Default of Commercial Mortgage Loans during the Financial Crisis

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1. Introduction

The recent financial crisis started in the subprime market soon spread to the prime and commercial markets.\(^1\) While numerous studies have been conducted on the default of subprime residential mortgages, little has been done on commercial mortgages.\(^2\) In this paper, we examine the default of loans backing the commercial mortgage-backed securities (hereafter CMBS loans) during the crisis. Particularly, we seek to answer the following two questions: 1) How high are the default rates of CMBS loans in recent years, compared to those in the previous periods and to those of loans in other segments of the mortgage market? 2) What are the drivers of elevated CMBS loan default during the crisis?

Popular news media and professional reports have quoted various statistics regarding mounting commercial mortgage default. However, frequently, there lacks a systematic documentation of CMBS default rate, especially one based on a clear and consistent default definition. In this paper, we distinguish among 30-day delinquency, 60-day delinquency, serious (over 90-day) delinquency, foreclosure, and REO, and conduct default rate comparisons over time and across market based on consistent definitions.

Berger and Udell (2002) present evidence that bank lending is pro-cyclical. Therefore, it is interesting to see whether CMBS lenders have reduced their underwriting prior to the crisis, which is the period when the commercial real estate market and the overall financial market have

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\(^1\) This is seen from the failure of many subprime mortgage lenders such as the New Century Financial Corporation and Ameriquest in 2007, followed by the government takeover of prime mortgage-backed securities issuers Fannie Mae and Freddie Mac in 2008 and large scale of CMBS downgrades by Moody’s and Standard and Poor’s during 2008-2009.

\(^2\) An incomplete list of research on subprime mortgage default include Foote, Gerardi, Goette and Willen (2008), Gerardi, Shapiro and Willen (2008), Danis and Pennington-Cross (2008), Demyanyk and Hemert (2009), Mian and Sufi (2009), Elul (2009), Ho and Pennington-Cross (2009), Agarwal, Ambrose and Sanders (2009), Haughwout, Okah and Tracy (2009), Keys, Mukherjee, Seru and Vig (2010), Green, Rosenblatt and Yao (2010), and An, Deng, Rosenblatt and Yao (2010).
experienced exceptional “good time”. Meanwhile, a number of recent studies have found reduced underwriting has contributed to the catastrophic default loss in the residential mortgage market and that the expansion of the securitization market has caused the lax underwriting (see, e.g. Mian and Sufi 2009, Elul 2009, Keys, Mukherjee, Seru and Vig 2010 and Rajan, Seru and Vig 2010). Given that the CMBS and the commercial real estate CDO markets have experienced booms similar to that in the prime MBS and the subprime ABS markets, it is natural to ask whether intensified securitization similarly has caused lax underwriting in the commercial mortgage market that causes high default rates.

Property price decline and the resulting negative equity is undoubtedly a critical driver of residential mortgage default (see, e.g. Deng, Quigley, Van Order, 2000; Demyanyk and Hemert, 2009). Similar to the unprecedented downturn in the residential market, commercial real estate prices have declined by 44 percent from the peak in October 2007 to the trough in October 2009 (figure 1). Therefore, we investigate the relation between property value depreciation and CMBS loan default. In addition, we examine the relation between CMBS default and commercial property NOI growth, as insolvency is another significant trigger of commercial mortgage default (see, e.g. Goldberg and Capone, 2002; Seslen and Wheaton, 2010). In the study of the aforementioned two drivers of CMBS loan default, we pay special attention to two issues: one is the potential lag of the impacts of negative equity and negative cash flow on default; the other is the possible structural beak in the mortgage market after the unprecedented real estate market crisis.

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3 It is important to observe that there is a difference between reduced underwriting standards and misleading underwriting standards. In a market where property values are increasing and delinquency rates are falling, procyclical underwriting would be the increase of loan-to-value ratios, interest-only loans and loan documentation. This is different than underwriting standards being substantially below what was promised.
We find that the default rates of conduit CMBS loans, including the 30+, 60+, and 90+ delinquency rates all have risen sharply since late 2008 and have reached 8.63%, 6.32% and 5.73%, respectively, in the second quarter of 2010. The 2010Q2 default rates are about 7 times of the 10-year average. On a longer horizon, the recent wave of CMBS loan default at the start of the crisis were low compared to historical default rate levels but they accelerated very quickly during the crisis and became much higher than those in the 1990-1992 commercial real estate recession. We also find that default rates of CMBS loans are cyclical. The analysis in the paper provides a first step towards a better understanding of the time series dynamics of commercial mortgage default risk and potential credit cycles in the mortgage market.

Cross sectional comparisons show that default rate conduit CMBS loans is lower than those of commercial mortgages held by banks and thrifts during the crisis but has surpassed the latter recently. However, default rate of conduit CMBS loans in the past 10 years has always been higher than those of the commercial mortgage loans held by life insurance companies and multifamily mortgages securitized by Fannie Mae and Freddie Mac. The serious delinquency rate of conduit CMBS loans is comparable to that of the prime conventional FRMs, and is about one third of that of prime conventional ARMs, about one fifth of that of subprime FRMs and nearly one eighth of that of subprime ARMs.

