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Toxic Asset Subsidies and the Early Redemption of TALF Loans

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Abstract: This paper develops a formula to numerically estimate the unsubsidized, fair-market value of the toxic assets purchased with Federal Reserve loans. It finds that subsidy rates on these loans were on average 33.9 percent at origination. In contrast, by the 3rd quarter of the 2010, there was on average no subsidy in TALF loans. The theoretical model is used to predict the early redemption of Term Asset-Backed Securities Loan Facility (TALF) loans used to purchase commercial mortgage-backed securities (CMBS). The predictions of the model are strongly supported by the data. In addition, this paper looks at the determinants of early redemption. CMBS originated inside the peak bubble years of 2005–2007 were much less likely to be redeemed early. The giant investment managers, Blackrock and PIMCO, were much more likely to redeem their TALF loans early than smaller investment managers.

Keywords: alternative investments; bailout; banking; Blackrock; call options; commercial mortgage-backed securities; CMBS; CDOs; Dodd-Frank Financial Reform Law of 2010; emergency lending; EESA; Emergency Economic Stabilization Act; lending; Legacy Securities Program; mortgages; PIMCO; Public-Private Investment Partnership; PPIP; put options; TALF; Term Asset-Backed Securities Loan; TARP; Troubled Asset Relief Program; toxic assets

JEL Classification: G12; G13; G18; G21; G28; G38

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1. Introduction

The Term Asset-Backed Securities Loan Facility (TALF) Commercial Mortgage-backed Security (CMBS) program was launched by the Federal Reserve in response to a large decline in the securitization of new CMBS and a drop off in trading of existing CMBS, after the failure of the investment bank Lehman Brothers and the freezing up of credit markets in late 2008 and 2009. The TALF CMBS program was one of three components of U.S. Treasury Secretary Timothy Geithner's efforts to revive the market for real estate related loans and securities which had been considered "toxic" by investors in 2008 and 2009, according to Wilson (2011).[1] By March 2009, the spread over swaps for investment grade CMBS was 12.4 percent. In 2009, there was only $3.4 billion in new CMBS issuance. Yet, the spreads in CMBS in the Barclays investment grade index had declined to 2.3 percent by the start of 2011. Analysts projected that $45 billion in new CMBS would be issued in 2011, but that would not be enough to displace the over $60 billion of CMBS that would be maturing in 2011.[2]

Barclay's CMBS index tracks various features of the BBB and higher rated CMBS market. In Figure 1, we can see that the index grew from just under $100 billion in market capitalization in 2000 to just under $600 billion at the end of 2007. This Barclays CMBS index is far from recovering those heights. It only had a market capitalization of $376 billion at the start of 2011.

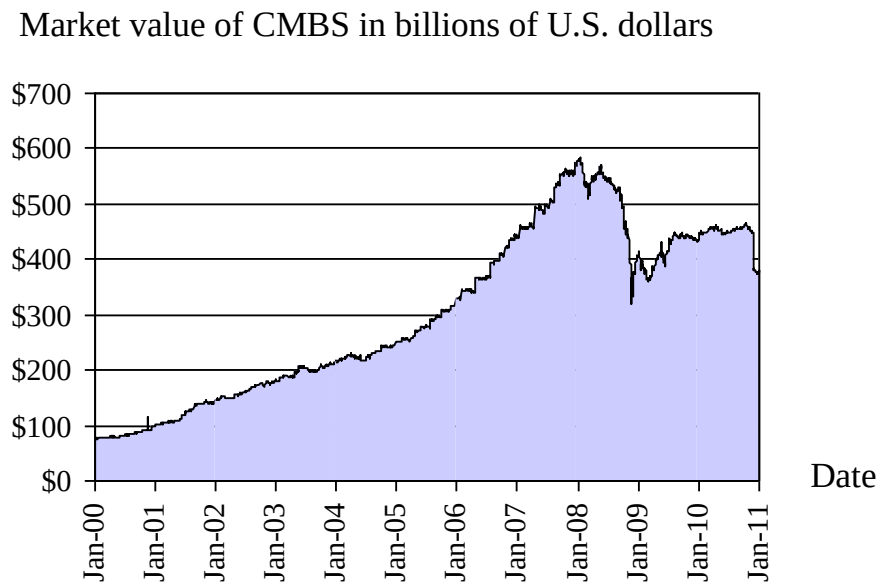

Figure 1. Market Capitalization of Investment Grade Commercial Mortgage-backed Securities (CMBS) from 3 January 2000, to 3 January 2011. Source: Barclays Capital's CMBS Index.

This paper studies the characteristics of Federal Reserve's TALF loans that were used to buy CMBS. These TALF loans were used to put up about 85 percent of the purchase price to buy AAA rated tranches of CMBS. Yet, AAA rating grade inflation in the securitization market meant that on average AAA tranches of CMBS had credit spreads above the benchmark risk-free rate between 151 and 302 basis points during the period studied, depending on the security's date of issue. Using a model developed in this paper, it is estimated that the average loan had a subsidy worth 34 percent of the loan amount when it was made. Yet, by the repayment date or the end of the period studied the average subsidy was −11 percent.

This paper focuses on the characteristics of TALF loans that were repaid early, prior to 30 September 2010. It finds that higher interest rate spreads over the risk-free rate, and lower volatilities were associated with early loan redemptions. Loans that bought more senior, better protected, CMBS tranches were also more likely to be repaid. Loans purchasing CMBS issued in the peak years of the credit bubble of 2005, 2006, and 2007 were significantly less likely to be repaid. The bond giants PIMCO and Blackrock were twice as likely as other asset managers to repay their TALF CMBS loans early. This effect is strong and significant even after controlling for other factors.

The predictions of the paper's theoretical model are strongly supported by the data. The model predicts that early repayments will occur when loan subsidies decline, the spread over U.S. Treasuries on the loans rises, and the volatility of the underlying asset declines. For the loans that were repaid early, the subsidies on TALF loans declined significantly from the loan date to the repayment date. The spread over the risk-free rate on repaid loans rose significantly from the loan date to the loan repayment date, and the volatility declined significantly.

When the COVID-19 pandemic hit, the Federal Reserve revived the TALF program to shore up credit markets between 23 March 2020, and 31 December 2020. Understanding what worked in the first iteration of this emergency lending program, may have influenced policy makers in 2020 and will inform policy makers confronting the next financial crisis.

In the next section, we discuss the relevant literature. This is the only empirical paper to study which TALF CMBS loans are repaid early. It is the first paper to estimate the subsidies on TALF loans to buy CMBS, using a continuous time model. Then the data is introduced in Section 3. In Section 4, a theoretical model is developed to estimate TALF loan subsidies, and its predictions are tested. Those predictions are strongly supported by the data. In Section 5, *t*-tests and logistic regressions are used to determine the characteristics

of TALF loans used to buy CMBS. There is little evidence that borrowers that redeemed TALF loans to buy CMBS early were better at market timing. Yet, there is strong evidence to say that the giant asset managers Blackrock and PIMCO were more likely to repay their government debts early.

2. Relevant Literature

This is the only paper to empirically study the characteristics of TALF CMBS loans that are repaid early. This is the only paper to develop a theoretical model of the subsidies in TALF loans and to empirically test if the subsidy rates are related to the propensity for firms to repay TALF loans early. This paper finds that as estimated subsidy rates decline, that TALF CMBS recipients are more likely to repay their Federal Reserve loans early.[3] Rhee (2020), Caviness et al. (2021), and Mizrach and Neely (2020), provide good summaries of this Federal Reserve emergency lending program that extended new loans to buy CMBS from 23 March 2009, to 31 December 2010. Pavlov and Wachter (2002, 2009a, 2009b) demonstrate how low interest nonrecourse loans can inflate real estate bubbles. From the date of the first loan to the end third quarter of 2010, the Federal Reserve's nonrecourse loans in the TALF's CMBS program may have contributed to a decline of AAA credit spreads for CMBS of between 87 to 239 basis points, depending on the date of issue of the referenced CMBS. Subsidized purchases of AAA CMBS may have contributed to this bond rally. Finally, this is also the first paper to develop a continuous-time numerical solution for the fair market value of the collateral purchases with subsidized government loans.

