA rating from two nationally recognized statistical rating organizations and no NRSRO having downgraded or placed the bond on negative watch. This requirement significantly affected which issuers have been able to issue TALF-eligible ABS. For example, given uncertainty over the financial condition of the Big Three auto manufacturers in 2009, major NRSROs were reluctant to permit captive auto finance companies to issue auto dealer floorplan ABS with AAA ratings until it became clear that the bankruptcies of Chrysler and GMAC would proceed in an orderly fashion. Similarly, the rating agencies' uncertainty over how the FDIC's "safe harbor" from repudiation would operate in the FAS 166/167 accounting regime shut down the issue of TALF-eligible credit card ABS for several months in late 2009 until the FDIC grandfathered new-issue transactions through the end of TALF in March 2010. As a final example, no rental fleet lease ABS came to TALF, as the weak condition of issuers in that very cyclical industry made them unable to meet the TALF rating requirement.

In addition to the rating requirement, legacy CMBS that were junior in credit to any other bond were excluded. From about 2005 on, AAA-rated CMBS had been divided into tranches labeled AJ, AM, and AS; the latter is often referred to as "super-senior." While all were rated AAA, the AJ and AM tranches take write-downs before the super-seniors and so, being at nontrivial risk of downgrade or default, were excluded from the TALF legacy CMBS program.

[16] See Moody's, "Default and Loss Rates of Structured Finance Securities: 1993-2009, Exhibit 40."

4.2 Risk Mitigation from Bond Credit Enhancement

Credit enhancement takes hard and soft forms. Hard credit enhancement is funded up front, in contrast to soft enhancement, which accumulates over time. Hard credit enhancement refers to the presence of subordinated tranches sold to investors or retained by the issuer, or overcollateralization obtained by issuing an amount of debt smaller than the loan pool, or through reserve accounts funded at the time of issue. The typical soft credit enhancement is excess spread—the difference between interest on the loan pool and on the bonds. As losses have to be larger than excess spread before hitting the lowest remaining tranche, excess spread can be an important risk mitigant. However, its efficacy depends not just on the amount of losses, but also on their timing, since excess spread must accumulate before it can cover losses. With $10 in excess spread per year, $20 in losses can be absorbed over two years without writing down a tranche; however, if losses all occur in the first year, impairment of the ABS will occur.

Hard credit enhancement refers to the presence of subordinated tranches sold to investors or retained by the issuer, or overcollateralization obtained by issuing an amount of debt smaller than the loan pool, or through reserve accounts funded at the time of issue. The typical soft credit enhancement is excess spread—the difference between interest on the loan pool and on the bonds.

In an amortizing ABS trust (that is, auto loans), there is a static pool of loans, and principal repaid by the borrowers is used to pay down the balance of the bonds. For these transactions, the credit enhancement required by the rating agencies for AAA-rated bonds is generally a multiple of three to

five times a baseline level of expected loss over the life of the pool. A higher multiple is generally applied to a lower level of baseline loss. When loss expectations rise in response to a deteriorating economic environment, as occurred in 2009, additional credit enhancement could be as much as three to five times the increase in baseline loss expectation. For example, the senior class of CarMax 2008-2 had initial loss expectations of 2.75 percent and hard credit support of 10.25 percent, providing loss coverage of 3.73x. In contrast, the senior class of CarMax 2009-1 had initial loss expectations of 4 percent and hard credit support of 16.5 percent, providing loss coverage of 4.13x. In this case, an increase in baseline losses of 1.25 percent led to an additional 6.5 percent of hard credit enhancement.

In a revolving ABS trust (for example, credit cards), repayments of principal by borrowers are used to purchase new receivables and not to pay down the balance of the bonds. For these transactions, required credit enhancement for AAA-rated bonds is generally based on analysis of the trust wind-down following an early amortization event. Such a wind-down takes place when the payment rate, defined as the rate at which borrowers in the pool repay their loans, falls below a trigger level. The trust is then no longer permitted to purchase new receivables and must use all principal received to pay down the tranches. Greater charge-offs during early amortization correspond to greater pool losses, consequently requiring greater credit enhancement for a given rating level.

While higher credit enhancement requirements would normally manifest themselves in new issuance, several credit issuers took the unexpected step of adding credit enhancement to their master trusts during 2009 to avoid downgrade actions driven by increases in charge-offs. Issuers can take a range of actions to increase credit enhancement, such as creating cash infusions through additional subordinate bond tranches, increasing overcollateralization, and strengthening excess spread by removing charged-off collateral. For example, the senior class of American Express Credit Account Master Trust Series 2008-1 had credit enhancement of 12 percent with annual charge-offs near 4 percent in January 2008, but Series 2009-1 had credit enhancement of 17.5 percent as annual charge-offs increased to 11 percent in June 2009.

The typical recent-vintage fixed-rate conduit commercial real estate deal is secured by loans to more than 100 different borrowers, with the top ten loans often corresponding to 40 percent of the pool. The underlying loans have fixed interest rates, and often had interest-only options, but are balloon loans that amortize over a thirty-year term but mature much more quickly. The typical loan had a ten-year maturity, but loan pools generally also have loans with five-year and seven-year maturities. Super-senior CMBS tranches had hard credit subordination of 30 percent. With a loss severity of 50 percent, well outside the post-World War II experience for commercial real estate cycles, it would take defaults on the order of 60 percent of the pool to cause a super-senior CMBS loss.

The most senior CMBS, the AS class, is generally time-tranched into at least four classes, A1 through A4. When loans are performing, the A4 class receives principal payments last, but if credit enhancement of the super-senior class is exhausted by losses, the cash flow waterfall switches from sequential to pro rata, and all super-senior tranches share in principal and credit losses. Moreover, recoveries that are typically around 50 percent on defaulting loans are first used to pay down the A1 and A2 (first and second pay) super-senior tranches until they are fully repaid, which means that even in dire credit loss scenarios, the A1 and A2 bonds are very difficult to break. However, the A1 and A2 bonds are subject to significant extension risk, because in an environment with little liquidity for refinancing maturing balloon loans or purchasing foreclosed properties, the best option for the trust may be to extend loans until the economic environment improves. The A4 (last pay) super-senior bonds generally have an average life at issue of about ten years, while the second-pay A2 bonds generally have an average life of five years. The average life of AM and AJ bonds, which are junior to the AS class in both payment and credit priority, is also ten years.

Apart from credit enhancement, TALF-eligible bonds are also protected by other structural features that vary greatly by collateral type and issue. For most structured credit products, in addition to the senior bonds' priority in credit, the prepayments, amortization, and recovery payments flow first to the most senior bonds. Another feature is that issuers of revolving trusts have historically provided recourse (an issuer guarantee) to their securitizations in order to avoid downgrades of existing notes. While the prospect of recourse is not taken into account in setting the level of required credit enhancement, it has had a significant positive effect on the ratings history of these asset classes.

4.3 Risk Mitigation from Haircuts

ABS losses are not binary, but incremental, building up over time at a pace depending on the extent and timing of losses in the collateral pool. In most ABS, it is a near certainty that at least some collateral losses will occur in the pool; the question is whether they will exceed the attachment point—that is, the credit subordination of a particular bond. Ideally, in order to

measure risk, one would like to perform a risk analysis on each loan in the collateral pool to estimate distribution of losses at a specific time horizon and then apply the cash flow waterfall to derive the distribution of credit losses of each bond.

In the case of ABS collateral, even when the underlying loans are granular, there is usually not enough historical data to estimate with accuracy the distribution of losses and, in particular, the performance of the loans during severe economic downturns. Credit card receivables, securitized since 1987, have the longest history of securitization other than residential mortgages. In the subsequent two decades, the credit characteristics of a typical receivables pool have evolved as credit card accounts have proliferated, effectively shortening the available history that would be useful in estimating loss distributions. Between 1987 and 2007, there were only two economic downturns in the United States, neither extremely severe. Credit card receivables are the most granular ABS asset class and have the longest data history, but the capacity to draw inferences about tail events is nonetheless limited.

For other securitization asset classes, the prospects of estimating loss distributions for the pools of underlying loans are even bleaker. Commercial mortgages are at the other end of the granularity spectrum from credit card receivables. CMBS generally have, at most, a few hundred loans in the collateral pool, and delinquency of a small number of loans can often make the difference between a security being impaired or not. Moreover, the loans are very different from one another in size and other characteristics. Each loan is unique; it is not feasible to forecast the loss distribution of a commercial mortgage using the performance history of a set of different loans.

The use of haircuts, or the practice of lending less than the value of the collateral, was a key risk mitigant as well as an incentive to potential borrowers to use the TALF program and make capital available to securitization issuers.

One key difficulty in applying such ground-up approaches to risk measurement of ABS is the role of default correlation, a measure of the likelihood of two different loans in the underlying collateral pool defaulting over a given time horizon. It captures systematic risk—the risk of a severe economic downturn in which an unusual number of underlying loans default simultaneously. This risk drives the tails of the distribution and is particularly relevant to TALF, which endeavored to reduce the probability of credit loss to a very low level. As with all financial assets, expected losses can be estimated with some accuracy, but the tails of the distribution are extremely difficult to gauge because large losses are rare events and long histories are needed to generate even a few observations on them. Of course, the tails of the distribution are what is most relevant to risk measurement.