Based on information from surveys of loan officers and investors, as well as origination weighted average loan-to-value (LTV) ratio and debt-service coverage ratio (DSCR) contained in CMBS pools, we find limited evidence of eased underwriting of CMBS loans prior to the crisis, which is consistent with findings in Stanton and Wallace (2010). However, this finding does not preclude the possibility that underwriting of CMBS loans before the crisis are based on inflated property value and thus there is virtually deterioration in underwriting standards.
We further confirm the significant negative relations between CMBS loan default and property value appreciation and NOI growth, predicted by a double trigger default model. Interestingly, through a simple regression exercise we discover that property price change affects default with a 4-quarter lag and change in NOI affects default with a 1-quarter lag, consistent with behavioral conjectures regarding commercial mortgage default. This provides implications for proactive default mitigation through special loan services. We also find a structural break of the relation between property value change and CMBS loan default in the start of the crisis, with CMBS borrowers respond more sensitively to property value decline during the crisis. This is consistent with findings in An, Deng, Rosenblatt, and Yao (2010) about asymmetric relations between mortgage default and property price movement in an up and a down market. However, the relation between CMBS loan default and NOI growth remains stable throughout the commercial real estate cycle.

We proceed as follows: in the next section, we document the time series dynamics of default rates of CMBS loans and compare them with those of other mortgage market segments; in section 3, we present a double trigger theoretical framework for default analysis, and investigate how changes in underwriting and property market conditions have caused elevated CMBS loan default; we provide conclusions and discussions in the final section.

2. Default Rate of CMBS Loans

Similar to residential mortgage loans, late fees will be charged if a CMBS loan is 30-day delinquent. When a CMBS loan is 60-day overdue, a notice of default is usually sent to the borrower and the servicing of the loan will be transferred from the primary servicer to a special servicer, who will first seek to workout the loan if appropriate. If a workout is unsuccessful, the
lender (through special servicer) will start the foreclosure process, which typically occurs after the loan is over 90-day delinquent and can result in trustee sale, short sale, or REO (unsuccessful trustee sale). Therefore, 30-day delinquency, 60-day delinquency and 90-day delinquency are critical events in the life of a CMBS loan and represent certain risks of default loss to lenders and investors. In the following, we document default rates based on three different definitions: 30+ delinquency includes 30- to 59-day delinquency, 60- to 89-day delinquency, 90-day and over delinquency, performing and nonperforming post balloon, foreclosure, and REO; 60+ delinquency includes all above except 30- to 59-day delinquency; and 90+ delinquency means the loan is either 90-day and plus delinquent, or in foreclosure, or REO.

2.1 Time Series Dynamics of CMBS Loan Default Rate

How default risk changes over time is a crucial topic for portfolio managers who care more about systematic risk than idiosyncratic risk and for financial regulators who are interested in the stability of the whole financial system. Therefore, a sizable literature has been developed in the past ten years on the time series dynamics of corporate default (see, e.g., Nickell, Perraudin, Varotto, 2000; Allen and Saunders, 2003; Pesaran, et al, 2003; Koopman, Lucas, Klaassen, 2005; Lown and Morgan, 2004; Koopman and Lucas, 2005; Koopman, Lucas, Daniels, 2005; Duffie, Saita, Wang, 2007). We take a first step toward that direction by documenting the changes in CMBS loan default rates over time.

In Figure 2, we present the 30+, 60+, and 90+ delinquency rates of conduit CMBS loans from the first quarter of 2000 to the second quarter of 2010. Note that we focus on conduit CMBS loans as conduit deals are the dominant type of CMBS deals and CMBS loans originated by

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4 See An (2007) for a more detailed survey of that literature.
conduits represent the “standard” CMBS loans. As seen from the figure, default rates of conduit CMBS loans have risen sharply starting from late 2008. In 2010Q2, the most recent quarter when data is available, the 30+, 60+, and 90+ delinquency rates have reached 8.63%, 6.32% and 5.73%, respectively. The average 30+, 60+, and 90+ delinquency rates over our 10-year sample period are 1.17%, 0.96% and 0.76%, respectively. Therefore, the most recent default rates are about 7 times of the 10-year averages. We also notice the cyclicality of conduit CMBS loan default rates over the 10-year period: default rates were low (30+ delinquency rate below 1%) before a wave of default hit the CMBS market during the 2002-2004 periods; then they trended down during 2005-2006 and became historical low in the first half of 2007 (30+ delinquency rate is about 0.3%); finally they became unprecedentedly high in 2009 and the first half of 2010. The waves of default tend to coincide with the commercial real estate downturns we observe from the NCREIF commercial property value index in Figure 1, although there seems to be a lag between CMBS loan default and property value decline. We will revisit this issue later in the paper.