2.1. Theory Papers on the Government's Toxic Asset Programs

There are several studies on the government's plans to buy toxic assets. Bhansali and Wise (2009) attempt to price the option of TALF borrowers to default on a bundle of correlated loans. Yet, unlike this paper, Bhansali and Wise (2009) does not use the data on actual TALF transactions in their theoretical model. Moreover, it does not attempt to estimate the Federal Reserve's subsidy on the loans it is making through the TALF program as is developed in this paper. Wilson (2011) like Bhansali and Wise (2009) is a theoretical model of the government's toxic asset programs including TALF. Nevertheless, Wilson (2011) does not solve for the government's subsidy in TALF loans, using a continuous time model. Wilson (2011) also does not perform any empirical tests of the model. Gaballo and Marimon (2022) argue that subsidized credit programs like the TALF can get the economy unstuck from a bad equilibrium.

The more informal models of Wilson (2010a) and Wilson (2010b) do not even deal with the TALF program directly. Wilson (2010b) discusses the Federal Deposit Insurance Corporation's (FDIC's) Legacy Loans Program to sell distressed real estate loans. Wilson (2010a) discusses why large banks would be reluctant to part with volatile toxic assets because that volatility adds shareholder value.

2.2. Empirical Studies on CMBS

The studies on the TALF CMBS program either have provided excellent introductions to the Federal Reserve program such as Agarwal et al. (2010) or have been event studies on the markets or securities affected by the TALF. Examples of the latter event studies are Campbell et al. (2011), Ashcraft et al. (2010), and Ashcraft et al. (2012). In contrast to the latter event studies, the present study looks at the characteristics of TALF CMBS loans which are repaid early.

Campbell et al. (2011) uses indicative dealer quotes, from a single dealer, JP Morgan, not actual trade data, to argue that the TALF program usually had no significant effect on the yields of individual securities. Nevertheless, it is hard to interpret quotes which do not commit the market maker to actually buy or sell the security at a given price. Moreover, the authors' conclusion from insignificant results that there was no subsidy in the Federal Reserve's TALF loans may be driven as much by the four authors' employment

at the Federal Reserve as by their statistical analysis of non-transaction data. Further, the theoretical analysis in the present paper is consistent with the idea that dealers would not adjust their prices for CMBS. The subsidy goes to the purchaser of the CMBS with the government's TALF loan. A purchaser without the government assistance will not accept lower yields.

In contrast to Campbell et al. (2011), Ashcraft et al. (2010) do find that the introduction of the TALF program did have a significant impact on the yields of CMBS. Ashcraft et al. (2012) also develop a macroeconomic model in which rising haircuts on collateralized loans leads to reduced economic activity. Ashcraft et al. (2010) argue that the Federal Reserve, by requiring below market haircuts, spurred economic activity and lowered yields on collateralized loans. The results in Ashcraft et al. (2010) are also confirmed in Ashcraft et al. (2012). Ashcraft et al. (2012) finds a negative and significant effect on yields when the Federal Reserve announced the TALF program in November 2008.

There is also some empirical literature on Commercial Mortgage-backed Securities (CMBS) that predates the bursting of the credit bubble in 2007 and 2008. The securitization of commercial mortgages is a relatively new phenomenon. Only 0.1 percent of commercial mortgages were securitized in 1970. Thus, the academic literature on CMBS is still at an early stage. The CRE finance council finds that commercial mortgage securitizations were never more than 28 percent of commercial mortgage originations in any given year. By the third quarter of 2010, the book value of CMBS outstanding was about 20 percent or $0.64 trillion compared to the $3.2 trillion of the U.S. commercial mortgage loans outstanding.[4]

Subordination is the cushion that protects the higher rated slices, or tranches, of CMBS from taking losses. An et al. (2008) find that rating agencies required significantly lower levels of subordination over time. In the last year of their study, 2005, the largest decline in subordination was observed. Thus, they show that ratings agencies' standards for CMBS slipped as the real estate bubble of the mid-2000s took off. We find that loans to buy riskier tranches of CMBS were significantly less likely to be repaid early. In contrast, TALF loans purchasing safer tranches of CMBS, were significantly more likely to be repaid at an early date.

Several studies look at the factors affecting CMBS yields. Titman et al. (2005) find that from 1992 to 2002 credit spreads over U.S. Treasuries on CMBS were highest for the riskiest segment of commercial loans, hotels. Other studies on securitization look at how the originator of the commercial mortgages affects their pricing and yields. An et al. (2009) argue that multifamily commercial mortgages that were securitized from 1992 to 2008 were able to offer interest rates of 11 to 20 basis points lower than comparable commercial mortgages held as portfolio loans of the originator. Titman and Tsyplakov (2010) look at data from 1996 to 2002. They find that commercial mortgage originators with bad accounting or stock price performance prior to securitization are required to have greater levels of subordination. Moreover, the poorly performing originators have mortgages packaged into CMBS with higher yields. Thus, poorly performing originators may let their standards slip to push a deal through. Finally, An et al. (2011) argue that lenders that cannot hold portfolio loans, conduit lenders, issue CMBS with yields 34 basis points lower than comparable lenders that choose between securitizing and holding their CMBS loans. They argue that this difference is due to the adverse selection of poor quality loans for CMBS by originators with more options than conduit lenders.

The present study finds no evidence that CMBS collateral from particular issuers were more likely to lead to early TALF loan redemptions after controlling for other factors. Nevertheless, in *t*-tests results from this study do find that the loans to buy CMBS issued by Lehman Bothers and Bear Stearns were significantly less likely to be paid back early at the 95 percent and 90 percent level of confidence, respectively.

3. Data

The Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 required the Federal Reserve to release the identities of borrowers who received $3.3 trillion of loans from 1 December 2007, to 21 July 2010. On 1 December 2010, the Federal Reserve complied with that law.[5] One of those lending programs was the Term Asset-Backed Securities Loan Facility (TALF) which made loans to investors purchasing asset backed securities. The TALF program passed out loans totaling $43 billion before the program was discontinued in 2010. The TALF program made 686 different loans totaling $12.1 billion dollars to purchase $14.3 billion of Commercial Mortgage-backed Securities (CMBS). The TALF sponsored purchases of CMBS were made from 24 July 2009, to 29 March 2010. The TALF CMBS program is now closed for new investment. As Wilson (2010a) explains, the CMBS TALF program was part of the U.S. Treasury's Legacy Securities Program (LSP) to encourage the investment in "toxic" mortgages.

Table 1. Summary statistics.

Data Item	Mean	Median	Minimum	Maximum	Standard Deviation
Loan Date	11/15/09	10/29/09	7/24/09	3/29/10	71.91
Subsidy at LD	33.87%	34.61%	21.40%	45.19%	6.19%
Subsidy at RD	−11.14%	−8.80%	−21.70%	6.43%	4.95%
TALF Spread LD	1.35%	1.37%	1.05%	1.53%	0.13%
TALF Spread RD	2.44%	2.37%	1.09%	3.95%	0.62%
CMBX AAA Credit Spread LD	2.58%	2.41%	1.44%	4.12%	0.79%
CMBX AAA Credit Spread RD	1.36%	1.28%	0.83%	3.13%	0.49%
CMBX AAA Credit Spread RD minus LD	−1.22%	−1.08%	−2.76%	0.10%	0.68%
60-Day Volatility at LD	12.49%	13.86%	4.60%	19.10%	4.02%
30-Day Volatility at LD	9.16%	6.05%	4.44%	19.63%	5.73%
60-Day Volatility at RD	4.03%	3.23%	3.22%	19.13%	1.68%
30-Day Volatility at RD	3.83%	3.36%	3.09%	19.67%	1.49%
TALF Interest Rate	3.33%	3.54%	2.72%	3.87%	0.44%
Years to Maturity at RD	3.37	3.98	1.82	4.99	1.04
Years to Maturity at LD	4.11	5.00	3.00	5.01	0.99
Loan Amount (millions)	$17.6	$14.9	$10.0	$80.3	$8.1
Assets Purchased (millions)	$20.9	$17.9	$11.8	$94.5	$9.6
Loan-to-Value Ratio	84.3%	84.8%	78.9%	85.6%	1.2%
Loan-to-Value Ratio	84.3%	84.8%	78.9%	85.6%	1.2%
Tranche Rank	2.83	2.00	1.00	7.00	1.05
2005 Vintage Dummy	0.233	0.000	0.000	1.000	0.423
2006 Vintage Dummy	0.319	0.000	0.000	1.000	0.467
2007 Vintage Dummy	0.343	0.000	0.000	1.000	0.475
Buyer Dummy Arrowpoint	0.058	0.000	0.000	1.000	0.234
Buyer Dummy Blackrock	0.137	0.000	0.000	1.000	0.344
Buyer Dummy DMR	0.070	0.000	0.000	1.000	0.255
Buyer Dummy Ladder	0.111	0.000	0.000	1.000	0.314
Buyer Dummy PIMCO	0.080	0.000	0.000	1.000	0.272