To see the impact of correlation, we return to the simple ABS example analyzed in the previous section using the single-factor credit risk model. The senior bond will suffer impairment only if the pool losses are so high as to wipe out the equity entirely. Equivalently, the senior bond will be impaired if the loan proceeds at maturity are insufficient to pay its principal and interest. The probability of a pool loss reaching that level or greater can be computed within the single-factor model for any pair of parameters π (loan pool default rate) and β (correlation parameter). These probabilities of impairment of the senior bond are expressed in percent below:

	$\beta = 0.025$	$\beta = 0.35$	$\beta = 0.99$
$\pi = 0.035$	0.00	0.17	4.36
$\pi = 0.070$	0.00	2.48	8.52
$\pi = 0.105$	0.00	9.19	12.58

The correlation parameter β has a large impact. If correlation is low, there is a negligible likelihood that even a high default rate will break the senior bond, given its 12.5 percent credit subordination and the 5.5 percent spread between the loan interest rate and 4 percent bond coupon. If correlation is medium or high, the senior bond has a higher likelihood of impairment even at a relatively low default rate.

The use of haircuts, or the practice of lending less than the value of the collateral, was a key risk mitigant as well as an incentive to potential borrowers to use the TALF program and make capital available to securitization issuers. Haircuts enabled borrowers to take leveraged positions in TALF-eligible ABS; the reciprocal of the haircut is the leverage ratio. The leveraged return has two parts: 1) the net spread—or the difference between the coupon and TALF lending rate, multiplied by the leverage ratio, minus the interest paid on the TALF loan, and 2) the bond's price appreciation times the leverage ratio.

The capital invested by the borrower in the form of a haircut is a first-loss position. Because the loan is nonrecourse, the maximum the investor can lose is 100 percent of that capital. Losses in excess of the haircut diminish the Federal Reserve's interest and fee income and, if large enough, can cause a net loss to the TALF's public sector funding. If, for example, spreads widen significantly but not drastically, and the bond price drops by, say, 2 points and the leverage ratio is 10, the

investor will suffer a 20 percent mark-to-market loss. A drastic widening leading to a 10-point decline will wipe the investor out.[17] At the other end of the return distribution, the investor can keep any gains from spread tightening. The haircuts were designed to provide high leveraged returns while protecting the Federal Reserve and Treasury. Haircuts were risk sensitive, varying by the underlying asset class and the security's weighted average life.

In the absence of adequate data on the credit quality of the underlying loans, and thus the ability to accurately estimate loss distributions "from the ground up," other approaches to quantitative risk measurement were explored and ultimately deployed. These approaches attempt to fully exploit the historical data on defaults and market pricing, or to take account of the credit characteristics of the collateral pool underlying a particular bond.

The first approach is to use historical data on ABS bond impairment to estimate future losses. These data represent the fraction of bonds in a given category, such as asset class and credit quality, that have suffered a material impairment over a given time horizon—say, one or five years. Data also exist on the expected loss on each bond, conditional on the occurrence of impairment. The impairment rate and loss given impairment can then be treated analogously to corporate or sovereign default and loss-given-default rates.

The second approach is to extract risk-neutral ABS loss rates from credit spreads on ABS. The credit spread is the compensation, expressed as a rate, that the market or typical investor requires as compensation for the risk of holding ABS. It has several components: the mean impairment rate and loss given impairment, the product of which gives the loss rate the market actually expects, and the risk premium, which is the compensation the market requires to bear all the risks of investing in ABS, including the tail credit risk, market spread fluctuations, and liquidity.

The third and final approach is to apply stress scenario analysis. In this approach, a stress scenario is defined that is more adverse than expected. The scenario can be defined in terms of macroeconomic variables; the severity of the scenario depends on the risk appetite of the program. A model is required to translate the scenario into losses in the collateral pool, which in turn, through the cash flow waterfall, can be used to compute losses on the bonds.

All of these approaches share model risk—namely, the risk of incorrectly estimating the parameters of the model and thus over- or underestimating the risk of the bonds. Additional conservatism was built into the TALF risk models in order to protect against model risk.

[17] The investor will, however, not put the bond prior to the maturity of the TALF loan as long as the cash flow from the transaction remains positive.

Using haircuts as a risk mitigant creates the potential for adverse selection, a problem that would affect any nonrecourse collateralized lending program. Adverse selection arises because a TALF borrower has an incentive to invest in bonds with a higher spread within an asset class and weighted-average-life category, since they would have the same haircut under the TALF terms and conditions as bonds with lower spreads. Weaker bonds would have higher spreads and thus higher leveraged returns, but also higher tail risk—that is, a higher probability that the collateral value would fall below the loan amount at the maturity of the TALF loan. Nonrecourse permits the borrower to shift the risk of an extreme loss to the lender. In the new-issue ABS program, adverse selection could manifest itself in a tendency for weaker issuers, or issuers in asset classes that are weaker in ways that are hard to mitigate through additional credit enhancement, to use the program. In the legacy CMBS program, adverse selection would express itself in a tendency for borrowers to borrow against legacy bonds of lower credit quality.[18]

4.4 Risk Mitigation through Credit Reviews

In the past, one answer to the difficulties of risk measurement for structured credit had been credit ratings. The credit rating agencies (CRAs) reviewed aspects of the deal relevant to credit quality, such as the quality of the underlying loans, the bankruptcy-remoteness of their sale into the trust, and the financial strength of the issuer. Most crucially, the CRAs opined on whether the attachment points of the bonds were consistent with the imperviousness to credit write-downs that investors should expect to be associated with various ratings.

However, in November 2008, structured product ratings were largely discredited. Subprime residential had performed execrably, with most bonds suffering downgrades; expected pool losses were many times the projected tail losses, and it became obvious that the ratings models, which had attributed a probability of zero to the event of house price declines, had been fundamentally flawed. The performance of ratings with respect to CMBS was far better, but still poor; senior bonds in late-vintage CMBS deals had, in some cases, been given ratings as high as bonds in earlier deals with far better underwriting standards. However, the CRAs appeared to have done a

[18] There are additional restrictions for financing subsidiaries of a public-private investment fund (PPIF) established pursuant to the Legacy Securities Public-Private Investment Program. In particular, in order to prevent double leveraging, these borrowers may participate in the legacy CMBS only if the PPIF is receiving Treasury-supplied debt financing equal to or less than 50 percent of the PPIF's total equity (including private and Treasury-supplied equity) and satisfies all other borrower eligibility requirements.

reasonably accurate job on nonmortgage ABS. A further difficulty was that for securitizations, as opposed to corporate bonds, the probabilities of default are based on sparse historical data sets and therefore are less reliable than corporate ratings, which can take into account a long history of corporate default experience.

A final problem was that the CRAs might well set credit enhancement levels or other ratings criteria at significantly *more* stringent levels than in the past, in order to repair their damaged reputations by overcompensating for the lower underwriting standards of late-vintage deals. In fact, credit enhancement levels have tended to be higher for 2009 and later ABS deals than in the recent past. In part, this has been a response to higher expected losses and to investor demand for higher credit enhancement. However, ratios of credit enhancement levels to expected losses have also risen.

To address the potential risk and problem with program effectiveness posed by the use of CRA ratings, the Fed conducted internal credit reviews before accepting bonds as collateral. This review provided a layer of due diligence beyond that of the credit rating agencies and investors, putting the public sector in a better position to manage adverse selection.

In view of these risk management challenges and the urgency of constructing a program as quickly as possible, it was hard to dispense with CRAs. Over time, their role in TALF evolved. Initially, with ABS being the only TALF-eligible asset class, the eligibility requirements focused on credit ratings. As additional asset classes were contemplated, the disinclination to rely too heavily on ratings grew. For legacy residential MBS, for example, ratings were nearly devoid of information content.

To address the potential risk and problem with program effectiveness posed by the use of CRA ratings, the Fed conducted internal credit reviews before accepting bonds as collateral. This review provided a layer of due diligence beyond that of the credit rating agencies and investors, putting the public sector in a better position to manage adverse selection. The reviews have been somewhat different for the three program segments.

In addition to formal risk assessments, the Federal Reserve revised its approach to selecting the set of CRAs whose ratings could be used to determine TALF eligibility. Initially confined to "major NRSROs," the set was expanded to include additional CRAs beginning in November 2008. Moreover, rather than drawing from a fixed list of CRAs, the Fed set criteria, enshrined in a rule, for determining the set of CRAs whose ratings could be used to determine TALF eligibility for each TALF asset class.[19]

Nonmortgage ABS

Beginning with the November nonmortgage ABS subscription,[20] the New York Fed performed its own risk assessment of nonmortgage ABS proposed as TALF-eligible loan collateral. To facilitate this review, the Fed asked sponsors or issuers of proposed TALF-eligible ABS to provide all data on the ABS or its underlying exposures that had been provided to any NRSRO well in advance of the applicable TALF subscription date.