In Table 1, we present a matrix that breaks down the serious (90+) delinquency rate by loan vintage and duration. For example, the first row shows the serious delinquency rate of conduit CMBS loans originated in 1999 at age 0 through age 10. Thus the numbers on the diagonal of the table represent the serious delinquency rates in a particular calendar year. For example, the bolded numbers represent the default rate in 2009 for different vintage CMBS loans, from which we see the worst vintage is 1999 with a 15% serious delinquency rate in 2009, followed by the 2000 vintage with a serious delinquency rate of 7.86%. However, these high default rates may also reflect the duration effect as existing studies have found that mortgage loans tend to have

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5 In addition to conduit deals, there are government agency CMBS deals, single borrower lease-based deals, seasoned loan deals, multiple borrowers floating rate deals, large-loan deals (consisting loans exceeding $20 million), etc.
different default propensities when they are at different stages in life (see, e.g. Deng, Quigley, Van Order, 2000; Ciochetti, Deng, Gao, Yao 2002). The 1999 vintage also has a high cumulative default rate of 26.5 percent during the 10 year period.

To look at CMBS default rates on a longer horizon, we compare default rates during the recent crisis presented in table 1 to those of the previous crisis in early 1990s. Commercial real estate market experienced a significant downturn in late 1980s and early 1990s, and a big wave of commercial mortgage loan default came in 1990-1992. Table 2 replicates the results from Esaki (2002) to show the serious delinquency rates of commercial mortgage loans originated during 1982-1992 and traced through 1992. Again, they are broke down by loan vintage and duration. The bold numbers on the diagonal are the default rates in 1992 for each cohort. As seen from the table, loans originated in 1986 are the worst vintage as their serious delinquency rates are 10.3% in 1992. In fact, Esaki (2002) reported that the 1986 vintage has 28 percent in loan counts and 32 percent in loan balance eventually defaulted in 14 years. Comparing Table 1 with Table 2, we find that CMBS loan default rates are higher in 2009 than those of commercial mortgage loans in 1992.

We also compare default rates of commercial mortgage loans during the two commercial real estate cycles in Figure 3. The default rates are calculated based on Table 1 and Table 2, and the shaded areas indicate the two recessions, which are 1990-1992 and 2007-2009. An important finding is that the serious delinquency rates are much lower at the start of the recent recession compared to the one in the 1990s, but they have accelerated much more rapidly. We observe cyclicality of commercial mortgage default rates in both cycles.

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6 Note that those loans were the ones held by life insurance companies.
2.2. Cross Sectional Comparisons

The CMBS market emerged as a “kitchen sink” for bad commercial mortgage loans as securitization in the early 1990s is mainly for the purpose of liquidating nonperforming commercial mortgage loan portfolios of failed thrifts (Geltner, Miller, Clayton, Eichholtz, 2007). However, in the past 10 years, the CMBS market has become the dominant funding source for commercial real estate, and is thought to have brought uniform underwriting standards, transparency, and efficiency gains to the commercial mortgage market (An, Deng, Gabriel, 2009).

In light of the recent crisis, there are rising concerns of the moral hazard in the “originate-to-distribute” model of mortgage lending and the performance of conduit loans (An, Deng, Gabriel, 2010). Therefore, it is interesting to compare the default rates of conduit CMBS loans with those of loans of other lending channels or investor types.

In Figure 4, we compare the serious delinquency rate of conduit CMBS loans with that of the commercial mortgages held by banks & thrifts in their portfolios. Apparently, the default rates of these two groups of loans are comparable. They have been low during 2000-2007 and both have reached unprecedented levels in the recent three years. In fact, the average serious delinquency rate over 2000-2010 of conduit CMBS loans and banks & thrifts loans are 1.44% and 1.42%, respectively. However, default rate of conduit CMBS loans is much more cyclical. It has higher peaks and lower troughs. This is not surprising as the funding and underwriting of conduit CMBS loans obviously are heavily affected by the fluctuations in the capital market.

Furthermore, we compare the default rate of conduit CMBS loans with those of commercial mortgages held by life insurance companies, as well as multifamily mortgages securitized by Fannie Mae and Freddie Mac. From figure 5, we see that the 60+ delinquency rates of
commercial mortgages held by life insurance companies and multifamily mortgages securitized by Freddie Mac are substantially lower. In fact, they are only one twentieth of the 60+ delinquency rate of conduit CMBS loans in the recent two years, and are less than one tenth of the 60+ delinquency rate of conduit CMBS loans over the past ten years. Life insurance companies, as long term investors of commercial mortgages, seem to have been acquainted with commercial mortgage business and have kept the default risk of their commercial mortgage portfolios under control.

Finally, it is interesting to see a comparison of the default rates in the commercial mortgage market with those in the residential mortgage market. Figure 6 presents such a comparison. Before the crisis, the serious delinquency rate of conduit CMBS loans is in line with that of prime conventional mortgages, both fixed rate and adjustable rate. Starting from late 2006, there is a big divergence of prime conventional ARM default rate from prime conventional FRM default rate. Since then, the conduit CMBS default rate has been significantly lower than that of prime conventional FRMs, until it surpassed the latter in the fourth quarter of 2009. Over the 10-year period, the average serious delinquency rate of conduit CMBS loans is comparable to the average serious delinquency rate of prime conventional FRMs (2.62% vs. 2.44%). Over the entire period, conduit CMBS loan default rate is remarkably lower than those of subprime FRMs and subprime ARMs. The 10-year average serious delinquency rate of conduit CMBS loans is about one fifth of that of subprime FRMs and nearly one eighth of that of subprime ARMs.

