The Financial Crisis of 2008 and Subprime Securities

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Subprime mortgages are commonly defined as loans issued at high rates to borrowers with lower credit quality. So, it is perhaps not so surprising that subprime mortgages suffered large losses in the Financial Crisis of 2008. It is more surprising that these losses in the U.S. created financial difficulties around much of the world.

However, securities based on subprime mortgage loans are indeed the key to understanding how financial problems spread both geographically, as well as across and within many different types of asset markets and institutions during 2007 to 2009. A worldwide demand for exposure to the United States real estate market spurred the creation of such securities, called collateralized debt obligations. These securities were purchased by international financial institutions, firms and even municipalities.[1] This paper outlines the complexities of CDOs and their pivotal role in the transmission of financial distress.

Housing Prices and Subprime Mortgages

The beginning of the story is in the U.S. housing market. Housing prices in much of the U.S. rose substantially (depending on the index used between 60 and 100 percent) until 2006 or 2007 and then began falling substantially until at least 2010. During a period of low inflation, these changes represented large capital gains, and subsequent losses, for people owning houses.

This run-up in housing prices was accompanied by substantial increases in the number of subprime mortgages originated. Subprime mortgages grew from $160 billion in 2001 to $625 billion in 2005. Over the same period, conventional (or prime) mortgage origination actually fell, from $1,265 billion to $990 billion.

Prime mortgages are well defined as mortgages accepted by two government-sponsored enterprises – Fannie Mae and Freddie Mac – but there is no formal definition of the term subprime. Probably the most common characteristic mentioned is a lower credit rating, although other characteristics such as a mortgage payment that is too large relative to income also can make a mortgage subprime.

[1] This story is discussed in detail in Dwyer and Tkac (2009).

This decrease in housing prices has been associated with a dramatic increase in delinquencies on mortgages and in foreclosures. While concentrated in California, Las Vegas, Phoenix and Florida, delinquencies and foreclosures have risen in other parts of the U.S. as well.

It is not an accident that foreclosures are concentrated in geographic areas that experienced very large housing price increases and subsequent decreases. People were more inclined to stretch to buy a house where prices were increasing substantially. In part, the higher foreclosures reflect the greater risk borne by mortgage lenders when borrowers stretch to buy a house and things do not work out. In addition, borrowers in areas with larger price increases were more likely to take out exotic mortgages such as interest-only loans and option adjustable-rate loans.

In part, higher foreclosures reflect what can be called strategic or opportunistic default. A person with a mortgage on a house that has fallen substantially in value not only loses the hoped-for gain but can be facing a known loss. The mortgage can be for substantially more than the value of the house and it may be many years before the house is worth more than the loan. In these circumstances, a question naturally occurs: Should I keep paying on this house? It might be better to bail out of the house and "give the house back to the bank." Indeed, the borrower may well be able to rent a similar house down the street for far less than the monthly mortgage payment.

Confronted with such stark choices, some borrowers choose go into foreclosure. These circumstances help to explain why falling housing prices are associated with more foreclosures and why foreclosures of subprime loans are higher than in earlier years.

Still, how does this loss get spread around the financial system and create substantial global problems? We (Dwyer and Tkac 2009) estimate that subprime loans outstanding were about $1 trillion in 2007. While a big number, this is not large when compared to an estimated world financial market on the order of $100 trillion (and this is likely an underestimate). Subprime mortgages were thus likely less than one percent of all financial assets. To put the problem in perspective, the U.S. stock market (valued at approximately $15 trillion in 2007) often goes up or down one percent in a day without dire consequences. It is hard to imagine that a one-percent loss of the value of financial instruments created a financial crisis.

And it didn't.

Collateralized Debt Obligations

The key to how problems in subprime loans became widespread problems in financial markets is a financial instrument called a "collateralized debt obligation" (CDO). It is a

bit of a path from a homely mortgage loan to a CDO, but it is worth grasping the essentials.

Contrary to practice fifty years ago, mortgages today typically are sold rather than held to maturity by the lender. Indeed, many lenders do not have the financial resources to hold the mortgages that they make; instead they specialize in making mortgage loans and selling them to another firm, which turns around and securitizes the mortgage.

Mortgages are securitized by pooling many mortgages together to form a Residential Mortgage Backed Security (RMBS), shares of which are sold to investors wishing to include real estate in their portfolio. While the actual financial and legal arrangements can be complicated, a basic feature of RBMS is that payments on mortgages by households flow through to the investors who own the securitized pools.