Table 1. *Cont.*

Data Item	Mean	Median	Minimum	Maximum	Standard Deviation
Issuer Dummy Bank of America	0.080	0.000	0.000	1.000	0.272
Issuer Dummy Bear Stearns	0.096	0.000	0.000	1.000	0.295
Issuer Dummy Citigroup	0.017	0.000	0.000	1.000	0.131
Issuer Dummy Credit Suisse	0.058	0.000	0.000	1.000	0.234
Issuer Dummy Goldman Sachs	0.064	0.000	0.000	1.000	0.245
Issuer Dummy JPMorgan	0.152	0.000	0.000	1.000	0.359
Issuer Dummy Lehman Brothers/UBS	0.077	0.000	0.000	1.000	0.267
Issuer Dummy Merril Lynch	0.052	0.000	0.000	1.000	0.223
Issuer Dummy Morgan Stanley	0.070	0.000	0.000	1.000	0.255
Issuer Dummy Wachovia	0.130	0.000	0.000	1.000	0.336
S&P Rated Dummy	0.729	1.000	0.000	1.000	0.445
Moody's Rated Dummy	0.767	1.000	0.000	1.000	0.423
Moody's or S&P Rated Dummy	0.959	1.000	0.000	1.000	0.198
Number of Observations	686				
Total Loans Funded (millions)	$12,069				
Total Assets Purchased (millions)	$14,316				

LD stands for "loan date", and RD stands for "redemption date". The redemption date (RD) is defined as the lesser of the day the TALF loans were repaid or 30 September 2010. CMBX is an index of credit default swaps for refenced commercial mortgage-backed securities (CMBS). Volatility is the standard deviation of the returns on the reference index of mortgage securities over a 30-day or 60-day time horizon. Tranche rank is the order in which the CMBS gets paid. A tranche rank of one means the tranche gets paid first and is less risky than lower ranked tranches with higher numbers. Dummies stands for dummy variables taking on the value of either zero or one. Dummies equal one if the vintage, buyer, issuer, or credit rating status are the same as in the dummy variable name and equal zero otherwise.

The subsidy rates were calculated using the formulas which will be developed in the Section 4's Equation (1) by numerically estimating them using a modified Black and Scholes (1973) call option pricing equation. The subsidy rates were calculated using the formulas which will be developed in the Section 4's Equations (1) through (4) by numerically estimating them using a modified Black and Scholes (1973) call option pricing equation. The loan date (LD) is when the TALF loan was made by the Fed. The redemption date (RD) was the date the asset managers repaid the Fed loan. Data about loan amounts, loan dates, redemption dates, assets purchased, the identity of borrowers and CMBS issuers are obtained from the Board of Governors of the Federal Reserve. U.S. Treasury rates are obtained from the St. Louis Federal Reserve bank's FRED data site.

The TALF loans had a spread over comparable maturity U.S. Treasuries of on average 1.35 percent when the TALF loans were originated. Let us denote the redemption date (RD) as the earlier of when the TALF loans were repaid or 30 September 2010. On the redemption date (RD) the spread over U.S. Treasuries for TALF loans was on average 2.44 percent. This reflects the fact that the yield curve was steeply upward sloping over time. Thus, the fixed rates on the TALF loans became much higher than the relevant U.S. Treasury rate as the years to maturity on these loans declined. Thus, the upward sloping yield curve created an incentive for early TALF CMBS repayment.

Another factor driving repayments was the decline in AAA CMBS spreads over this period. Almost all the CMBS tranches purchased with TALF loans were rated AAA or Aaa by Moody's or S&P, respectively, by the start of 2011, according to the author's analysis. Yet, as we will see below, the credit worries of investors with respect to AAA rated CMBS declined over this period. The increasing spreads on TALF loans and the decreasing market spreads should combine to make these Federal Reserve loans less appealing.

The CMBX is an index owned and operated by Markit which allows investors to take long or short positions on a basket of 25 large CMBS issues. Short investors in the CMBX buy credit protection, while long investors receive fixed premiums for supplying the credit protection. According to Todd and Iwai (2006) a decline in the CMBX index, or equivalently an increase in the credit spreads of the index, means that investors believe that the credit worthiness of CMBS of a particular rating or vintage of issue have declined. The CMBX has five different vintages for each credit rating for roughly a six-month period from the first half of 2006 to the first half of 2008. After 2008, the issuance of CMBS had slowed dramatically. The drop of in new issuances was so dramatic that there were not enough new CMBS originations to allow for another vintage of the index in the second half or 2008 as well as 2009 and 2010. While the financial crisis of 2008 and 2009 led to a huge widening of even the AAA rated credit spreads on the CMBX, Figure 2 shows that those spreads generally declined from the first CMBS purchase with TALF funds on 24 July 2009, until the end of the Federal Reserve's reporting period of 30 September 2010. This means that investors' fears of default for AAA rated CMBS declined over this period. Moreover, the figure and Table 2 demonstrate that later vintages of AAA CMBS from 2007 and early 2008 were perceived to have greater default risk than vintages of AAA CMBS originated in early 2006 and late 2005.

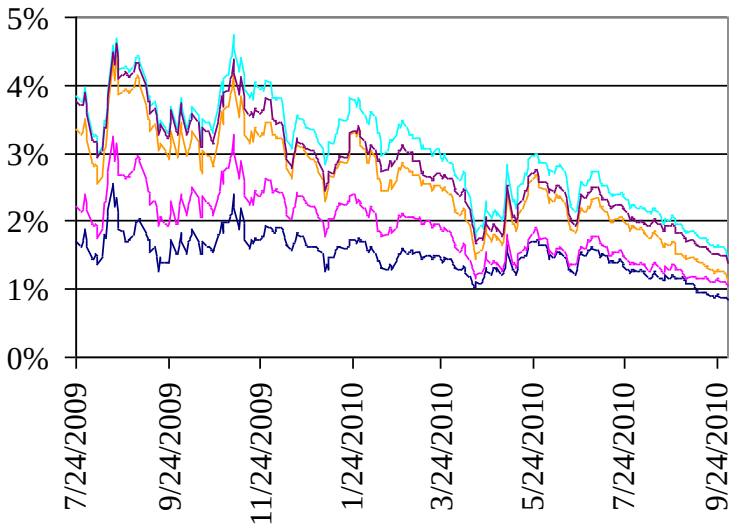

Figure 2. AAA credit spreads in percent for five vintages of the CMBX index plotted from 24 July 2009, to 30 September 2010. The figure plots the credit spreads in percent implied by various vintages of the CMBX AAA indexes owned by Markit. The figure plots the credit spreads from the date of the first Term Asset-Backed Securities Loan Facility (TALF) sponsored purchase of Commercial Mortgage-backed Securities (CMBS) on 24 July 2009, until 30 September 2010. These are the rates that a credit protection buyer, credit default swap (CDS) buyer, must pay to insure a given amount of the referenced securities. Almost all of the collateral for TALF loans are rated AAA or Aaa by Standard & Poor's and Moody's, respectively. The CMBX allows investors to take long or short positions in a basket of 25 different tranches of various ratings and vintages of issue. The top line tracks the credit spreads of the fourth vintage of the CMBX AAA index launched in late 2007. The next-highest line plots the CMBX's fifth AAA vintage launched in early 2008. The third highest line plots the credit spreads from the third vintage of the CMBX AAA index launched in early 2007. The second-to-the-bottom curve plots the credit spreads from the second vintage of the CMBX AAA index launched in the second half of 2006. The bottom line tracks the credit spreads from the first vintage of the CMBX AAA index launched on 7 March 2006. It is clear over this period credit spreads have generally declined, signaling declining fears of default risks on the AAA tranches of the referenced CMBS issues.