3. Drivers of CMBS Loan Default

3.1. The Theoretical Framework
We follow existing studies such as Goldberg and Capone (2002), Archer, Elmer, Harrison and Ling (2002), Ciochetti, Deng, Gao and Yao (2002), and Seslen and Wheaton (2010) to present a double trigger default model that illustrates the relations between CMBS loan default and underwriting, commercial property NOI growth and value change. We do not intend to provide an analytical solution to a structural model, if such analytical solution ever exists. Instead, we use this theoretical framework to derive the qualitative relations and help us develop the intuitions for our empirical analysis.

Without market frictions such as transaction cost and short selling constraints, a rational commercial mortgage borrower will default his loan when the net operating income of the collateral (property) is not enough to cover his debt payment (insolvency) and the property value is lower than the market value of the mortgage loan (negative equity). We stress the simultaneity of the insolvency and negative equity as conditions of commercial mortgage default because if the borrower is insolvent but has positive equity he can sell the property and pay off the mortgage loan, and vice versa, if the borrower has negative equity but is solvent he would prefer to keep the loan and receive positive cash flows.\(^7\)

Denote, at time \( t \), the mortgage debt service as \( D_t \), property net operating income (NOI) as \( C_t \), property value as \( P_t \), and market value of the mortgage loan as \( M_t \), then the aforementioned default conditions are:

\[
C_t < D_t \quad \text{and} \quad P_t < M_t
\]  

(1)

The default probability of the commercial mortgage loan is thus:

\(^7\) Even a balloon default with similar situation can be avoided with short selling.
We express the time \( t \) property NOI as the loan origination NOI, \( C_0 \), times a NOI growth rate \( g_t \), i.e. \( C_t = C_0 \cdot g_t \). Similarly, we represent the time \( t \) property value as the loan origination property value \( P_0 \) times a property value growth rate \( I_t \), i.e. \( P_t = P_0 \cdot I_t \). Further, assume the debt service at time \( t \) as a positive function of the debt service at origination, i.e. \( D_t = f(D_0) \), with \( \frac{\partial f}{\partial D_t} > 0 \).  

Finally, the market value of the mortgage loan depends on the original loan balance \( M_0 \), loan amortization \( t \), and time \( t \) market prevailing commercial mortgage interest rate \( R_t \), i.e. 

\[
M_t = g(M_0, t, R_t), \text{ with } \frac{\partial g}{\partial M_0} > 0, \frac{\partial g}{\partial t} < 0 \text{ and } \frac{\partial g}{\partial R_t} < 0.
\]

With the above set up, we can express commercial mortgage default probability as a function of underwriting debt-service coverage ratio (DSCR) \( C_0/D_0 \), NOI growth \( g_t \), underwriting loan-to-value (LTV) ratio \( M_0/P_0 \), property value growth \( I_t \), time since loan origination \( t \), and market prevailing commercial mortgage interest rate \( R_t \). Denote such a function as \( Z \). We can easily derive the following comparative statics:

\[
\frac{\partial Z}{C_0/D_0} < 0, \frac{\partial Z}{M_0/P_0} > 0, \frac{\partial Z}{g_t} < 0, \frac{\partial Z}{I_t} < 0.
\]

The implications of the these comparative statics include: deteriorating underwriting standards can subsequently lead to elevated default rate as the lower the DSCR or the higher the LTV at loan origination, the higher the default risk of commercial mortgage loans. Furthermore,

\[\text{Pr}_t = \text{Pr}\left\{(C_t < D_t) \cup (P_t < M_t)\right\}.\]
difficulties in the commercial property market such as worsening NOI and declining property value will be transformed into increased default rate of commercial mortgage loans.

3.2. CMBS Loan Underwriting and Default

Berger and Udell (2002) present evidence that bank lending is pro-cyclical – banks loosen their lending standards during good times which results in added default loss in subsequent bad times. The commercial real estate market and the overall financial market have experienced exceptional “good time” after the 2001 recession and just before the recent crisis suddenly came. Therefore, it is interesting to see whether CMBS lenders have loosened their underwriting during that period, which could contribute to the massive default of CMBS loans we see in the recent two years.

On the other hand, several recent studies such as Demyanyk and Hemert (2009), Keys, Mukherjee, Seru and Vig (2010) and Rajan, Seru and Vig (2010) suggest that the boom in the securitization market during 2003-2006 has led to lax underwriting in the subprime mortgage market, which subsequently resulted in catastrophic default loss of subprime mortgage loans. Similar to the subprime market, elevated securitization and re-securitization have occurred in the commercial mortgage market during 2005-2007, as evidenced by Figures 7. This leads to the question of whether the booms in the CMBS and commercial real estate CDO markets have cause lax underwriting of CMBS loans.