There is one wrinkle that is important for the subsequent story. In a typical security – say AT&T corporate bonds – if AT&T fails to pay, all holders of the bonds suffer the same proportionate loss. All the holders of the bonds have the same risk. This is not so for many RMBSs. Some holders of RMBS bear more risk than others and some bear less. This is accomplished by 'tranching' the RMBS security and constructing what is called a "waterfall" of payments.

Figure 1 shows the waterfall of payments on a simple RMBS. There are three tranches in the figure, a AAA tranche, a BBB- tranche and an equity tranche. An actual security would have more tranches but three are enough to illustrate how tranching works.

You can view the mortgage payments coming in at the top of the waterfall. First, the mortgage payments go to the highest-rated tranche, the AAA tranche in the figure. If there are remaining funds – water in the figure -- the remaining payments go to the next tranche, the BBB- tranche. Last, any remaining payments go to the equity tranche. In economics, equity holders are often called "residual claimants" and that holds here. The equity tranche gets whatever is left over.

Another way of seeing the effect of tranching is from the bottom up. The equity tranche also is said to be the first-loss position. The equity tranche suffers initial losses if any of the mortgages defaults and the higher rated tranches suffer no losses until enough defaults occur so that the equity tranche receives nothing. If the equity tranche is wiped out, the BBB- tranche suffers losses. If the BBB- tranche is wiped out, then the AAA tranche suffers losses.

While actual RBMS have more tranches than this example, the general principle that higher rated tranches experience less risk of loss still holds. Actual tranches generally cover the entire range from the AAA to the equity tranche with each intermediate grade included (AAA, AA, A, BBB, BBB-, equity) and often there is more than one AAA tranche.

The collateralized debt obligations (CDOs) at the center of the financial crisis are created from tranches of RMBSs. Figure 2 illustrates how this is done. The figure is similar to Figure 1 except that the underlying portfolio is not a portfolio of subprime mortgages. The underlying portfolio of a CDO is a portfolio of BBB tranches of different RMBS. The allocation of risk is similar, with the waterfall of payments being similar. The AAA tranche often was roughly 85 percent of the value of these CDOs. The lower rated tranches account for the remaining 15 percent and represent the degree of subordination in the CDO. The higher the subordination, the less risk that a AAA tranche will experience a loss.

Figure 3 shows the path of cashflows from the underlying subprime mortgages to the tranches of the CDO. This path is quite complicated. People pay on their mortgages and payments are allocated to tranches of the RMBS. Some of the tranches are used to create CDOs and the payments to these tranches of the RMBSs start the waterfall of payments to the tranches of the CDO. As long as everyone is paying on the mortgages, the complex nature of this path is not necessarily evident or problematic.

Once some people are not paying on their mortgages though, how much are the tranches of the CDO worth?[2] This is not so easy to determine.

An immediate answer might be to look at market prices to determine the value of the CDO. Unfortunately, the value of any particular CDO depends on the specific mortgages underlying that CDO. CDOs are idiosyncratic securities. Trying to value one CDO by looking at another would be like trying to value AT&T bonds by looking at Sprint bonds. It is possible to get some indication of the value of a CDO by looking at the prices of similar deals, but it will not get one all the way to what this particular CDO is worth.

Moreover, CDOs are not standardized contracts. Each CDO has its own contractual terms and these terms can differ materially. CDOs are noticeably more complicated than the simple example provided here, with payments across tranches often depending on delinquencies. CDOs also can have reserve accounts that act to limit losses to higher rated tranches. These differences make it even harder to compare CDOs.

As a result of their idiosyncracy, CDOs are traded over the counter, not on an organized exchange. There is no CDO analog to the NYSE, no organized market with readily available prices, and thus there is no “market price” that reveals all.

For the overall financial system, the problem with CDOs is the complexity of valuing them once some borrowers begin to default. Two problems arise. First, buying CDOs when delinquencies and defaults are common requires time-consuming and expensive research into the underlying mortgages to determine what payments are likely. Second, because the values are problematic even for the owners of CDOs, the value of CDOs

[2] Smithson (2009) provides a nice summary of the valuation issues.

held by another institution can be practically impossible to determine. This, in turn, makes it difficult for institutions to assess whether their trading partners are solvent.