To calculate the decline in credit spreads over the private investors' TALF holding period, each loan was matched with the CMBX AAA index that closely matched the CMBS's issue date. Vintages of CMBS issued in 2008 or later were matched with the fifth and latest vintage of the CMBX AAA index. Commercial mortgages issued in 2007 were assigned the average credit spread for a given loan date or redemption date of the third and fourth vintages of the CMBX AAA. The third and fourth vintages of the CMBX AAA index debuted in the first and second half of 2007. CMBS issued in 2006 were matched with the second vintage of the AAA index. Finally, all CMBS issued in 2005 or earlier were assigned credit spreads from the CMBX AAA's first vintage which consisted of CMBS issued in 2005 and early 2006.

Table 2. *t*-tests of the differences in average credit spreads among the five different vintages of the CMBX index from 24 July 2009, to 30 September 2010.

		Difference in Average Credit Spread between Vintages				
Vintage	**Average Spread**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
(1) 2006-1	1.51%	NA	−0.40%	−1.08%	−1.51%	−1.29%
t-statistic			−12.05	−23.73	−32.04	−27.72
p-value			0.000	0.000	0.000	0.000
(2) 2006-2	1.91%		NA	−0.68%	−1.11%	−0.89%
t-statistic				−13.29	−21.14	−17.08
p-value				0.000	0.000	0.000
(3) 2007-1	2.58%			NA	−0.43%	−0.21%
t-statistic					−7.11	−3.45
p-value					0.000	0.001
(4) 2007-2	3.02%				NA	0.23%
t-statistic						3.65
p-value						0.000
(5) 2008-1	2.79%					NA
t-statistic						
p-value						

The first Commercial Mortgage-backed Securities (CMBS) investments with Term Asset-Backed Securities Loan Facility (TALF) loans were made on 24 July 2009. The Federal Reserve's data on early TALF redemptions only goes up to 30 September 2010. Over this period the credit spreads over various vintages of the CMBX AAA index were tracked. All vintages had significantly different spreads. On average the 2006-1 vintage had the lowest credit spreads of on average 1.51 percent and the 2007-2 vintage had the highest credit spreads at 3.02 percent. The two-tailed paired *t*-tests of means were statistically significant with greater than 99.9 percent confidence. These tests are based on closing credit spreads for 299 trading days of data over this period. Data on the CMBX is from Markit which owns that index.

Table 2 finds that the all vintages of CMBX AAA index have significantly different credit spreads than all other vintages of that index. All these two-tailed *t*-tests of the difference between means are statistically significant with greater than 99.9 percent confidence. The greatest credit spreads and credit risk are associated with the fourth, fifth, third, second, and first vintages of the CMBX AAA index. That means that the first vintage from early 2006 is associated with the lowest credit risk over the TALF investment period, and the fourth vintage from late 2007 is associated with the highest credit risk. By the fifth vintage there had been mass ratings downgrades of Aaa and AAA rated residential mortgage-backed securities (RMBS) and collateralized debt obligations (CDOs) in July 2007, October 2007, and January 2008 by both Moody's and S&P, respectively.[6] See Levin (2010). In other words, investors could no longer ignore the risks in the securitization markets by

the fifth iteration of the CMBX index, and tightened credit standards may have begun to take hold, leading to less risky securitizations.

Private investors who bought CMBS when CMBS spreads over U.S. Treasuries were high (and the CMBS prices were, thus, low) and sold those securities when the spreads were low (and the CMBS prices were, thus, high) likely booked a tidy profit. We would expect that investors, buying over a period of declining period of CMBS spreads, would be more likely to sell their holdings and to repay their TALF loans early. This would let these investors book a market timing profit.

Hypothesis 1 (H1). *The investors that repay their TALF loans early are more adept at timing the market as measured by a decline in credit spreads. That is, the loans that are repaid early were used to purchase Commercial Mortgage-backed Securities (CMBS) that experienced greater declines in credit spreads over the holding period than CMBS bought with TALF loans that are not repaid.*

We will test this hypothesis in Section 4. We will see that market timing can be decisively rejected as a reason why some investors redeemed their TALF loans early.

All the data discussed in the next few paragraphs below is summarized in Table 1.

The annualized volatility was estimated from agency mortgage-backed securities returns. Exchange traded funds are securities that usually track an index but can be bought and sold on an exchange similar to a stock. The exchange traded fund, which goes by the ticker MBG, tracks the agency mortgage pass through market. The securities making up the MBG exchange traded fund are mortgage-backed securities issues backed by Fannie Mae, Freddie Mac, and Ginnie Mae, for example. Historic prices and dividends for MBG were obtained from Yahoo! Finance. The 30-day historic volatility averaged 9.2 percent at the TALF loan date (LD), but it declined to 3.8 percent by the earlier of the redemption date or the 30 September 2010. The later date is denoted by RD in the table. The 60-day historic volatility declined from 12.5 percent to 4.0 percent from LD to RD on average.

The average TALF CMBS loan paid a fixed interest rate of 3.33 percent, and it had about 4.11 years to maturity on the origination date. By the redemption date, the TALF loans had 3.37 years to maturity on average. On average, TALF CMBS loans were for $17.6 million. The smallest TALF CMBS loan was for $10 million, and the largest TALF CMBS loan was for $80.3 million. Loans ranged from 78.9 percent of the purchase price to a maximum of 85.6 percent of the purchase price.

Most of transactions were for CMBS originated in the peak bubble years of 2005, 2006, and 2007. 23.3 percent, 31.9 percent, and 34.3 percent of the CMBS was originally issued in those three years respectively.

The actual number of loans of each manager is the buyer dummy in Table 1 times the number of observations in Table 1, 686. The top five private investors in TALF CMBS deals, which each participated in 40 or more loans, were Arrowpoint (40 deals), Blackrock (94 deals), DMR (48 deals), Ladder (76 deals), and PIMCO (55 deals). Combined, the five firms received 45.6 percent of the 686 TALF CMBS loans. The author could find out little about Arrowpoint which is a Denver, Colorado, based investment manager. Blackrock's website said it had as of 30 September 2010, $3.45 trillion in assets under management. Declaration Management & Research (DMR) listed its assets under management at $10.7 billion as of 30 September 2010, on its website. Likewise, Ladder Capital listed its assets under management at $2.5 billion. In contrast, the Newport Beach, California, based PIMCO managed over $1.24 trillion by the third quarter of 2010. Thus, both Blackrock and PIMCO are much larger asset managers than the other three of the top-five TALF CMBS investors. We would expect that both Blackrock and PIMCO would be worried about political consequences of defaulting on TALF loans. Wilson and Wu (2012), for example, argue that political stigma may have driven large banks to repay TARP loans early in 2009. Those larger funds may also have investment management skill which allows them to garner greater assets under management than other large TALF CMBS investors. More skilled investors will be able to close out their TALF CMBS loans early and book a profit.

Finally, it seems likely Blackrock and PIMCO have greater access to credit than Arrowpoint, DMR, and Ladder. Covitz et al. (2021) find that credit constraints for ABS investors were significant in predicting if asset managers would seek TALF funding. Thus, the former firms would be able to refinance the TALF loans more easily as the Fed loans matured.

Hypothesis 2 (H2). *The biggest asset managers Blackrock and PIMCO will be more likely to repay their TALF CMBS loans early than smaller asset managers.*

Hypothesis 2 receives strong support when we test the data in Section 4.

We can see from Table 1 that the top ten issuers of CMBS purchased with TALF money were Bank of American, Bear Stearns, Citigroup, Credit Suisse, Goldman Sachs, JP Morgan, the team of Lehman Brothers and UBS, Merrill Lynch, Morgan Stanley, and Wachovia. Only JP Morgan and Wachovia issued more than 10 percent of the CMBS purchased through the TALF program. The top ten issuers made up 79.7 percent of the 686 TALF CMBS deals. The dummy variable equals one if the commercial mortgage-backed security was issued by the bank for which the dummy variable is named and zero otherwise.