In Figure 8, we plot the net percentage of domestic respondents tightening standards for commercial real estate loans from the Federal Reserve Senior Loan Officer Survey. These respondents include those who make commercial mortgage loans for their own portfolios (as opposed to selling to the CMBS market). From the plot, we see that commercial real estate lenders have somewhat loosened credit during 2004Q1-2005Q4 but have tightened credit
substantially during 2008-2009. It is interesting to see that commercial mortgage lenders have started to tighten credit in 2006, even before commercial mortgage securitization reaches its peak.

In figure 9, we plot the underwriting information on commercial mortgage DSCR from an investor survey conducted by the RealtyRates.com. Interestingly, we see that while apartment and office loans have maintained high levels of DSCR during 2003-2006 industrial and retail loans have increased DSCRs during the same period. The DSCRs of all property types have dropped in 2007 and early 2008 but then started to increase in late 2008. While the recent climb in DCSR of commercial mortgage loans reflects lenders awareness of default risk in light of the crisis, the high levels of DSCR prior to the crisis may reflect the strength in the property market. It is not clear from this picture whether commercial mortgage lenders tightened or loosened underwriting.

Information in the aforementioned two figures pertains to all commercial mortgage loans and thus is not specific to loans that went to the CMBS market. Thus we further examine underwriting information of CMBS loans through CMBS deals. In Figures 10-12, we present the box plots of underwriting variables such as LTV, DSCR, and maturity. The variables are weighted average numbers from loans in each CMBS pool and the distribution shows the statistics across different CMBS pools. There are a total of 420 deals that contain 66,615 CMBS loans worth $728 billion in our database. The vertical lines show the range of those variables and the boxes show the mean and median of those variables. The LTV and DSCR plots tend to suggest that CMBS lenders slightly loosened underwriting requirements in 2005, 2006 and 2007. Additionally, we study the property type composition of conduit CMBS loan collaterals, which is plotted in Figure 13. Consistent with that of the LTV and DSCR plots in Figure 10 and Figure 11, CMBS lenders originated increasing shares of higher risk hotel and office loans during 2005-
2007. They shut down the origination of those types of CMBS loans in 2009 and have only originated multifamily CMBS loans in recent two years.

Finally, we look at the percentage of CMBS deals that are composed of single-borrower loans or floating rate loans. Those two types of CMBS loans (deals) are usually seen as having high risk. However, we find no evidence of CMBS issuers putting more of those higher risk loans into the CMBS market during the high securitization years (2005-2007). We do see the CMBS issuers putting minimal level of floating rate loans into CMBS deals starting from 2008, possibly due to the astonishing high default rates of ARMs seen in the residential mortgage market.

Based on the above analysis, we find limited evidence of lax underwriting in CMBS loans before the crisis. This is consistent with findings in Stanton and Wallace (2010) that loans underlying CMBS did not significantly change their characteristics during 1996-2008. However, it is noteworthy that our analysis on underwriting is based on very limited information. A more detailed analysis is needed to reach a firm conclusion. For example, it will be helpful if we know the percentage of loans (loan months) with interest only (IO) periods. Moreover, our findings here does not preclude the possibility that underwriting of CMBS loans prior to the crisis are based on inflated property value and thus constitute a real deterioration in standards. Finally, commercial lenders may have changed their underwriting standards in an unperceivable way as argued in Rajan, Seru and Vig (2010).

3.3. Property Value, NOI, and CMBS Loan Default

House price decline and the resulting negative equity is undoubtedly a critical driver of the recent subprime mortgage market crisis (Sanders, 2008; Demyanyk and Hemert, 2009). Our analysis in section 3.1 further suggests that negative cash flow and insolvency is another driver
of commercial mortgage default. When the commercial property NOI is not enough to cover the mortgage payment, the likelihood of a default increases substantially.

In studying the relations between CMBS loan default and changes in property value and NOI, we pay special attention to the following two issues. First, there tends to be a lag between property value decline (or decrease in NOI) and mortgage default. On one hand, Guiso, Sapienza and Zingales (2009) find that many borrowers will consider to default their mortgage loans only after they have over 10% of negative equity. On the other hand, as stressed in our theoretical analysis in section 3.1, insolvency and negative equity are joint conditions of commercial mortgage default. If the borrower has negative equity but is solvent he would prefer to keep the loan and receive positive cash flows, which includes the “extend and pretend” strategy some borrower employ when they have difficulty refinance their loans and thus face balloon default. Similarly, if the borrower is insolvent he will take time to try to sell his property to pay off the mortgage loan until the property sale is not feasible.⁹

Second, given the unprecedented collapse of the housing and commercial property markets, there may be a structural break in the mortgage market. Sanders (2008) provides evidence that the relation between serious delinquency rate and change in house price in Arizona, California and Nevada was weak before 2005 but it has become significant post-2005. An, Deng, Rosenblatt and Yao (2010) also find that the sensitivity of subprime mortgage default rate to declining house price has increased remarkably in the recent two to three years.