New-Issue CMBS

A more intensive risk review was associated with the new-issue CMBS program, which included not only an analysis of the underlying loan pool and trust structure, but also a review of key legal documents. In addition, certain protections for the public sector were to be incorporated in the trust structure of single-borrower deals, in which one borrower places loans on a number of properties it owns and operates into the CMBS trust (unlike a conduit or fusion CMBS, in which the underlying properties are owned by many borrowers). Pooling of cash flows across properties reduces the probability that any one property will default on its mortgage, but concentrates property ownership and management, potentially amplifying conflicts of interest between the owner and bondholders. Single-borrower transactions therefore typically have lower loan-to-value ratios than conduit deals and include only investment-grade bonds. (Conduit deals, however, include B-rated bonds.)

The Federal Reserve retained the right to reject individual loans from a proposed pool in the new-issue CMBS program. Intermediaries were reluctant to add rather than reduce assets

[19] The announcement of the rule can be found at http://www.federalreserve.gov/newsevents/press/monetary/20091204a.htm.

[20] For a description of TALF's operations schedule, see the subsection TALF Operations (3.6).

in the post-Lehman environment, especially given CRE credit risk. Potential CMBS issuers were therefore uneasy about originating loans with a view to a TALF-eligible securitization that might be rejected by the Fed after the issuer funded the loans. Consequently, issuers initially endeavored to securitize single-borrower pools, for which TALF eligibility could be clarified more easily in advance of funding.

As part of its credit review, the Federal Reserve was also attentive to potential conflicts of interest within the governance structures of potential new-issue CMBS deals. An important example is the role of the special servicer, a firm entrusted with the administration and disposition of delinquent properties. In a typical CMBS transaction, the special servicer is instructed under a servicing agreement to make decisions in the interest of the trust as a whole, according to an industry standard. In late-vintage CMBS transactions, however, the most junior bond class, which absorbs losses first, was typically given consent rights and the right to replace the special servicer, giving the junior investor leverage over decision making. Allocating these rights to the junior investor has the function of disciplining the special servicer, benefiting all investors. However, this mechanism also creates scope for abuse owing to the conflicts between junior and senior tranches, particularly regarding the decision to foreclose versus extend a loan. Typically, the junior tranches prefer to extend troubled loans, thus preserving the "option value" of possible recovery, while the senior tranches prefer rapid foreclosure, reducing the potential for further deterioration of recovery value. Senior investors' concerns about such conflicts are amplified by the often limited transparency of the rationale behind the special servicer's decisions. In its capacity as lender to the senior investor, TALF shared these concerns.

In the event, only one new-issue CMBS transaction, a single-borrower issue sponsored by Developers Diversified Realty (DDR) in November 2009, was supported by TALF. The DDR trust agreement addressed governance concerns through these features:

- Enhanced reporting to all investors regarding the rationale behind major decisions (particularly an analysis of whether the action would produce the largest net present value) and disclosure of relevant assumptions in the calculation. In principle, this communication should provide transparency into why a special servicer has taken a particular course of action, providing additional discipline on servicer behavior and increasing the confidence investors have in the integrity of the transaction.
- No individual tranche has either consultative rights or the right to replace the special servicer. With the advantage of junior-tranche investors removed, there is no scope for them to intimidate the special servicer into taking their preferred course of action. While it resolves the conflict, this feature does remove an important check on the special servicer's behavior. In order to rectify this, the transaction introduced the concept of an independent operating advisor (OA), who represents the trust and has consultative rights over major decisions by the special servicer. The OA can recommend to investors that the special servicer be replaced, and a majority vote of each class is required to overturn this recommendation. A regime giving any one class a veto would mean that the class benefiting from the special servicer's decision would be able to block the OA's attempt to remedy the situation and thus protect the interest of the trust as a whole.

Legacy CMBS

For the legacy CMBS program, the New York Fed conducted a risk assessment of loan requests in the period between the subscription date and the settlement date. In particular, the Fed worked with collateral monitors to estimate stress valuations for the collateral behind each loan request. These are forward valuations of the submitted collateral, measured at TALF loan maturity in a severe credit and spread environment. These stress valuations are compared with the loan amount in order to identify loan requests where the borrower would be likely to put the collateral. The New York Fed disclosed the outcome of the risk review to the market in order to prevent the process from creating information asymmetries (between the borrower and other investors) that would reduce market liquidity.

The risk review process was an important check on adverse selection by TALF borrowers, despite the low rejection rate of 13 percent.

The risk review process was an important check on adverse selection by TALF borrowers, despite the low rejection rate of 13 percent.[21] Its effectiveness in inducing monitoring of collateral quality by TALF borrowers is evidenced in dealers' calls, during TALF's active lending phase, for greater transparency into the "black box" of the legacy CMBS risk review and, in particular, for the Fed's publication of a list of

[21] This rate is measured as the ratio of the number of rejected CUSIPs to the total number tendered during the nine legacy CMBS subscriptions.

eligible legacy CMBS CUSIPs prior to subscriptions. Had the program done so, market participants would have had an incentive to submit lower-quality collateral chosen from that list. The TALF portfolio would then be weighted toward the lower-quality end of the generally high credit quality super-senior spectrum. The possibility of CUSIP rejection motivated borrowers to perform their own due diligence on the bonds and refrain from submitting bonds from deals with serious known problems, as they would then have risked either holding the bonds or selling them into the market at a loss following rejection. While this may have limited liquidity support by the program for the most risky super-senior bonds, it avoided funding a portfolio of the riskiest eligible bonds.

Beyond the impact on risk taken by the public sector, publishing a list of eligible bonds might also have reduced the informativeness of market prices. In particular, there was a risk that the program would attract investors with little experience in the sector who would then "free ride" on the private expertise, buying bonds on the basis of yield in the sector with little appreciation for risk. While this would be a positive for the current owners of eligible bonds, spread differentiation related to risk would diminish, raising the question of whether the program was having a net benefit on the market. The threat of rejection was likely a factor in keeping uninformed investors on the sidelines, preventing the harm that would ensue from uninformed bond buying.

4.5 Risk Mitigation from Borrower Payments

Risk mitigants from payments made by the borrower include the loan rate, premium payment, carry cap, and the small administration fee earned by the Fed for operating the program.

The TALF Loan Rate

The interest rate on TALF loans is generally high relative to the historical coupon rate on ABS and CMBS. This high rate serves two important purposes. First, it is an important source of credit enhancement to the public sector. The difference between the loan rate, typically one-month Libor plus 100 basis points for floating-rate loans, and the Federal Reserve's cost of funds, measured at OIS plus 25 basis points, accumulates in TALF LLC, the entity writing the put option to the borrower. With the Libor-OIS spread close to its normal level of zero, 75 basis points of spread is set aside each year to build a reserve against losses, a large number relative to the historical loss experience of the eligible asset classes.[22] Second, the high loan rate is also an important part of the exit strategy. As historical spreads on the senior-most new-issue ABS and CMBS were significantly less than 100 basis points, the loan rate would make the facility uneconomic as new-issue spreads reverted toward their historical norms. Thus, the need for the facility would diminish as the markets recovered. TALF borrowers would also have an incentive to repay loans prior to maturity since, at tighter spreads, the likelihood of a sharp widening would increase relative to the likelihood of a sharp further tightening, increasing the risk of a large mark-to-market loss.

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The Premium Payment

As described above, the premium payment is intended to prevent the loan-to-value ratio for bonds presented at a premium price from declining over the life of the loan. The need for a premium lending regime was originally motivated by the desire to support small-business lending through the Small Business Administration. However, it was recognized that if the program wanted to provide liquidity support to other asset classes of new-issue ABS in subsequent subscriptions, it would have to accept TALF-eligible collateral at above-par prices, as spreads were likely to narrow over time.

The SBA offers guarantees on the principal balance of small-business loans originated by SBA-approved lenders. It offers fixed-rate loans to fund the purchase of equipment through its 504 program and floating-rate loans to fund working capital through its 7a program. In both programs, the originating lender retains a portion of the balance of each loan, typically about 85 percent, and the SBA-guaranteed portion is sold to a

[22] As described above, the three-year cumulative loss is 8 basis points, or fewer than 3 basis points per year. See Moody's, "Default and Loss Rates of Structured Finance Securities: 1993-2009, Exhibit 40."

pool assembler, who securitizes the pool into a pass-through security. Risk retention by the originator aligns its incentives with the SBA's in order to prevent adverse selection of underlying loans. The presence of SBA credit guarantees on the securitized balance implies that the main risk to the investor is prepayment rather than credit risk, which comes in the form of voluntary prepayments by the borrower as well as accelerations—that is, immediate repayment by the SBA of defaulted loans. Given the low-interest-rate environment in which recently originated loans were underwritten, there is little risk of voluntary prepayment. However, the weak economic environment has adversely affected the credit quality of small businesses, which are more vulnerable to the economic cycle, and may ultimately result in historically high levels of acceleration by the SBA.