CMBS have various slices or tranches of differing seniority. The waterfall structure of these securities means that money flows into the highest rated tranches before any lower rated tranches are paid in a given period. Even if several tranches are rated AAA, the more senior tranches are safer because they have more protection against default. By searching the CUSIP numbers of the CMBS at the S&P and Moody's web sites, the author found the seniority and rating of the tranches of the CMBS issued. For 664 or the 686 CMBS purchases with Federal Reserve loans, the author was able to obtain the tranche of the CMBS. A number between one and seven was assigned to the tranche to denote its rank. A rank of one indicates that the CMBS was the most senior tranche of that issue.

The rating of the collateral for the TALF loans was also obtained from Moody's and S&P's websites. About three quarters of the issues were rated by Moody's, and three quarters of the issues were rated by S&P. 96 percent of the issues were rated by one of the two agencies. Very few CMBS tranches which were used as collateral for TALF loans were rated less than Aaa or AAA by either agency in January 2010 when the ratings data was collected.

4. A Theoretical Model of TALF Loans

In this section we develop a theoretical model of the hidden subsidy embedded TALF's nonrecourse loans. Nonrecourse loans allow borrowers to walk away from the loan by ceding the collateral with no other ill effects to the borrower. Thus, the non-collateral assets of the borrower are safe. These loans give the borrower essentially a call option, according to Krugman (2009), Stiglitz (2009), and Wilson (2011), because the loans do not have to be paid if the collateral is worth less than the loan. Thus, we can model the behavior of a TALF borrower similar to that of the buyer of a call option using a Black and Scholes (1973) framework. The TALF asset manager buys a call option on the underlying asset worth M. While M is not directly observed, it can be estimated using this Black and Scholes (1973) setup.

We want to numerically solve for the M that satisfies the equation below:

$$\begin{aligned} &(a) \quad C_0 = MN(d_1) - [\lambda M^* \exp(Rt)] \exp(-r_f t) N(d_2) = M^* - L \\ &(b) \quad d_1 = \frac{\ln\{M/[\lambda M^* \exp(Rt)]\} + (r_f + \sigma^2/2)t}{\sigma\sqrt{t}} \\ &(c) \quad d_2 = d_1 - \sigma\sqrt{t} \end{aligned} \tag{1}$$

C_0 is the value of the asset manager's call option or stake in the TALF collateral. $N(d_i)$ is the cumulative normal density function, where $i = 1$ or 2. exp( ) stands for the exponential number. ln{} is the natural log. M^* is the price paid for the CMBS. L is the loan funded by the New York Fed. λ is the leverage ratio, which is defined as $L/M^* = \lambda$. R is the rate of interest charged on the TALF loan converted to continuous compounding. r_f is the risk-free

rate adjusted for continuous compounding. σ is the annualized volatility of the CMBS. In Equation (1), we want to numerically solve for the M that causes both the right-hand side and the left-hand side of line (a) to be equal to each other.

Once we have numerically assigned a value to the toxic asset, M, using Equation (1), we can estimate the loan's subsidy at the date of issue, using put-call parity. Put call parity in this instance could be written as follows:

$$M^* - L = M - [\lambda M^* \exp((R - r_f)t)] + P \tag{2}$$

$M^* - L$ is the value of the call option on the toxic asset, which is observable from the price paid, M^*, and the loan amount, L. M is the underlying asset solved for in Equation (1). $\lambda M^* \exp((R - r_f)t)$ is the present value of the strike price on the call option. P is the put option written by the New York Fed that allows the borrower to default on the loan and cede only the asset. Rearranging Equation (2), the value of the TALF loans to the New York Fed and the U.S. Treasury, which has a junior stake in those loans, is the following:

$$M + L - M^* = [\lambda M^* \exp((R - r_f)t)] - P \tag{3}$$

The right-hand side is easy to value after numerically solving Equation (1). The present value of the TALF CMBS loan can be found by subtracting the loan amount from the right-hand side of Equation (3). Thus, the present value of the TALF loan to the Fed is $M - M^*$. If this number is negative, then there is a subsidy to the private investors. The subsidy rate, s, of any given TALF loan can be calculated as the following:

$$s = \frac{M^* - M}{L} \tag{4}$$

Hypothesis 3 (H3). *The subsidy rates of TALF loans $(M^* - M)/L$ will be higher when the CMBS is purchased than when the Federal Reserve loans are paid in full.*

The author predicts that private investors will only accept TALF loans when the financial terms entail a subsidy. Likewise, when there is little or no subsidy, then the private investors will tend to repay their TALF loans early. When $M^* = M$, there is no subsidy implied by the loan terms. Yet, if $M^* > M$, then the redemption of the TALF loans means that the investor is giving up some subsidized financing. If $M^* < M$, redemption of the TALF loans allows the investor to shed financing that has become more expensive than it is worth.

Hypothesis 4 (H4). *The spread over the risk-free rate will be higher on the TALF CMBS redemption date than on the loan date.*

Higher spreads over the risk-free rate mean the TALF loans are more expensive forms of financing. The steeply upward sloping yield curve over this period means that the fixed rate TALF loans become more expensive as they mature. This is because the yields on the U.S. Treasury bills and notes falls as the maturity of the loan shortens, while the fixed rate of the TALF loan is unchanged.

Hypothesis 5 (H5). *The volatility of the CMBS will be higher on the TALF loan date than on the redemption date.*

Higher volatility means that the call option on the CMBS is more valuable. Thus, private investors will accept TALF financing when the volatility of the CMBS is high and shun TALF loans when the volatility is low.

All three hypotheses are strongly supported by the data. The loan date subsidy rate is significantly greater than the redemption date subsidy rate. The loan date interest rate spread over U.S. Treasuries is significantly lower than the redemption date interest rate spread over U.S. Treasuries. Finally, the estimated volatility is significantly lower when the funds repaid their TALF loans than when they accepted the government's loans. In Table 3, all three hypotheses are statistically significant of the predicted sign with greater than 99.9 percent confidence.

Table 3. Two-tailed *t*-test of the means for Hypotheses 3, 4, and 5.

Hypothesis	Loan Date (LD)	Redemption Date (RD)	Difference (LD)—(RD)	*p*-Value	Hypothesized Difference
(H3) Subsidy	34.72%	−10.44%	45.16%	0.000	positive
(H4) TALF Spread in %	1.36%	2.13%	−0.77%	0.000	negative
(H5) 60-Day Volatility	12.58%	4.85%	7.73%	0.000	positive
(H5) 30-Day Volatility	9.36%	4.32%	5.04%	0.000	positive
Number of Observations	338				

For the TALF loans that were repaid in our sample, we tested the following three hypotheses about the changes in the TALF subsidy rate, TALF loan spread over treasuries, and the volatility of the reference index between the loan date (LD) and redemption date (RD). All hypotheses repeated below were supported by the *t*-tests of means with over 99 percent confidence. This is the sub-sample of TALF loans that were paid in full on or prior to 30 September 2010. **Hypothesis 3.** *The subsidy rates of TALF loans* $(M^* - M)/L$ *will be higher when the CMBS is purchased than when the Federal Reserve loans are paid in full.* **Hypothesis 4.** *The spread over the risk-free rate will be higher on the TALF CMBS redemption date than on the loan date.* **Hypothesis 5.** *The volatility of the CMBS will be higher on the TALF loan date than on the redemption date.*

5. Predicting Early TALF CMBS Redemptions

5.1. Two-Tailed t-Tests of Factors Associated with Early TALF CMBS Loan Redemptions

In Table 4, we look at the differences between the means for investments where the TALF loans were repaid prior to 30 September 2010, and those investments where the TALF loans were still outstanding. There were 338 loans with a par value of $5.9 billion that were repaid, and 348 loans with a par value of $6.1 billion that were still outstanding at the end of the third quarter of 2010. For the purposes of this table and Table 5, the redemption date (RD) is defined as the lesser of the day the TALF loans were repaid or 30 September 2010.

Table 4. *t*-tests of means for TALF CMBS loans that have been repaid and TALF CMBS loans that were still outstanding on 30 September 2010.