In Figures 14-17, we plot the 30+ delinquency rate of conduit CMBS loans and change in commercial property values from 2001Q1 to 2010Q1 for the four major CMBS loan collateral

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⁹ The recent default of the W hotel in San Diego by the Sunshine Hotel Investors is a good illustration of this type. The Sunshine Hotel Investors had made up their mortgage payments with their own funds for over half a year before they finally default their mortgage loan.
types. As we can see, there is a clear negative relationship between default and property value change during 2008-2009 – as property value declines, more CMBS loans are defaulted. There seems to be a lag between property value change and loan default. For example, for multifamily, industrial and office property loans the default rates accelerate in 2009 and 2010 even though the commercial property value declined the most in late 2008 and early 2009.

We plot the 30+ delinquency rate of conduit CMBS loans and NOI growth of commercial properties by property type in figures 18-21. Clearly, a negative relation between those two variables exists, and the relation tends to be consistent throughout the entire 2001-2009 period.

In Table 4 and Table 5, we present results of simple regressions of 30+ delinquency rate on changes in property value or NOI. In those regressions, we pool the time series of quarterly default rate of the four property types together and obtain corresponding change in property value or NOI measures from NCREIF. We experiment with the number of quarter lags in the explanatory variable to find the best fitting. From these two tables, we confirm the negative relations between CMBS loan default and property value (NOI) change we see in the Figures 14-21. Furthermore, we find the 4-quarter lag in property value change has the highest explanatory power on CMBS loan default while 1-quarter lag in NOI growth provides the highest fit.

In Table 6, we enter change in property value and NOI growth into the regression at the same time, following our double trigger default framework. We use the optimal lags in the explanatory variables we identify in Tables 4 and 5. In model 11, we see both property value change and NOI growth have negative impacts on CMBS loan default, although the coefficient of NOI growth is marginally significant. In model 12, we allow a structural break in the relations between default and changes in property value and NOI. We interact the two explanatory variables in model 11
with a dummy variable representing time after 2007Q4 when a recession in the overall economy is declared by NBER and when commercial property values started to decline either by the NCREIF measure or the Moodys/REAL measure (Figure 1). The results in model 12 suggest that there is a structural break in the relation between CMBS loan default and property value change since 2007Q4. The sensitivity of CMBS loan default to property value decline increased. However, the relation between default and NOI growth remain stable over the entire 2000-2010 period. Finally, we notice that the model with structural break has the highest fitting among the 12 models we present in Table 4-6.

4. Conclusions and Discussions

Default loss and default risk of CMBS loans have been and will remain major concerns of investors, lenders, servicers, CMBS rating agencies as well as financial regulators who are concerned with big financial institutions’ involvement in CMBS loan originations and investments.

In this paper, we document the default rates of CMBS loans during the current crisis. We find that the default rates of conduit CMBS loans, including the 30+, 60+, and 90+ delinquency rates all have risen sharply since late 2008 and have reached levels that are about 7 times of the 10-year average. We also compare the CMBS loan default rates in the recent crisis with those in commercial real estate market crisis in the early 1990s, and find that default rates of CMBS loans at the start of the current crisis were low compared to historical default rate levels but they accelerated rapidly during the crisis and became much higher than those in the 1990-1992 recession. Cross sectional comparisons show that conduit CMBS default rate is similar to the default rate of commercial mortgage loans held by banks & thrifts. However, the default rate of
conduit CMBS loans in the past 10 years has always been higher than those of the commercial mortgage loans held by life insurance companies and multifamily mortgages securitized by Fannie Mae and Freddie Mac. We also find conduit CMBS loan default rate is comparable to that of prime conventional FRMs. Over the entire 2000-2010 period, conduit CMBS loan default rate is remarkably lower than those of subprime FRMs and subprime ARMs.

We find limited evidence that substantial deterioration in CMBS loan underwriting occurred prior to the crisis. We confirm that commercial property value decline is an important driver of the elevated CMBS loan default during the crisis and deteriorating cash flows of underlying properties add to the problems. Furthermore, we discover that property value change has a 4 quarter lag in its impact on CMBS loan default and that NOI growth has a 1-quarter lag in its impact. Finally, we find a structural break in the relation between property value change and CMBS loan default starting from 2007Q4 but the relation between CMBS loan default and NOI growth remains stable over the entire 2000-2010 period.

Needless to say, better information is needed. In future research, loan level information on CMBS default will greatly sharpen our analysis if such data becomes available.
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21