As a historical convention, SBA loan originators want to be compensated up front for their costs of origination, which requires the loans, and consequently the SBA certificates, to be priced at a premium, typically around $105, at issue. In other words, the issuer sells the pool to investors for $105 and buys the loans from the originator at $104, pocketing $1 for underwriting expenses and compensating the originator $4 immediately for origination costs. The premium price is justified by the absence of credit risk on the underlying loans as well as an above-market rate of interest for a security without credit risk. This premium price is simply the net present value of the above-market interest payments, calculated over the average life of the security, which is defined as the time until the average principal payment is remitted to the investor. In order to calculate the average life, it is necessary to make an assumption about prepayment speeds, which is the most important variable in determining valuation. If prepayment speeds accelerate faster than expected at issue, the premium price will fall because the average life is shorter and the investor receives above-market interest rates for a shorter amount of time.

The premium price generates prepayment risk for TALF. If the prepayment speed on the collateral is much faster than anticipated, the premium price reverts toward par. If there is enough acceleration, and the TALF has loaned in excess of par, it is conceivable—though unlikely—that the market value of the bond could fall below the loan amount even with no change in interest rates. Given the nature of the SBA asset class, the TALF program has a number of important mitigants in place to ensure the proper trade-off between the goal of facilitating small-business lending (which requires lending at an above-par price) and the desire to minimize prepayment risk.

The first mitigant to prepayment risk is the presence of haircuts, which generally exceed the premium. The average life of SBA 7(a) certificates is typically seven to eight years based on the TALF assumed conditional prepayment rate (CPR) of 14 percent ("14 CPR"), implying that 14 percent of the remaining balance of the pool will repay each year. The corresponding TALF haircut is 6 to 7 percent. The average life on fixed-rate SBA 504 certificates is typically ten years at the TALF prepayment speed of 5 CPR, which corresponds to a TALF haircut of 8 percent. When the haircut is larger than the premium, there is no prepayment risk on the TALF loan because the SBA will have guaranteed repayment of an amount larger than the loan amount.[23]

The second mitigant to prepayment risk is the presence of a cap on the value of the collateral at $110, which limits the maximum loss severity of TALF. In an extreme scenario, if an entire pool priced at $109 and with a haircut of $7 defaulted on the day after issue, the haircut would be inadequate and the program would take a loss of $2. The cap on price limits loss severity to the difference between the cap and the haircut. However, this risk is very low, as such rapid acceleration is far outside the range of historical experience. Moreover, with a typical five-year loan term, there will generally be adequate loan spread generated to offset this exposure. For example, for a loan against 7(a) collateral, the loan rate is the five-year swap rate plus 50 basis points. Given a Federal Reserve cost of funds equal to OIS plus 25 basis points and a five-year swap rate at 250 basis points, TALF LLC is compensated 250 basis points per year in spread income, which should be enough to offset the $2 of maximum prepayment exposure after just one year.

The program's final risk mitigant is the requirement that investors make an additional payment each month, called a "premium payment," to account for the expected reversion of the price back toward par over time. Without this payment, the loan-to-value (LTV) and the leverage of the loan would increase as above-market interest was distributed to the investor, leaving the TALF program more vulnerable to a put at loan maturity. To mitigate this, the investor must make an additional payment that amortizes the premium over the average life of the security. The formula employed is conservative, so if the TALF assumption on prepayment speed is realized, premium payments cause the LTV to decline modestly over time. However, if prepayment speeds were much higher than expected, these payments would not suffice to keep the LTV from increasing over time. The premium payment limits the potential loss severity to a level easily covered by spread income, minimizing the risk of loss to the program.

[23] The CPR assumptions and haircuts can be found in "Term Asset-Backed Securities Loan Facility: Frequently Asked Questions," available at http://www.newyorkfed.org/markets/talf_faq.html.

The Carry Cap

The carry cap was a feature designed to mitigate adverse selection in the legacy program and to manage the policy risk to the Federal Reserve of committing its balance sheet far into the future under a five-year TALF loan. In particular, the investor could not receive more than 25 percent of the original equity investment per year in the first three years of the loan. In the fourth and fifth years, the percentages drop to 10 percent and 5 percent, respectively. Any net carry—interest received from the ABS or CMBS minus interest paid on the TALF loan—in excess of this amount would be used to pay down the TALF loan and delever the transaction.

Illustrating the first rationale, initial surveys of how market participants would value leverage provided against legacy securities suggested that many would "price to the put." In other words, they would start with the assumption that the collateral would be surrendered at TALF loan maturity and that their equity would be wiped out. Despite this assumption, investors expected the leverage provided to have a significant effect on prices given how wide spreads were, which would permit the borrower to earn more than enough carry over the life of the loan to offset the complete loss of TALF borrower equity. The problem with this behavior is obvious, as it would incentivize investors to choose risky collateral that had the most carry. The risk to the public sector of providing leverage on those terms was clearly unacceptable.

The carry cap addressed this problem by obliging TALF borrowers to keep at least some capital at risk through the life of the loan. Note that the sum of these annual caps is equal to 90 percent of the TALF borrower's equity; the borrower receives no upside until the loan to the public sector is repaid. If spreads tightened enough, the investor could realize a capital gain by repaying the TALF loan and selling the collateral in the market. But if spreads remained wide, returns from interest-related cash flows could not exceed the investor's equity. With the cap in place, the investor was unable to "price to the put," as such an assumption would result in losses. By effectively subordinating the investor's upside to the TALF loan, the carry cap provided a strong incentive to select good collateral and reduced the scope for adverse selection.

Regarding the second rationale, the Federal Reserve was not eager to provide a TALF loan maturity of five years, as this would commit its balance sheet, and thus the monetary base, five years into the future. While the Fed has tools to address the size of its balance sheet, longer-term TALF loans could increase the challenge in the event the economy had fully recovered, and the Fed viewed inflation as a serious risk. On the other hand, legacy fixed-rate CMBS generally had an average life at issue of five to ten years, and investors appeared reluctant to bear the refinancing risk associated with funding long-term debt with short-term leverage. In order for the legacy program to succeed, it was necessary to find some middle ground. This was accomplished through the step-down in the carry cap to 10 percent and 5 percent in the fourth and fifth years of the TALF loan. In the event that markets had recovered by then, investors would have the incentive to seek alternative funding or sell the collateral. However, if the economy and financial markets were still weak, investors could keep the funding through five years and hope for improvement. The step-down in carry cap incentivized the investor to seek alternative private funding when it was most likely to be available and most desirable for the Fed from a monetary policy standpoint for them to do so.

5. Impact of TALF on Term ABS and CMBS Markets

This section reviews the impact of the TALF on the new-issue ABS, legacy CMBS, and new-issue CMBS markets. The program was designed to prevent a sustained shutdown of the securitization channel of credit intermediation by supporting liquidity in the ABS and CMBS markets, and it should be evaluated in terms of its intended effects. We therefore assess TALF by observing volumes and patterns of ABS and CMBS issuance as well as liquidity conditions in these markets.

The low level of TALF usage reflected the strong risk mitigants the program incorporated as well as the rapid improvement in market conditions in the term ABS and CMBS markets.

Overall, the improvement in market conditions and liquidity in the term ABS and CMBS markets in 2009 was dramatic, particularly in view of the lower-than-expected volume of lending through TALF. A total of $71.1 billion in TALF loans was requested (Table 7) and the volume of outstanding loans peaked in March 2010 at $48.2 billion (Chart 4), although the program was authorized to reach $200 billion and at one point up to $1 trillion in loan volume was envisioned.[24]

[24] See the Federal Reserve Board announcement of February 10, 2009, available at http://www.federalreserve.gov/newsevents/press/monetary/20090210b.htm.

Table 7

TALF Loans by Subscription and Asset Class

Millions of Dollars, Except as Noted

Panel A: March-October 2009

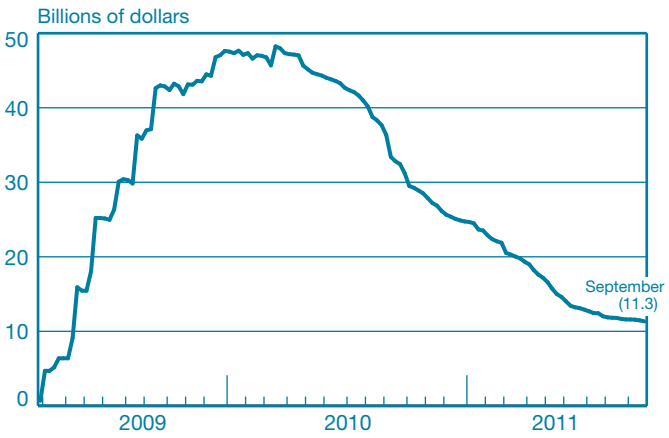
	2009							
	March	April	May	June	July	August	September	October
Auto	1,908.9	796.9	2,310.9	2,945.9	2,830.7	555.3	1,159.8	190.8
Credit card	2,804.5	890.8	5,514.7	6,022.7	1,459.1	2,553.6	4,399.1	224.4
Equipment	NA	0.0	445.6	590.2	0.0	0.0	110.6	38.8
Floorplan	NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Premium finance	NA	NA	NA	0.0	0.0	0.0	0.0	0.0
Servicing advances	NA	0.0	0.0	438.6	34.4	107.5	0.0	475.2
Small business	0.0	0.0	86.5	29.4	62.2	147.4	161.9	262.5
Student loan	0.0	0.0	2,281.5	226.7	986.8	2,444.7	177.1	287.7
ABS total	4,713.4	1,687.7	10,639.2	10,717.3	5,373.2	6,814.0	6,538.5	2,366.0
New-issue CMBS	NA	NA	NA	0.0	0.0	0.0	0.0	0.0
Legacy CMBS	NA	NA	NA	NA	635.8	2,148.3	1,351.1	1,930.6
CMBS total	NA	NA	NA	0.0	635.8	2,148.3	1,351.1	1,930.6
Amount of loans	4,713.4	1,687.7	10,639.2	10,717.3	6,009.0	8,962.3	7,889.6	4,296.6
Number of loans	136	83	205	275	165	294	200	170