Panel A					
Data Item	**(A) Repaid**	**(B) Outstanding**	**Difference (A)–(B)**	**T-Statistic**	***p-Value***
Loan Date	*10/28/09*	*12/4/09*	*−36.85*	*−6.94*	*0.000*
Subsidy LD	*34.72%*	*33.06%*	*1.66%*	*3.55*	*0.000*
Subsidy RD	*−10.44%*	*−11.81%*	*1.37%*	*3.65*	*0.000*
TALF Loan Spread over Treasuries at LD	1.36%	1.34%	0.02%	1.58	0.115
TALF Loan Spread over Treasuries at RD	*2.13%*	*2.73%*	*−0.60%*	*−14.58*	*0.000*
CMBX AAA Credit Spread LD	*2.56%*	*2.60%*	*−0.04%*	*−9.44*	*0.000*
CMBX AAA Credit Spread RD	*1.66%*	*1.07%*	*0.58%*	*−41.15*	*0.000*
CMBX AAA Credit Spread RD minus LD	*−0.91%*	*−1.53%*	*0.62%*	*very large*	*0.000*

Table 4. *Cont.*

Panel A					
Data Item	**(A) Repaid**	**(B) Outstanding**	**Difference (A)–(B)**	**T-Statistic**	***p-Value***
60-Day Volatility at LD	12.58%	12.40%	0.17%	0.56	0.574
30-Day Volatility at LD	9.36%	8.98%	0.38%	0.87	0.385
60-Day Volatility at RD	*4.85%*	*3.23%*	*1.62%*	*14.36*	*0.000*
30-Day Volatility at RD	*4.32%*	*3.36%*	*0.97%*	*8.97*	*0.000*
Interest Rate in %	*3.51*	*3.16*	*0.36*	*11.70*	*0.000*
Years to Maturity at RD	*3.82*	*2.94*	*0.88*	*12.23*	*0.000*
Years to Maturity at LD	*4.46*	*3.76*	*0.70*	*9.87*	*0.000*
Loan Amount (millions)	$17.5	$17.7	−0.12	−0.11	0.916
Assets Purchased (millions)	$20.9	$20.9	0.03	0.05	0.964
Loan-to-Value Ratio	*83.9%*	*84.6%*	*−0.68%*	*−7.96*	*0.000*
Tranche Rank	*3.012*	*2.647*	*0.365*	*4.55*	*0.000*
Number of Observations	338	348			
Total Loans Funded (millions)	$5926	$6142			
Total Assets Purchased (millions)	$7059	$7257			
Panel B					
Data Item	**(A) Repaid**	**(B) Outstanding**	**Difference (A)–(B)**	**T-Statistic**	***p-Value***
2005 Vintage Dummy	0.210	0.256	−0.046	−1.41	0.158
2006 Vintage Dummy	*0.393*	*0.247*	*0.146*	*4.16*	*0.000*
2007 Vintage Dummy	*0.269*	*0.414*	*−0.145*	*−4.03*	*0.000*
Buyer Dummy Arrowpoint	0.044	0.072	−0.027	−1.53	0.125
Buyer Dummy Blackrock	*0.266*	*0.011*	*0.255*	*10.43*	*0.000*
Buyer Dummy DMR	*0.000*	*0.138*	*−0.138*	*−7.34*	*0.000*
Buyer Dummy Ladder	*0.000*	*0.218*	*−0.218*	*−9.70*	*0.000*
Buyer Dummy PIMCO	*0.139*	*0.023*	*0.116*	*5.72*	*0.000*
Issuer Dummy BAC	0.077	0.083	−0.006	−0.31	0.758
Issuer Dummy Bear Stearns	0.077	0.115	−0.038	−1.69	0.092
Issuer Dummy Citigroup	0.021	0.014	0.006	0.63	0.527
Issuer Dummy Credit Suisse	0.059	0.057	0.002	0.09	0.924
Issuer Dummy Goldman Sachs	0.080	0.049	0.031	1.66	0.097
Issuer Dummy JPMorgan	0.175	0.129	0.045	1.65	0.099
Issuer Dummy Lehman Brothers/UBS	*0.056*	*0.098*	*−0.041*	*−2.04*	*0.042*
Issuer Dummy Merril Lynch	0.062	0.043	0.019	1.12	0.265
Issuer Dummy Morgan Stanley	0.062	0.078	−0.015	−0.79	0.428
Issuer Dummy Wachovia	0.130	0.129	0.001	0.03	0.973
S&P Rated Dummy	0.713	0.744	−0.031	0.92	0.358

Table 4. *Cont.*

Panel B					
Data Item	**(A) Repaid**	**(B) Outstanding**	**Difference (A)–(B)**	**T-Statistic**	***p-Value***
Moody's Rated Dummy	0.772	0.761	0.011	0.33	0.741
Moody's or S&P Rated Dummy	0.962	0.957	0.005	0.31	0.759
Number of Observations	338	348			
Total Loans Funded (millions)	$5926	$6142			
Total Assets Purchased (millions)	$7059	$7257			

(**Panel A**) Two-tailed, paired *t*-tests that are significant at greater than the 95 percent level are in italics. LD stands for "loan date", and RD stands for "redemption date". The redemption date (RD) is defined as the lesser of the day the TALF loans were repaid or 30 September 2010. We look at the differences between TALF loans that were repaid by 30 September 2010, and TALF loans still outstanding at that date. Loans repaid prior to 30 September 2010, were made significantly earlier than loans still outstanding. Repaid loans had significantly higher subsidy rates at the loan date. Repaid loans had significantly higher subsidies at the redemption date. The spread over Treasuries was not significantly different at the loan date for repaid and outstanding loans, but that spread over Treasuries was significantly lower for repaid loans at the redemption date. Repaid loans had significantly lower spreads over the CMBX index than outstanding loans at the loan date and the redemption date. Moreover, repaid loans had a significantly lower decline in their spread over the CMBX index from loan date to redemption date. The reference index volatility of repaid and outstanding loans was not significantly different at the loan date, but the reference index volatility was significantly higher for repaid loans at the redemption date. Repaid loans had significantly higher interest rates and years to maturity at both the loan and redemption dates. There was no significant difference in terms of loan amounts or assets purchased between repaid and outstanding loans. The loan-to-value ratio of repaid loans was significantly lower as was the tranche rank of repaid loans. (**Panel B**) Two-tailed, paired *t*-tests that are significant at greater than the 95 percent level are in italics. All repayments are for TALF loan repayments on or prior to 30 September 2010. TALF loans to purchase CMBS originated in 2006 were significantly more likely to repaid by 30 September 2010, but TALF loans to buy the 2007 vintage of CMBS was significantly less likely to repaid by that date. The asset managers Blackrock and PIMCO were significantly more likely to repay TALF loans, but the asset managers DMR and Ladder were significantly less likely to repay TALF loans. Lehman Brother's issued CMBS was significantly less likely to have its TALF loans repaid.

Loans that were repaid were made over a month earlier on average than investments that were still outstanding by 30 September 2010. Since historic volatilities declined over this period, the loan date (LD) and redemption date (RD) volatilities were higher for loans that were repaid than loans that were still outstanding. Also the subsidies estimated from Equations (1) and (4) were higher both at the loan date and redemption date for loans that were repaid versus loans that were still outstanding. By the redemption date, the model in Section 3 estimated that the subsidies had disappeared from the TALF loans. Thus, if an investor failed to redeem a TALF loan, then that was probably a sign that that particular CMBS issue was underperforming the market as a whole.

Because of the decline in credit spreads in Figure 2 and the earlier loan dates (LD) and redemption dates (RD) for investors repaying the TALF loans, loans that were repaid had significantly higher CMBX spreads at the LD and RD than loans that were not repaid. The decline in credit spreads from LD to RD was greater for investors that held on to TALF loans than investors that repaid them. Thus, with over 99.9 percent confidence, we can reject Hypothesis 1, which predicted early repayments would be the result of market timing. (We will come to a similar conclusion in the multivariate tests of this hypothesis in Table 5.) Thus, there is no evidence that better market timing as measured by declines in credit spreads explains early TALF CMBS loan repayments.

Investors that did repay early paid significantly higher interest rates,[7] and had significantly longer maturities at both the loan date (LD) and redemption date (RD). The maturity at the loan date was 0.7 years longer for loans that were repaid early, relative to loans that were still outstanding. Loan-to-value (LTV) ratios were significantly higher for loans that were not repaid. Yet, the difference was small (less than one percent), relative to the overall leverage ratio of about 84 percent LTV for both groups.