Figure 1: Real Estate Indices: NCREIF NPI, Moodys/REAL CPPI, and Case-Shiller Composite 20. The NCREIF NPI is constructed using both transaction data and appraisal data. See, Fisher, Gatzlaff, Geltner and Haurin (2003) for detailed methodology. The NCREIF NPI shown here is the appreciation index (not including income return). The Moodys/REAL CPPI is a periodic same-property round-trip investment price change index of the U.S. commercial investment property. The index uses no appraisal valuations. The methodology employed to construct the index is a repeat-sales regression (RSR), as described in detail in Geltner & Pollakowski (2007). Data source: NCREIF, Moodys/REAL, and Standard and Poor’s. The shaded area indicates the recent recession dated by the Business Cycle Dating Committee of the National Bureau of Economic Research (NBER).
Figure 2: Historical default rates of conduit CMBS loans, 2000Q1-2010Q2. Data source: CRE Finance Council, and RealPoint.
Figure 3: Serious (90+) delinquency rates of commercial mortgage loans during the two commercial real estate cycles. Data source: Esaki (2002), and Standard and Poor’s. The default rates during 1980s and 1990s are for commercial mortgage loans held by life insurance companies. The recent default rates are for CMBS loans.
Figure 4: Serious (90+) Delinquency Rate: Conduit CMBS Loans vs. Commercial Mortgage Loans Held by Banks & Thrifts. Data source: CRE Finance Council, and Mortgage Bankers Association. 2000-2009 data are the fourth quarter rate, while 2010 data is the second quarter rate.
Figure 5: 60+ Delinquency Rate: Conduit CMBS Loans vs. Commercial/Multifamily Mortgages Held by Life Insurance Companies, Fannie Mae and Freddie Mac. Data source: Mortgage Bankers Association. 2000-2009 data are the fourth quarter rate, while 2010 data is the second quarter rate.
Figure 6: Serious (90+) Delinquency Rate: A Comparison of the Conduit CMBS Loans with Residential Mortgage Loans. Data source: CRE Finance Council, Moody's, Mortgage Bankers Association.
Figure 7: Annual Issuance of CMBS and Commercial Real Estate CDO in Million $, 1990-2010. The 2010 number is as of October, 2010. Data source: CRE Finance Council.
Figure 8: Net Percentage of Lenders Tightening Commercial RE Credit. Data source: Federal Reserve Senior Loan Officer Survey.
Figure 9: DSCR Ratio of Commercial Mortgage Loans. Data source: RealtyRates.com investor survey.
Figure 10: Weighted Average LTV of Conduit CMBS Deals. The box plot contains the following statistics: mean, median, min and max. The grey bars represent the origination volume of CMBS loans covered in the same database. Data source: Inside CMBS.
Figure 11: Weighted Average DSCR of Conduit CMBS Deals. The grey bars represent the origination volume of CMBS loans covered in the same database. Data source: Inside CMBS.
Figure 12: Weighted Average Maturity of Conduit CMBS Deals. The grey bars represent the origination volume of CMBS loans covered in the same database. Data source: Inside CMBS.
Figure 13: Property type composition of conduit CMBS loan collaterals.
Figure 14: Multifamily conduit CMBS loan delinquency rate and property value change. Data source: CRE Finance Council and NCREIF.
Figure 15: Industrial conduit CMBS loan delinquency rate and property value change. Data source: CRE Finance Council and NCREIF.
Figure 16: Office conduit CMBS loan delinquency rate and property value change. Data source: CRE Finance Council and NCREIF.
Conduit CMBS Loan Delinquency Rate and Property Value Change:
Retail

Figure 17: Retail conduit CMBS loan delinquency rate and property value change. Data source: CRE Finance Council and NCREIF.
Figure 18: Multifamily conduit CMBS loan delinquency rate and NOI growth. Data source: CRE Finance Council and NCREIF.
Figure 19: Industrial conduit CMBS loan delinquency rate and NOI growth. Data source: CRE Finance Council and NCREIF.
Figure 20: Office conduit CMBS loan delinquency rate and NOI growth. Data source: CRE Finance Council and NCREIF.
Figure 21: Retail conduit CMBS loan delinquency rate and NOI growth. Data source: CRE Finance Council and NCREIF.
### Table 1: Serious Delinquency (90+) Rate of All CMBS Loans by Vintage

<table>
<thead>
<tr>
<th>Vintage</th>
<th>Year 0</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Year 6</th>
<th>Year 7</th>
<th>Year 8</th>
<th>Year 9</th>
<th>Year 10</th>
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</thead>
<tbody>
<tr>
<td>1982</td>
<td>0.73</td>
<td>1.54</td>
<td>1.77</td>
<td>1.44</td>
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<td>0</td>
<td>4.42</td>
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<td>1.84</td>
<td>0.65</td>
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### Table 2: Serious Delinquency (90+) Rate of All CMBS Loans by Vintage

<table>
<thead>
<tr>
<th>Vintage</th>
<th>Year 0</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Year 6</th>
<th>Year 7</th>
<th>Year 8</th>
<th>Year 9</th>
<th>Year 10</th>
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<tbody>
<tr>
<td>1999</td>
<td>0.13</td>
<td>0.59</td>
<td>1.37</td>
<td>1.24</td>
<td>2.72</td>
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<td>1.85</td>
<td>0.82</td>
<td>0.79</td>
<td>2.68</td>
<td>15.07</td>
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<tr>
<td>2000</td>
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<td>0.63</td>
<td>1.6</td>
<td>2.72</td>
<td>3.38</td>
<td>2.07</td>
<td>1.52</td>
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<td>1.95</td>
<td>7.86</td>
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<tr>
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<td>3.68</td>
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<tr>
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<td>0.11</td>
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Note: Bold indicates SDQ in the year of 2009. Data source: Moody’s and Standard & Poor’s.
Table 3: Percentage of Single-borrower and Floating Rate CMBS Deals