Panel B: November 2009-June 2010

	2009		2010						
	November	December	January	February	March	April	May	June	Total
Auto	0.0	0.0	0.0	91.0	0.0	NA	NA	NA	12,790.2
Credit card	63.1	1,528.7	242.2	205.0	409.2	NA	NA	NA	26,317.1
Equipment	57.1	199.2	0.0	31.1	139.3	NA	NA	NA	1,611.7
Floorplan	0.0	0.0	0.0	0.0	0.0	NA	NA	NA	0.0
Premium finance	0.0	0.0	0.0	0.0	0.0	NA	NA	NA	0.0
Servicing advances	0.0	137.7	0.0	114.8	0.0	NA	NA	NA	1,308.1
Small business	408.7	274.6	332.4	37.7	349.5	NA	NA	NA	2,152.9
Student loan	85.0	665.1	0.0	54.4	1,760.1	NA	NA	NA	8,969.1
ABS total	1,059.3	2,977.4	1,067.5	973.6	4,097.8	NA	NA	NA	59,024.9
New-issue CMBS	72.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	72.2
Legacy CMBS	1,329.5	1,282.4	1,326.0	1,133.0	857.0	NA	NA	NA	11,993.8
CMBS total	1,401.8	1,282.4	1,326.0	1,133.0	857.0	0.0	0.0	0.0	12,066.1
Amount of loans	2,461.1	4,259.8	2,393.5	2,106.6	4,954.8	0.0	0.0	0.0	71,091.0
Number of loans	117	144	109	105	149	0	0	0	2,152

Source: Federal Reserve Bank of New York: http://www.newyorkfed.org/markets/talf.html.

Chart 4
Outstanding TALF Loans



Source: Federal Reserve Statistical Release H.4.1, "Factors Affecting Reserve Balances, Table 1."

The low level of TALF usage reflected the strong risk mitigants the program incorporated as well as the rapid improvement in market conditions in the term ABS and CMBS markets. As spreads narrowed, the balance of risk and reward in levered positions in ABS and CMBS shifted, at least partly offsetting the benefit of term financing with positive net carry. At tighter spreads, the potential for further capital gains from tightening must be weighed against the potential for losses induced by widening. These considerations reduced incentives to borrow through TALF and led some borrowers to repay TALF loans prior to maturity, which they are permitted to do at no cost.

5.1 Issuance Impact of TALF

While greatly reduced compared with results from prior years, term ABS and CMBS issuance did not collapse in 2009. The initial post-Lehman transactions in each sector were TALF-eligible and drew at least partly on TALF liquidity support, indicating that TALF contributed to keeping the securitization channel functioning. The effect of TALF can be seen not only in the volume of securities financed by the program, but also in the following:

- The volume of TALF-eligible securities marketed without TALF financing increased, a sign that the sector had grown less dependent on TALF financing and was likelier to thrive without public sector support.
- ABS and CMBS in TALF-eligible asset classes were issued, but with features that made them ineligible TALF collateral. Issuance of ABS in TALF-eligible asset classes, but with no potential for direct TALF support, was also a sign of recovery in the sector.
- Within the latter category, issuance of subordinate bonds (bonds with credit quality lower than what was required for TALF eligibility) was particularly significant.

Chart 5 displays total ABS issuance in new-issue ABS and CMBS asset classes included in the TALF program, the volume of TALF-eligible bonds, and the amount of bonds actually pledged as collateral against TALF loans.[25] The fraction of total ABS issuance directly supported by TALF loans was high at the start of the program and close to half during the program's first six subscriptions, but fell dramatically over time, especially in major asset classes, averaging around 20 percent in the last six subscriptions. While early on, about two-thirds of total ABS issuance was TALF eligible, and most of that was actually pledged—by the end of the program more than half of ABS issuance in TALF asset classes was financed away from TALF or held unlevered.

These trends suggest that as market conditions improved, cash investors were induced to participate in the term ABS market, and private sector financing became more available to levered investors, permitting TALF to operate as a backstop rather than a form of direct support. In addition, as ABS spreads narrowed during the course of 2009, the balance of risk in leveraged investment in ABS and CMBS shifted, reducing incentives to put on such trades: At very wide spreads, the likelihood of further widening and capital losses is smaller relative to the likelihood of tightening and capital gains than when spreads have narrowed.

As market conditions improved, cash investors were induced to participate in the term ABS market, and private sector financing became more available to levered investors, permitting TALF to operate as a backstop rather than a form of direct support.

Table 8, panel A, displays the volume of term ABS issuance for the major TALF-eligible asset classes—credit cards, auto loans and leases, equipment loans and leases, and private student loans—since 2005:

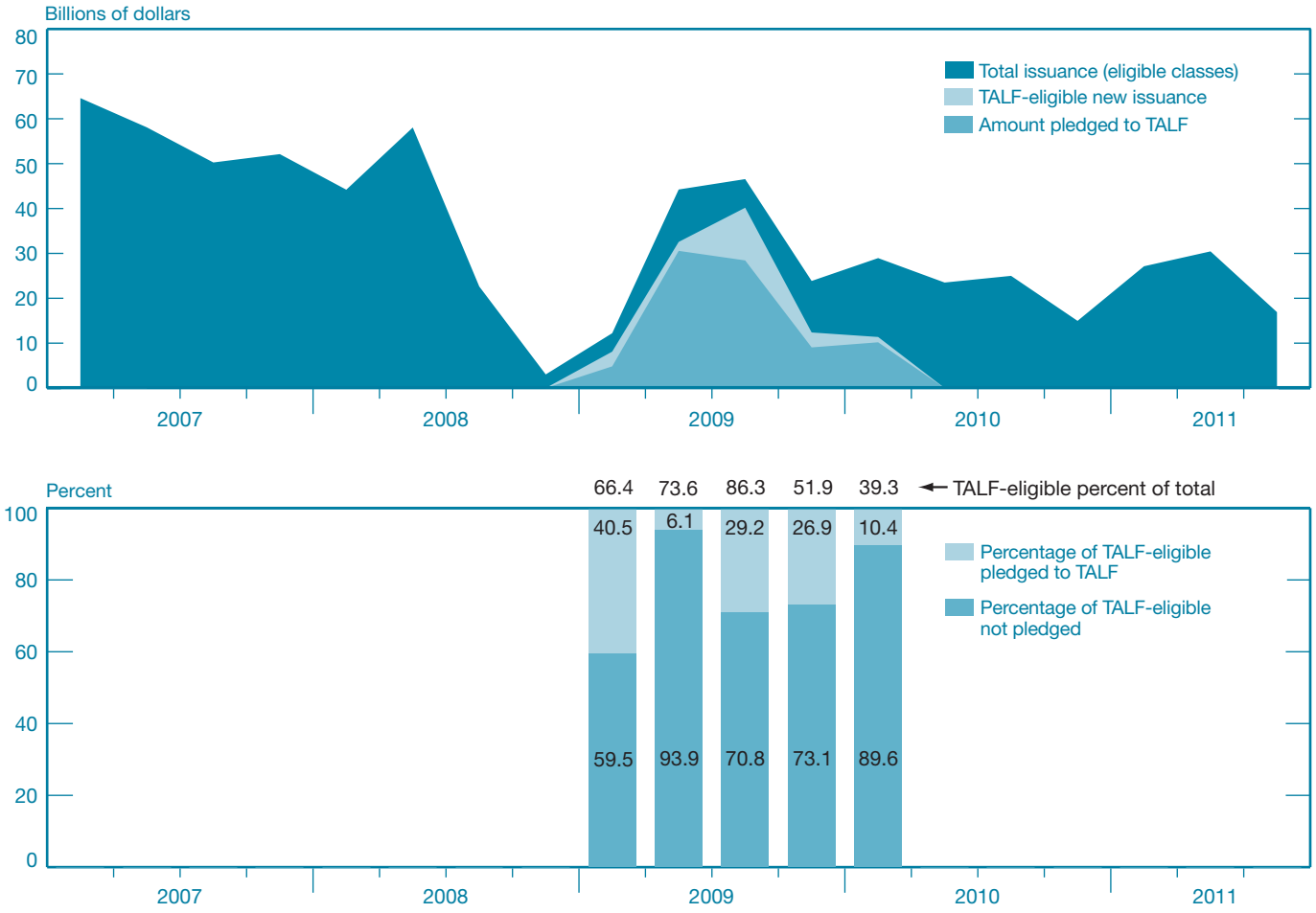
- Auto ABS issuance had peaked at $85 billion in 2005 and declined somewhat through 2007, likely because

[25] Table 7 displays TALF loans at each subscription by ABS and CMBS sector.