Less senior tranches of CMBS were more likely to be repaid early. Thus, part of the explanation for early repayments may be that less senior tranches saw greater recoveries over this period than more senior tranches. Loans made on CMBS of the 2006 vintage were

significantly more likely to be repaid. In contrast, loans that were made with collateral from the 2007 vintage of CMBS were significantly less likely to be repaid. Yet, many of the findings highlighted in this paragraph are reversed in the logistic regressions in Table 5 when we control for other factors.

Of the top-five purchasers of CMBS with TALF loans both Blackrock and PIMCO were significantly more likely to repay TALF loans early. This result is significantly greater than zero than 99.9 percent confidence. This supports Hypothesis 2 that those large asset managers would repay their TALF loans earlier than other asset managers. Hypothesis 2 is also strongly supported in the logistic regression results in Table 5. The small asset managers DMR and Ladder which both took out more than forty TALF loans were significantly less likely to repay their TALF loans early. Yet, these latter results about DMR and Ladder are not borne out when we adjust for other factors in the logistic regressions.

There were few strong relationships between the issuer of the CMBS and early TALF loan repayment. With 95 percent confidence, TALF loans used to purchase CMBS issued by Lehman Brothers/UBS were significantly less likely to have repaid early. This effect disappeared in logistic regressions which controlled for other factors. For the sake of brevity, the logistic regressions with issuer dummies were not reported. There was no significant relationship between the identity of the CMBS issuer and early TALF loan redemptions in the logistic regressions.

Likewise, both in the reported univariate tests and the unreported logistic regressions the dummy variables for a Moody's or S&P rating were not significantly related to early TALF redemption. Thus, a rating by either one of these agencies was not associated with any increased or decreased propensity for the TALF loans to be paid back before 30 September 2010.

5.2. Logistic Regressions of Factors Associated with Early TALF CMBS Loan Redemptions

The logistic regression allows us to test the significant factors associated with early TALF CMBS redemptions after controlling for other factors. Let p_i be the probability that the i-th TALF loan will be repaid in full on or prior to 30 September 2010. If the dependent variable, Y_i, equals one, then the TALF loan is repaid in full by that date. If Y_i equals zero, then the TALF CMBS loan has not been repaid in full by 30 September 2010. Let $\mathbf{x}_i$ be a row vector of independent variables of the i-th TALF CMBS loan observation. β is defined as a column vector of the coefficients estimated from the model. From Johnston and Dinardo (1997, p. 424), the probability of the dependent variable being unity in the logistic model is

$$p_i = E(Y_i = 1|\mathbf{x}_i) = \frac{e^{\mathbf{x}_i\beta}}{1 + e^{\mathbf{x}_i\beta}}. \quad (5)$$

Five different specifications of the logistic regressions are reported in Table 5.

Table 5. Logistic regression of factors associated with early repayment of TALF loans to purchase CMBS.

	Model 1	Model 2	Model 3	Model 4	Model 5
Subsidy at LD	10.451	11.344	39.033	50.110	10.273
	0.000	*0.000*	*0.001*	*0.000*	*0.000*
TALF Loan Spread at LD in %	736.491	476.117	380.475	396.781	357.930
	0.000	*0.002*	*0.000*	*0.001*	*0.000*
Change in CMBX from LD to RD	260.741	270.079	254.022	243.825	248.688
	0.000	*0.000*	*0.000*	*0.000*	*0.000*
60-Day Volatility at LD			−52.888	−72.010	
			0.083	*0.000*	

Table 5. *Cont.*

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
30-Day Volatility at LD	−13.691	−12.591			−12.160
	0.000	*0.001*			*0.000*
Assets Purchased (millions)	0.000	0.005	−0.002	0.007	0.014
	0.986	*0.695*	*0.865*	*0.540*	*0.235*
Loan-to-Value Ratio	−38.417	−36.311	−0.220	−5.995	−52.820
	0.004	*0.013*	*0.990*	*0.711*	*0.000*
Tranche Rank	−0.713	−0.617	−0.613		−0.370
	0.000	*0.000*	*0.000*		*0.011*
2005 Vintage Dummy		−2.797	−2.741	−2.805	−2.898
		0.000	*0.000*	*0.000*	*0.000*
2006 Vintage Dummy		−2.165	−2.174	−2.489	−2.672
		0.000	*0.000*	*0.000*	*0.000*
2007 Vintage Dummy		−2.350	−2.312	−2.648	−2.777
		0.000	*0.000*	*0.000*	*0.000*
Buyer Dummy Arrowpoint	−0.691	−0.754	−0.483		
	0.141	*0.148*	*0.800*		
Buyer Dummy Blackrock	3.632	3.488	3.086	3.424	4.092
	0.000	*0.000*	*0.000*	*0.000*	*0.000*
Buyer Dummy DMR	−21.717	−21.310	−20.852		
	0.997	*0.997*	*0.997*		
Buyer Dummy Ladder	−20.945	−20.811	−21.148		
	0.996	*0.996*	*0.996*		
Buyer Dummy PIMCO	1.707	2.123	2.435	2.752	2.412
	0.001	*0.000*	*0.000*	*0.000*	*0.000*
Intercept	25.310	28.109	−5.060	−2.901	42.509
	0.026	*0.024*	*0.751*	*0.848*	*0.000*
Number of Observations	686	664	664	664	664
Number of Obs. Where Y = 1	327	327	327	327	327
Number of Obs. Where Y = 0	337	337	337	337	337
Correct Predictions	83.40%	88.7%	87.5%	85.7%	87.0%
Psuedo R-squared	0.532	0.569	0.567	0.517	0.511

Coefficients are on top in normal font, and *p*-values are below in italics. The dependent variable equals one (Y = 1) if the loan is repaid early and zero (Y = 0) otherwise. The logistic model predicts whether a TALF loan will be repaid by 30 September 2010. LD stands for "loan date", and RD stands for "redemption date". The redemption date (RD) is defined as the lesser of the day the TALF loans were repaid or 30 September 2010. CMBX is an index of credit default swaps for referenced commercial mortgage-backed securities (CMBS). Volatility is the standard deviation of the returns on the reference index of mortgage securities over a 30-day or 60-day time horizon. Tranche rank is the order in which the CMBS gets paid. A tranche rank of one means the tranche gets paid first and is less risky than lower ranked tranches with higher numbers. Dummies stands for dummy variables taking on the value of either zero or one. Statistical significance is a confidence level greater than 95 percent that the coefficients are different from zero. Dummies equal one if the vintage, buyer, issuer, or credit rating status are the same as in the dummy variable name and equal zero otherwise. At the loan date, a higher estimated TALF loan subsidy or TALF loan spread over Treasuries were positively associated with early TALF loan redemption. If the CMBX for the underlying CMBS declined from loan date to redemption date, then the TALF loans were significantly more likely to be repaid. Higher volatility at the loan date, higher loan-to-value ratios, and lower tranche ranks were associated with loans significantly less likely to be repaid. TALF loans to buy the 2005, 2006, and 2007 vintages of CMBS were significantly less likely to repaid. TALF loans extended to the largest asset managers, Blackrock and PIMCO, were significantly more likely to be repaid early.

A number of factors are significantly associated with early TALF redemptions. Higher loan date (LD) estimated subsidy rates, higher TALF spreads over U.S. Treasuries at the loan date (LD), and a bigger change in the CMBX from loan date to redemption date (RD) are all associated with a significantly higher propensity to repay TALF loans early.

The positive sign of the CMBX coefficient allows us to reject the market timing hypothesis, Hypothesis 1. A greater decline in credit spreads from the loan date to the redemption date is associated with a decreased propensity to repay TALF loans. Thus, early redemption cannot be explained by market trends. Early redemption must be attributed to factors specific to the CMBS tranche purchased or the borrower of the TALF money.

While we can reject Hypothesis 1, Hypothesis 2, is strongly supported. If the identity of the buyer of the CMBS is Blackrock or PIMCO, then the TALF loans are significantly more likely to be repaid early.

To quantify the magnitude of this latter effect, let us consider model 1. If the average characteristics of the TALF loans are selected from Table 1, and the buyer of the CMBS is not one of the top five borrowers from the TALF, then predicted probability of early TALF redemption according to Equation (5) and model 1 is 49.0 percent. Yet, if the buyer is Blackrock, then the predicted probability of TALF redemption jumps to 97.3 percent. A similar, but less dramatic increase in the chances of early TALF repayment occurs if the buyer is PIMCO. A loan with the average characteristics and PIMCO as the buyer has an 84.2 percent predicted probability of an early TALF loan repayment, according to model 1 in Table 5. Since the Federal Reserve and U.S. Treasury are guaranteed to make money from loans that are paid in full early, they should be happy that both Blackrock and PIMCO have displayed a tendency to repay TALF CMBS loans early.