<table>
<thead>
<tr>
<th>Year</th>
<th>Total number of non-agency CMBS deals</th>
<th>Percentage of Single borrower deals</th>
<th>Percentage of floating rate deals</th>
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<tbody>
<tr>
<td>2000</td>
<td>84</td>
<td>28.6%</td>
<td>20.2%</td>
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<td>2001</td>
<td>103</td>
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<tr>
<td>2002</td>
<td>77</td>
<td>20.8%</td>
<td>19.5%</td>
</tr>
<tr>
<td>2003</td>
<td>102</td>
<td>23.5%</td>
<td>18.6%</td>
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<tr>
<td>2004</td>
<td>95</td>
<td>7.4%</td>
<td>14.7%</td>
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<tr>
<td>2005</td>
<td>106</td>
<td>12.3%</td>
<td>16.0%</td>
</tr>
<tr>
<td>2006</td>
<td>106</td>
<td>8.5%</td>
<td>16.0%</td>
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<tr>
<td>2007</td>
<td>91</td>
<td>4.4%</td>
<td>14.3%</td>
</tr>
<tr>
<td>2008</td>
<td>10</td>
<td>10.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>2009</td>
<td>26</td>
<td>15.4%</td>
<td>3.8%</td>
</tr>
<tr>
<td>2010</td>
<td>13</td>
<td>30.8%</td>
<td>0.0%</td>
</tr>
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</table>
### Table 4: OLS Estimates of the 30+ Delinquency Models with NPI (lags) as Explanatory Variable

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.381***</td>
<td>1.407***</td>
<td>1.456***</td>
<td>1.517***</td>
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<tr>
<td>Change in property value</td>
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<tr>
<td>Change in property value 1 quarter lag</td>
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<tr>
<td>Change in property value 2 quarter lag</td>
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<td>-0.347***</td>
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<tr>
<td>Change in property value 3 quarter lag</td>
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<td>-0.383***</td>
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<tr>
<td>Change in property value 4 quarter lag</td>
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<td></td>
<td></td>
<td>-0.426***</td>
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<tr>
<td>N</td>
<td>164</td>
<td>164</td>
<td>164</td>
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<tr>
<td>Adjusted R-Square</td>
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<td>0.3218</td>
<td>0.4638</td>
<td>0.5193</td>
<td>0.5468</td>
</tr>
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</table>

Note: *** for p<0.001; ** for p<0.01; * for p<0.05. We pool data for the 4 property types together in the regressions. Data sources: CRE Finance Council and NCREIF.

### Table 5: OLS Estimates of the 30+ Delinquency Models with NOI (lags) as Explanatory Variable

<table>
<thead>
<tr>
<th></th>
<th>Model 6</th>
<th>Model 7</th>
<th>Model 8</th>
<th>Model 9</th>
<th>Model 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.558***</td>
<td>1.580***</td>
<td>1.572***</td>
<td>1.542***</td>
<td>1.485***</td>
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<tr>
<td>NOI growth</td>
<td>-0.100***</td>
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<tr>
<td>NOI growth 1 quarter lag</td>
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<tr>
<td>NOI growth 2 quarter lag</td>
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<td>NOI growth 3 quarter lag</td>
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<td>-0.072***</td>
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<td>NOI growth 4 quarter lag</td>
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</tr>
<tr>
<td>N</td>
<td>164</td>
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<tr>
<td>Adjusted R-Square</td>
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<td>0.1397</td>
<td>0.1061</td>
<td>0.0623</td>
<td>0.0252</td>
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Note: *** for p<0.001; ** for p<0.01; * for p<0.05. We pool data for the 4 property types together in the regressions. Data sources: CRE Finance Council and NCREIF.
Table 6: OLS Estimates of the 30+ Delinquency Models with both NPI and NOI (lags) as Explanatory Variables

<table>
<thead>
<tr>
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<th>Model 11</th>
<th>Model 14</th>
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<tbody>
<tr>
<td>Intercept</td>
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<tr>
<td>Change in property value 4 quarter lag</td>
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<td>-0.188***</td>
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<tr>
<td>NOI growth 1 quarter lag</td>
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<td>-0.306***</td>
</tr>
<tr>
<td>Change in property value 4 quarter lag * 2007Q4 and after</td>
<td>-0.042*</td>
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</tr>
<tr>
<td>NOI growth 1 quarter lag * 2007Q4 and after</td>
<td></td>
<td>-0.053</td>
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<tr>
<td>N</td>
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<td>164</td>
</tr>
<tr>
<td>Adjusted R-Square</td>
<td>0.5504</td>
<td>0.5833</td>
</tr>
</tbody>
</table>

Note: *** for p<0.001; ** for p<0.01; * for p<0.05. We pool data for the 4 property types together in the regressions. Data sources: CRE Finance Council and NCREIF.