Chart 5

Asset-Backed Security Issuance, 2007-11

Total Issuance in TALF-Eligible Classes and Breakdown of TALF Issuance



Sources: Board of Governors of the Federal Reserve System; Bloomberg Financial L.P.; discount window data.

Note: Eligible classes exclude legacy commercial-mortgage-backed-security transactions.

of the loss of vehicle market share by ABS-dependent U.S. auto manufacturers.[26] However, issuance collapsed to $5 billion in the second half of 2008, bringing the 2008 total to $36 billion. Following the introduction of TALF, 2009 issuance was more than $60 billion.

- In contrast, credit card ABS issuance had been increasing from less than $70 billion in 2005 to almost $100 billion in 2007, then fell to $60 billion in 2008. No credit card ABS were issued in the fourth quarter of 2008. Card issuance rebounded to $46 billion for 2009, one-fourth outside the program. Most major issuers were able in 2009 to issue enough to refinance maturing ABS, although with shorter terms than they likely preferred. Card issuance came to a complete halt in late 2009, largely on concerns by credit rating agencies about the impact of FAS 166/167 on bank-sponsored securitization volume.[27]
- Student loan ABS issuance continued its volume decline since 2005 and was relatively dependent on direct TALF support. Investors initially hesitated to assume the refinancing risk associated with three-year TALF financing of longer-dated student loan ABS. Beginning in June, five-year TALF loans became available.

[26] Auto ABS fund static pools of loans and leases, so issuance is closely related to the amount of lending, which in turn is closely related to sales of new and used vehicles. In contrast, card ABS fund revolving pools of receivables, so the amount of issuance depends more on the maturity profile of the trust and normally has a less immediate relationship to the volume of lending.

Table 8
Volume of New Issuances
Billions of Dollars

Panel A: Major Asset Classes

Asset Class	2005	2006	2007	2008	2009	2010	2011	Total
Auto–non-TALF	84.9	81.9	74.1	36.2	13.8	51.1	45.8	387.8
Auto–TALF					41.6	2.7		44.2
Credit card–non-TALF	67.8	66.9	99.5	59.1	32.8	7.4	6.2	339.7
Credit card–TALF					29.1	0.3		29.4
Equipment–non-TALF	10.4	8.8	5.8	3.1	0.9	4.3	6.3	39.5
Equipment–TALF					6.5	0.6		7.1
Student loan–non-TALF	63.2	67.1	61.4	28.2	11.6	13.5	13.7	258.7
Student loan–TALF					7.4	2.2		9.6
CMBS	181.1	235.7	245.6	17.8	11.9	25.0	34.4	751.4
Total	415.0	451.2	494.5	149.3	165.8	128.6	144.4	1,867.4

Panel B: Minor Asset Classes

Asset Class	2005	2006	2007	2008	2009	2010	2011	Total
Floorplan–non-TALF	12.9	13.3	6.9	1.2	0.7	10.7	5.8	51.5
Floorplan–TALF					4.3	3.4		7.7
Small business–non-TALF	5.3	8.7	7.7	1.9			0.2	23.8
Small business–TALF					3.8	0.6		4.4
Insurance–non-TALF	2.9	5.7	3.4	0.1	0.1	0.5		12.7
Insurance–TALF					1.2	1.2		2.4
Servicer–non-TALF	0.2	0.3	0.3	0.3	1.4	2.2		4.7
Servicer–TALF					1.5	0.2		1.7
Total	21.4	28.0	18.3	3.5	12.8	18.7	6.0	108.7

Sources: JPMorgan Chase; Bloomberg Financial L.P.

Note: Commercial-mortgage-backed-security (CMBS) data exclude agency issuances.

- Equipment ABS is the smallest of the major sectors, with $10 billion or less in issuance between 2005 and 2007. Issuance in this sector also evaporated in the second half of 2008. It has returned to pre-crisis levels, but appears to have been more dependent on the TALF support.

As seen in Table 8, panel B, ABS issuance by minor sectors—servicing advances, dealer floorplan, insurance premium receivables, and small-business loans—actually rose in 2009 compared with recent years, suggesting that TALF had a significant impact on funding liquidity. The pattern of loan requests suggests that it took some time for these sectors to come to market. In the case of auto-dealer floorplan, it was particularly difficult for issuers to secure AAA ratings given the bankruptcy risk of the largest domestic auto manufacturers.

Overall, term ABS issuance in 2009 was about half that in 2005. Issuers had a lower need to issue ABS, since lending was reduced by both the recession and higher credit standards, while bank issuers, at least, had alternative sources of cheap funding. Some issuers also had difficulty securing AAA term credit ratings for their securitizations.

[27] In particular, the FDIC has the authority to repudiate contracts when resolving a failed bank, and that power includes the right to take securitized assets back on to the balance sheet. In 2000, the FDIC implemented a rule-making suggesting that as long as a securitization transaction met accounting true sale requirements, it would benefit from a safe harbor from this resolution authority. However, under the new accounting regime, most credit card revolving master trusts would no longer benefit from true sale accounting treatment and, consequently, would no longer benefit from the 2000 safe harbor. As the change in accounting rules introduced sponsor credit risk into what was supposed to be a bankruptcy-remote transaction, the credit rating agencies refused to rate the senior notes of credit card master trusts with AAA ratings unless the sponsor had a AA credit rating. Given downgrades of major financial institutions below that level, this put their trusts at risk of downgrade. Moreover, given the AAA-rating requirement of TALF, this prevented major issuers from being able to issue through the program. The FDIC in late November extended the 2000 regime through the end of March until the end of TALF.

Table 9

New Issuances of Commercial Mortgage-Backed Securities, 2009

JPMCC 2009-IWST

Class	Size (Millions of Dollars)	Ratings (RP/S)	Debt Yield (Percent)	LTV (Percent)	WAL	Initial Px Guidance	Final Pricing
A1	58.3	AAA/AAA	18.90	45.80	5.62	S+150-165	S+150
A2	330.6	AAA/AAA	18.90	45.80	9.95	S+205-220	S+205
B	24.1	AA/AA	17.80	48.60	9.95	S+360-385	S+360
C	42.9	A/A	16.10	53.70	9.95	S+410-435	S+420
D	44.0	BBB-/BBB-	14.70	58.90	9.95	8.25-8.50 percent	9.00 percent
X	10.0	AAA/AAA	NA	NA	NA		

BALL 2009-FDG

Class	Size (Millions of Dollars)	Ratings (RP/S)	Debt Yield (Percent)	LTV (Percent)	WAL	Initial Px Guidance	Final Pricing
A	350	AAA/AAA	22.00	39.20	6.67	S+190-210	S+225
B	30	AA/AA	20.30	42.50	7.11	S+385-405	S+400
C	33	A/A	18.70	46.20	7.11	S+435-455	S+450
D	47	BBB-/BBB-	16.80	51.50	7.11	8.25-8.50 percent	8.75 percent

DDR1 2009-DDR1

Class	Size (Millions of Dollars)	Ratings (RP/S)	Debt Yield (Percent)	LTV (Percent)	WAL	Initial Px Guidance	Final Pricing
A	323.5	AAA/Aaa/AAA	20.50	41.80	4.62	S+175-200	S+140/3.810 percent
B	41.5	AA/Aa/AA	18.10	47.20	4.89	7.5-8.5 percent	S+335/5.737 percent
C	35.0	A/A/A	16.50	51.70	4.89	8.5-9.5 percent	S+385/6.230 percent

Sources: Bloomberg Financial L.P.; security prospectus supplements.

While only one TALF-eligible, new-issue CMBS transaction was brought to market—a single-borrower issue sponsored by DDR—it appears to have had a large and positive impact on market conditions. At the time of issuance, the DDR transaction was the first U.S. CMBS issue in more than eighteen months. The market impact of the transaction can be seen in several ways. TALF received $72 million in loan requests, compared with $323 million in AAA-rated bonds issued, and spreads on all bonds in the DDR deal were progressively tightened during the preissuance marketing period. This evidence that the transaction was well supported by cash buyers, together with the data it provided on the pricing levels for new CMBS backed by recently and conservatively underwritten loans, led within weeks to two non-TALF, single-borrower CMBS transactions. These deals, sponsored by LWest and Flagler, were of comparable size, $350 million and $390 million, versus $325 million for DDR (see Table 9 for a summary of the terms of these transactions). The underwriters responded to improved market conditions by seeking higher proceeds and longer underlying loan maturities. The non-TALF transactions were tranched down to a BBB rating, compared with single-A for DDR. The AAA tranche of the non-TALF deals had loan-to-values of 39.2 percent and 45.8 percent, compared with 42 percent for DDR. Despite the greater deal leverage and longer weighted average life, spreads at issuance for the non-TALF AAA tranches were only 50 to 75 basis points wider than DDR's.