In total, Blackrock has repaid 90 of its 94 TALF CMBS loans early, and PIMCO has repaid 47 of its 55 TALF CMBS loans early. Compare this to the ratio of 201 early redemptions out of 537 loans take out by all the other asset managers, besides Blackrock and PIMCO, combined. Thus, using the simplest calculus, Blackrock and PIMCO were at least twice as likely to repay their loans to buy CMBS as other asset managers. In addition, since Blackrock is one of the eight active asset managers for the U.S. Treasury's toxic asset program, the Legacy Securities Program, the early redemptions in the TALF CMBS program may indicate that taxpayers are likely to turn a profit on Blackrock's management of RMBS and CMBS portfolios financed by taxpayers in the LSP. By the end of the third quarter of 30 September 2010, Blackrock's percent returns on its LSP investments were the third highest of the eight asset managers, according to the U.S. Treasury's calculations.[8]

Other factors are significantly associated with a lower propensity to repay TALF loans backed by CMBS. Higher volatilities at the loan date make early TALF redemptions less likely. This is consistent with the subsidy in TALF loans from Equations (1) and (4) being a positive function of the volatility of the CMBS. Consistent with this theme, less senior or higher numbered tranches, are more risky and significantly less likely to redeemed early. Loans backed by CMBS issued in the peak bubble years of 2005, 2006, and 2007 are significantly less likely to be repaid early. Finally, higher leverage makes the strike price of the put written by the Federal Reserve higher. The put embedded in the non-recourse loans is more valuable when the strike price or loan-to-value ratio is higher. Thus, it is not surprising that a higher leverage ratio is associated with a lower propensity to repay the TALF CMBS loans early.

6. Conclusions

This is the first study to empirically test the performance of the U. S. government's attempt to purchase non-agency mortgage-based assets after the financial crisis of 2008 and 2009. The Term Asset-Backed Securities Loan Facility's (TALF's) commercial mortgage-backed securities (CMBS) purchase program funded the purchase of $14.3 billion of CMBS with low-interest, nonrecourse loans from 24 July 2009, to 29 March 2010. The Federal Reserve offered private asset managers three-to-five-year loans for up to 85.6 percent of

the purchase price of CMBS. Approximately half these 686 loans were repaid early by 30 September 2010.

This paper develops a model based on standard option pricing techniques to estimate the subsidies embedded in the Federal Reserve loans. While this paper estimates that the subsidy rates for these loans were in the neighborhood of 34 percent of the loan value at the time of issue, the subsidy rate was negative by the end of the period studied. Early TALF loan repayments coincided with disappearing loan subsidies, rising TALF loan spreads, and declining collateral volatility. These findings are consistent with the predictions of the theoretical model tested. As the TALF loan subsidies became less valuable, the TALF loans were repaid early.

This paper looks at several other characteristics of early loan repayments in the TALF CMBS program. Loans used to buy bubble year vintages, 2005–2007, of CMBS were significantly less likely to be repaid. Yet, the study finds no evidence that asset managers that were better at market timing repaid their TALF loans early. In contrast, the identity of the asset manager seems to matter. TALF loans extended to Blackrock and PIMCO were significantly more likely to be repaid in full early. The predicted probability of repaying the TALF loans estimated in one specification of the logistic regressions jumped from 49 percent to 97 percent or 84 percent if the asset manager was one of the bond giants Blackrock or PIMCO, respectively. It is possible that the larger asset managers Blackrock and PIMCO may have been more sensitive to political blowback from taking government loans or faced fewer credit constraints than smaller investment managers. In addition, loans used to buy more senior CMBS tranches were more likely to be repaid.

There are some policy implications coming out of this study's results. Since the Fed never takes losses from emergency loans that are repaid early, the Fed may want to favor asset managers with larger assets under management if those managers are more likely to exit emergency programs early as was the case of the TALF. Further, the Fed could minimize future losses by focusing emergency lending on the higher ranked tranches of asset-backed securities. In addition, if the Fed sets the emergency lending program interest rates higher initially, there is evidence that that is associated with earlier redemptions of emergency loans.

Finally, loans with higher spreads over U.S. Treasuries were significantly more likely to be paid back before maturity. Those higher spread TALF loans were more expensive to service as credit conditions improved and thus were significantly more likely to be repaid early.

The Fed only makes available data on the loans that were made. It would be interesting to compare the loans that were made to all the TALF loans applied for. We don't know anything about the loans to buy CMBS that the Fed rejected. That would be an interesting avenue for researchers who might obtain that data. Further, it would be interesting to see how the TALF 2.0, which stopped making new loans at the end of 2020, performed in terms of early loan redemptions and its expanded asset-backed securities (ABS) classes eligible for loans. This study only looks at TALF 1.0, which stopped making loans in 2010.

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Notes

[1] According to Wilson (2011), there were two other components of the U.S. government's toxic asset purchase plans. Those other two programs were the Legacy Securities Program (LSP) run by the U.S. Treasury and the Legacy Loans Program (LLP) run by the Federal Deposit Insurance Corporation (FDIC). The legacy securities program has financed the purchase of CMBS, but primarily it has financed the purchase of residential mortgage securities. Only 18 percent, or $3.4 billion, of the $19.3 billion of securities purchased through the LSP by 30 September 2010, consisted of CMBS. See U.S. Treasury, 20 October 2010, "Legacy Securities Public-Private Investment Program, Program Update, 30 September 2010," *U.S. Treasury, Office of Financial Stability*, Available online: http://www.financialstability.gov/docs/External%20Report%20-%2009-10%20vFinal.pdf (accessed on 9 January 2011).

Unlike the Federal Reserve's TALF program, the U.S. Treasury has not released any data on the actual CMBS and Residential Mortgage Backed Securities (RMBS) purchased with the LSP by the start of 2011.

[2] Sarah Mulholland, 4 January 2011, "Wall Street Preparing $4 Billion of Commercial-Mortgage Bonds," Bloomberg, Available online: http://www.bloomberg.com/news/print/2011-01-04/wall-street-banks-preparing-4-billion-of-commercial-mortgage-bond-sales.html (accessed on 9 January 2011).

[3] Nonrecourse loans allow borrowers non-collateral assets to be protected in the event of default. Wilson (2011) has a good non-technical description on nonrecourse loans.

[4] See Exhibits 19 and 21 of CRE Finance Council, 14 January 2011, *Compendium of Statistics*, Available online: http://www.crefc.org/uploadedFiles/CMSA_Site_Home/Industry_Resources/Research/Industry_Statistics/CMSA_Compendium.pdf (accessed on 16 January 2011).

[5] See Craig Torres and Scott Lanman, 1 December 2010, "Fed Emergency Borrowers Ranged From GE to McDonald's," Bloomberg, Available online: http://www.bloomberg.com/news/print/2010-12-01/fed-crisis-borrowers-ranged-from-bank-of-america-to-mcdonald-s.html (22 February 2012); and Board of Governors of the Federal Reserve System, 1 December 2010, "Press Release: Federal Reserve releases detailed information about transactions conducted to stabilize markets during the recent financial crisis," Federal Reserve, Available online: http://www.federalreserve.gov/newsevents/press/monetary/20101201a.htm (accessed on 2 January 2011).

[6] This is a similar finding to Ambrose and Sanders (2003) who find that prepayments on CMBS are more likely to occur when the spread between the coupon rate on the mortgage and current interest rates widens.

[7] This is a similar finding to Ambrose and Sanders (2003) who find that prepayments on CMBS are more likely to occur when the spread between the coupon rate on the mortgage and current interest rates widens.

[8] See U.S. Treasury, 20 October 2010, "Legacy Securities Public-Private Investment Program, Program Update, 30 September 2010", *U.S. Treasury, Office of Financial Stability*, Available online: http://www.financialstability.gov/docs/External%20Report%20-%2009-10%20vFinal.pdf (accessed on 9 January 2011).

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