Despite the program's success in facilitating these transactions, as of this writing, issuance in the CMBS market has remained subdued compared with pre-crisis levels. As is the case for nonmortgage ABS, this owes in part to reduced underlying lending activity. Also, some large real estate investment firms that are potential sponsors of single-borrower deals have been able to access both the unsecured debt and equity markets, reducing the need for secured financing.

TALF also had an impact on the ABS and CMBS investor base. A higher fraction of the smaller volume of issuance from 2009 on was taken up by asset managers and hedge funds than in prior years. Much of this new investment took place through relatively small specialized funds managed by large asset or hedge fund management companies that borrowed from the TALF and invested only in TALF-eligible securities. The fraction of ABS and CMBS issuance taken up by participants in securities lending programs and by off-balance-sheet vehicles such as SIVs, largely sponsored by banks, declined sharply. While TALF was premised on the need to continue providing leverage to a sector that had come to rely on it, the overall extent of leverage employed by ABS and CMBS investors likely fell as this shift in the investor base occurred. Table 1 displays data on the investor base for term ABS before and after the implementation of TALF in 2009.

As the investor base has shifted, TALF and recent non-TALF ABS and CMBS deals have, in important respects, stepped back from some of the more baroque features of late-stage pre-crisis securitization. The complexity of ABS and CMBS structures has been reduced—no longer, for example, do they feature microtranching, the practice of issuing very thin tranches, particularly in the mezzanine part of the liability structure. These bonds were created to appeal to particular clienteles seeking high yields alongside high systematic risk: When losses in the loan pool are great enough to affect these thin tranches, their loss given default can be close to 100 percent.

The Federal Reserve's requirements as a nonrecourse secured lender with a low risk appetite also had an influence on deal structures. The Fed's announcement of the introduction of formal risk assessments for nonmortgage ABS reiterated its criteria of "transparency, and simplicity of structure."[28] These criteria were aligned with the market's own recoil from the complexity and opacity of pre-crisis ABS structures.

5.2 Liquidity Impact of TALF

Secondary-market credit spreads are a key indicator of liquidity conditions as well as of credit risk. Spreads on structured credit products widened dramatically in the fall of 2008 and tightened almost as dramatically in the early months of TALF operations. Term ABS spreads continued to narrow throughout early 2010, in line with unsecured corporate spreads.

One cannot say with certainty how much of this improvement is attributable to TALF rather than to a more positive view on credit risk. But the suddenness and rapidity of the tightening suggest that TALF had a disproportionate effect on liquidity. The provision of liquidity may have had a proportionally greater impact on new-issue ABS, where liquidity was the primary problem, and less of an immediate and evident impact on legacy and new-issue CMBS, where problems were related to credit as well as liquidity. It is difficult to ascertain the relative contribution of TALF versus a more general reduction of spreads and risk premiums. Other factors at work include the following:

- massive public sector support for the financial system;
- abatement of risk aversion, expressed particularly by opportunistic investors buying oversold assets; and
- portfolio balance effects arising from increasing supplies of low-risk government bonds and the drastic reduction in supply of credit-risky bonds, including securitizations.

As seen in the top panel of Chart 3, secondary-market spreads on short-dated, AAA-rated credit card and prime auto loan ABS widened to over 600 basis points, from near zero. Relative to their extremely tight starting point, ABS spreads widened more than the spreads on AAA-rated corporates with similar duration.

While the new-issue ABS TALF did not support the secondary market directly, there are several channels through which support of primary markets could have contributed to the tightening in the secondary market. Relative-value arbitrage forces secondary-market spreads to narrow in anticipation of new issuance at tighter spreads. In addition, regaining access to term nonmortgage ABS funding reduced the risk of nonbank issuer insolvency arising from inability to roll over maturing funding. This would lower secondary-market spreads, since issuers are generally the servicers of nonmortgage ABS, and good financial condition of servicers is associated with good loan pool performance.

One cannot say with certainty how much of this improvement is attributable to TALF rather than to a more positive view on credit risk. But the suddenness and rapidity of the tightening suggest that TALF had a disproportionate effect on liquidity.

Additional evidence for the program's positive impact on liquidity is the decline in utilization relative to the total volume of new ABS issuance. As early as the fall of 2009, for major asset classes, most new-issue ABS investors were not using TALF,

[28] See http://www.federalreserve.gov/newsevents/press/monetary/20091005b.htm.

either because they were cash investors or because (to a minor extent) they had obtained leverage elsewhere. The program thus served predominantly as a backstop for issuers, generating significantly less volume and public sector risk exposure than originally envisioned.

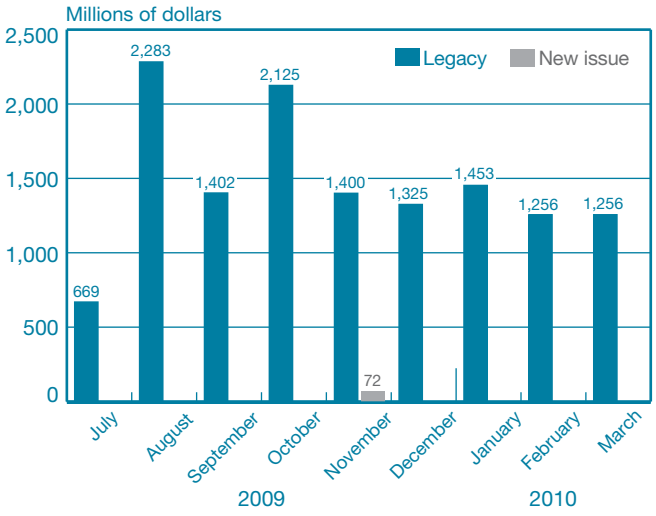
The bottom panel of Chart 3 chronicles the behavior of fixed-rate conduit CMBS spreads on what were originally AAA tranches from August 2008 through the end of November 2009. Spreads spiked in November 2008, and again in March, the low point for many credit- and equity-risk asset prices, peaking around the announcement of the legacy TALF program. In addition to the overall flight from risky assets between September 2008 and March 2009, which affected all securitizations, the CMBS market had to cope with recognition of low underwriting standards in many late-vintage CMBS deals and with the difficulty of refinancing CRE loans in the new-issue CMBS market.

The rollout of the legacy TALF program coincided with a dramatic decline in spreads, although news of a change in Standard and Poor's fixed-rate conduit CMBS ratings criteria unnerved markets in the weeks before the program started. As seen in the bottom panel of Chart 3, the peak in spreads coincided with the March 2009 announcement that TALF would include CMBS, and the most rapid decline in spreads commenced with the posting of details on the new-issue and legacy CMBS programs in May 2009.

Chart 6 shows loan requests for legacy CMBS over the life of the program. The first legacy subscription occurred in July 2009, with loan requests of just under $670 million. Monthly loan requests varied between $1.3 billion and $2.3 billion, for a total over the life of the program of $13 billion in loan requests. The extent of secondary-market spread tightening in 2009 and early 2010, displayed in Chart 3, is noteworthy in view of the comparatively small volume of TALF lending.

However, it is hard to isolate the impact of the program, as spreads tightened not only for TALF-eligible super-senior (AS) tranches, but also for AM and AJ tranches, which were not eligible. While spreads on all CMBS AAA-rated bonds narrowed steadily from early 2009, spreads for AM and AJ bonds narrowed more than those of super-senior bonds. Together with the general narrowing of risk spreads, this indicates the impact of factors other than TALF. In March 2009, for example, the U.S. Treasury announced the Legacy Securities PPIP program, targeted at a far broader range of securities, by asset type and credit quality, than TALF. Although it became clear on May 19, 2009, that AM and AJ bonds would be excluded from TALF, spreads for all three classes of bonds continued to narrow.

Chart 6
TALF Commercial-Mortgage-Backed-Security Loan Requests



Source: Federal Reserve Bank of New York: http://www.newyorkfed.org/markets/cmbs_operations.html.

Additional insights into the impact of TALF on liquidity can be obtained from the response of legacy CMBS spreads to TALF subscription results. As noted above, the New York Fed had the right to reject legacy TALF loan requests if it believed that the loan amount would be larger than the bond's stress value (its value in a severe economic stress scenario). It identified specific bonds accepted and rejected following a risk assessment, but otherwise gave the market limited insight into how it assessed the risk of the bonds. Accordingly, the announcements generally contained some news. Chart 7 shows the number of CUSIPs submitted at each operation and the fraction rejected during the risk assessment.

If the TALF program were having an important impact on spreads, one might expect the acceptance or rejection announcement to have a lasting impact on the prices at which bonds were traded. In fact, Campbell et al. (2011) find such an impact, particularly that of rejections. Loan rejections appear to have had a stronger impact on secondary-market spreads in the early months of the program, while later rejections had a more transitory impact on spreads, suggesting that a significant amount of non-TALF liquidity had entered the market. The surge in loan requests in the last (March 2010) legacy CMBS operation is consistent with this observation. Purchasers of eligible CMBS in the secondary market would have been more reluctant to bear the risk of loan rejection had they expected a sharp widening of the spread to result.

As with new-issue ABS, secondary-market spreads have come in without the program taking a significant amount of

exposure, and it has been able to do so in the presence of conservative haircuts for the underlying credit risk and strong mechanisms to limit adverse selection.

6. Conclusion

In several key respects, the public policy posture and intent of TALF have been easy to misunderstand. TALF appears on its face to provide direct credit support for either certain categories of lending, such as consumer credit card and auto loans or commercial real estate investors, or certain ABS issuers who would otherwise have had enormous difficulty carrying on their businesses.

The distinction between liquidity support and credit support is key to understanding the design of TALF. Preventing the shutdown of lending to consumers and small businesses was the goal. But the means was not having the Fed take on material credit risk in those loans. Rather, it was to encourage private investors to do so, by providing them with liquidity in the form of access to leveraged financing of investments, and to the market in the form of pricing benchmarks.

TALF might also have been misinterpreted as a validation of the "shadow banking system," or of the particular forms taken by securitization of credit over the past decade. There was, however, no intent to signal satisfaction with securitization as it existed. The design of TALF was intended to counter some undesirable features insofar as they were relevant to the Federal Reserve as a nonrecourse lender collateralized by senior bonds, such as overreliance on ratings, trust structures that could disadvantage senior bonds in certain situations, and opaque structures generally. TALF was designed to use an existing securitization channel of credit intermediation in an emergency, regardless of its imperfections or of any intention to institute reforms in the future.

Insofar as the TALF program was intended to provide liquidity rather than credit support to the market, it is consistent with the classical doctrine on central banks' lender-of-last-resort policy during a crisis: Lend at a penalty rate on good collateral. It was unusual in providing that liquidity support to the market as a whole, through investors in a class of securities, rather than to financial intermediaries.[29]

However, the balance between credit risk and program objectives was delicate. If the credit risk tolerance had been set too low—through haircuts, lending rates, or other terms and conditions—the program would not have been effective. It was not obvious ex ante that there was a program design that would lead to new issuance of ABS without exposing the Federal Reserve to more credit risk than desired.

The implementation of TALF for nonmortgage new-issue ABS was associated with a dramatic recovery in secondary-market spreads, outpacing the broad recovery in spreads across credit markets. While there was also a sharp recovery in issuance volumes in 2009, issuance has not returned to its pre-crisis levels, no doubt reflecting the poor overall state of the economy, among other factors. Although spreads have come in, the market is no longer dominated by levered buyers. The stronger presence of cash investors suggests that this nontraditional exercise of the lender-of-last-resort function did not simply pump up ABS and CMBS prices, but rather helped markets solve a coordination problem.

The rollout of the legacy TALF program also corresponded to a dramatic decline in spreads. While news of the change in Standard and Poor's fixed-rate conduit CMBS criteria unnerved markets in the weeks before the program started, and loan rejection had a dramatic impact on spreads in the early months of the program, later loan rejections appear to have had only a transitory impact on secondary-market spreads, suggesting a recovery of non-TALF liquidity in the market. The high rejection rate in the final legacy CMBS subscription in March 2010 (Chart 7) confirms investors' confidence in their ability to finance positions without TALF. As with new-issue ABS, secondary-market spreads came in without the program taking a significant amount of exposure, and it has been able to do so in the presence of conservative haircuts for the underlying credit risk and strong mechanisms to limit adverse selection.

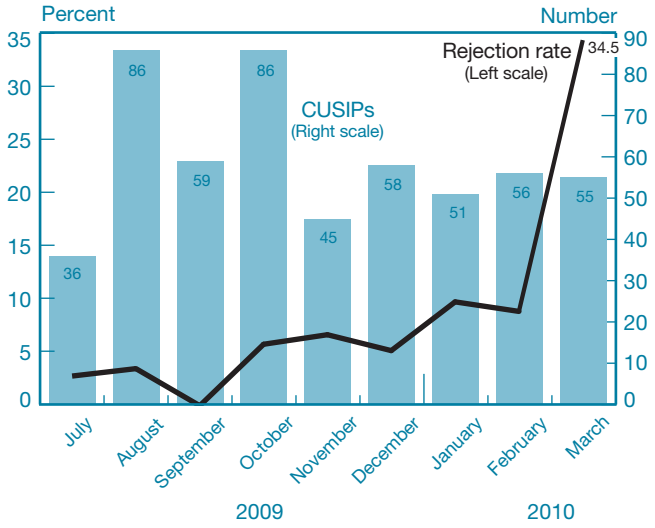
The most impressive achievement of the TALF program is how much it was able to accomplish with so little exposure and with such conservative terms.

Finally, the new-issue CMBS program had remarkable success in bringing the first transaction to market in more than eighteen months, which was quickly followed by other single-borrower transactions. It was able to accomplish this with minimal program exposure, tight loan underwriting standards, and a conservative trust structure that protects senior investors. However, the impact of the program on the supply of commercial real estate credit has clearly been much smaller than the impact of the new-issue ABS program on the supply of consumer and commercial credit.

[29] See Madigan (2009) and Sack (2010) for further discussion of these issues.

Chart 7

Legacy Commercial-Mortgage-Backed-Security CUSIP Rejection Rate



Source: Federal Reserve Bank of New York: http://www.newyorkfed.org/talf_cusips_archive.html.

Note: The chart shows the total number of CUSIPs submitted and rejected CUSIPs as a fraction of the total (in percent).

One interpretation of events is that the provision of liquidity can alleviate funding constraints created by illiquidity. However, it is much more difficult for liquidity provided under prudent terms to have a significant impact on markets where deeper structural issues exist. The fundamental uncertainty about the depth of the commercial real estate cycle, combined with poor performance of the rating agencies in CMBS, suggests that liquidity has not been the only problem limiting the supply of CRE credit.

The most impressive achievement of the TALF program is how much it was able to accomplish with so little exposure and with such conservative terms. Its impact on market conditions raises important questions about how liquidity works. TALF will remain an interesting data point in understanding the nature of liquidity, suggesting that it may be related as much to multiple equilibria (investor psychology) as to leverage (the supply of credit). To the extent that TALF had an impact on liquidity, and in view of the low lending volume of the program, how was that impact transmitted? Among the possible mechanisms are the following:

- A handful of benchmark transactions conveyed important information about market-clearing spreads to the market, encouraging issuers.
- Provision of term funding induced investors to participate, permitting the financing of entire new trusts.
- TALF's credit standards supported the marketplace's more stringent requirements around credit quality and structure.

These and other issues related to this complex emergency liquidity program are worth exploring in the future.

References

Agarwal, S., J. Barrett, C. Cun, and M. De Nardi. 2010. "The Asset-Backed Securities Markets, the Crisis, and TALF." Federal Reserve Bank of Chicago Economic Perspectives 34, no. 4 (fourth quarter): 101-15.

Ashcraft, A., N. Gârleanu, and L. Pedersen. 2010. "Two Monetary Tools: Interest Rates and Haircuts." NBER Working Paper no. 16337, September.

Campbell, S., D. Covitz, W. Nelson, and K. Pence. 2011. "Securitization Markets and Central Banking: An Evaluation of the Term Asset-Backed Securities Loan Facility." Journal of Monetary Economics 58, no. 5 (July): 518-31.

Dudley, W. 2009. "A Preliminary Assessment of the TALF." Remarks delivered at the Securities Industry and Financial Markets Association and Pension Real Estate Association's Public-Private Investment Program Summit, New York City, June 4. Available at http://www.newyorkfed.org/newsevents/speeches/2009/dud090604.html.

Madigan, B. 2009. "Bagehot's Dictum in Practice: Formulating and Implementing Policies to Combat the Financial Crisis." In Financial Stability and Macroeconomic Policy, Jackson Hole Symposium, Federal Reserve Bank of Kansas City, August 10-11. Available at http://www.kc.frb.org/publicat/sympos/2009/papers/Madigan-2009.pdf.

Robinson, K. 2009. "Jump-Starting the Securitization Markets." Federal Reserve Bank of Dallas *Economic Letter* 4, no. 6 (August).

Sack, B. 2010. "Reflections on the TALF and the Federal Reserve's Role as Liquidity Provider." Remarks delivered at the New York Association for Business Economics, New York City, June 9. Available at http://www.newyorkfed.org/newsevents/speeches/2010/sac100609.html.

Vasicek, O. 1991. "Limiting Loan Loss Probability Distribution." KMV Corporation, August 9. Available at http://www.moodysanalytics.com/~/media/Insight/Quantitative-Research/Portfolio-Modeling/91-08-09-Limiting-Loan-Loss-Probability-Distribution.ashx.

Other Electronic Sources

Board of Governors TALF Site	http://www.federalreserve.gov/newsevents/reform_talf.htm
Factors Affecting Reserve Balances (H.4.1)	http://www.federalreserve.gov/releases/h41/
Independent Auditors Annual Report (FRBNY)	http://www.ny.frb.org/aboutthefed/annualreports.html
Financial Stability Information	http://www.financialstability.gov
Monthly Transparency Reports	http://www.federalreserve.gov/monetarypolicy/bst.htm