Values of Collateralized Debt Obligations

Figure 4 shows the evolution of indices that track the values of subprime mortgage CDOs formed at the start of 2006 and 2007.[3] When initiated, the indices generally traded at 100. The index beginning in January 2006 (2007) is based on CDOs created in the last half of 2005 (2006) using mortgages originated at about the same time.

These indices show that the values of CDOs fell substantially. There are similarities in the price falls across these two vintages. The lowest rated tranches fall more, which is consistent with the waterfall of payments into these tranches and the cash flows in periods of opportunistic default. The lowest rated tranches, the BBB- and BBB tranches are essentially worthless by the end of 2008.

The AAA tranches of both vintages fall by amounts that are hard to square with a low-risk security. The AAA tranche of the 2006 vintage falls close to 40 percent, from 100 to about 60 by early 2009. The AAA tranche of the 2007 falls quite a bit more, from 100 to about 25 by early 2009, a 75 percent decline in value.

There are two possible, though not mutually exclusive, explanations for the greater losses in the 2007 vintage. It is possible that the loans made in the last half of 2006 (at the end of the period of housing price increases) were riskier, less well documented and included more fraud. In addition though, the people who obtained mortgages in the last half of 2006 were doing so at the end of the increases in house prices. Since prices have subsequently fallen dramatically, these people are more likely to owe more than the house is worth. Consequently, they are more likely to default.

Either way, it is not surprising that the value of the 2006 vintage of the CDOs has held up better than the 2007 vintage.

Relationship to the Financial Crisis

The problems with these securities contributed to the financial crisis in two ways.

First, CDOs were purchased by entities all over the world, spreading the risk far outside the borders of the United States. For example, four townlets in northern Norway took substantial positions in AAA tranches of subprime CDOs. The AAA rating made these tranches seem like a fine, and safe, purchase and it is certain that some entities purchasing highly rated tranches CDOs bought them because of the rating and

[3] There are indices that begin in the middle of 2006 and 2007 which provide information consistent with these two indices.

understood little else about them. Furthermore, high-rated tranches were used in a variety of other financial transactions and arrangements. Some commercial banks created special purpose vehicles (SPVs) that held subprime CDOs and some investment banks funded themselves by using AAA tranches of CDOs as collateral. As things turned out, these were not low risk choices. The decline in housing prices and the rise in defaults ate away at the cashflows expected of the AAA tranches.

When faced with difficult to value securities, potential buyers demand a risk premium. As defaults began to climb beyond the expected levels, the value of all CDO tranches began to decline and the declines were reinforced by demands for higher risk premiums prompted by the growing level of uncertainty surrounding the still declining housing market.

Second, the difficulty valuing these securities created concerns across the financial system about the solvency, or potential insolvency, of many financial institutions. These problems were heightened with the failures of Bear Sterns and Lehman Brothers. Such concerns about counterparty risk led to higher interest and funding costs for institutions known or suspected to be holding subprime CDO's, exacerbating any direct subprime losses. In extreme cases such this lack of liquidity and concerns about counterparties can lead institutions to pull back from risky credit markets and pursue a flight to safety (i.e. invest in U.S. Treasury securities which were immune to these credit risk concerns).

Conclusion

Collateralized debt obligations based on subprime mortgages are themselves subprime securities. While they are simple to value when all cash flows arrive as expected, they are hard to value when mortgage payments are delinquent. They inevitably are illiquid because any purchaser must spend significant resources to determine their value. A purchaser will thus demand a lower price – a higher risk premium – than if the security was simple to value. This is both because of the lack of full information on the security's cashflows but also because they know that if they wish to sell in the future, a similar premium is likely to be demanded. This illiquidity was not evident before the financial crisis but it is evident to all now.

Focusing on these securities should not be interpreted as implying that CDOs caused the financial crisis. This would be a misreading of our research. CDOs were the mechanism by which problems were transmitted. A more fundamental examination of the causes of the financial crisis would examine why the quantity of subprime mortgages originated increased. An increase in the quantity of loans desired by borrowers is one answer. It also quite is possible that the creation of CDOs increased the demand for subprime mortgages by transforming risk in ways that holders preferred or thought they preferred. A consequential explanation is that increased holdings by Fannie Mae and Freddie Mac contributed substantially to the increase in demand.

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References

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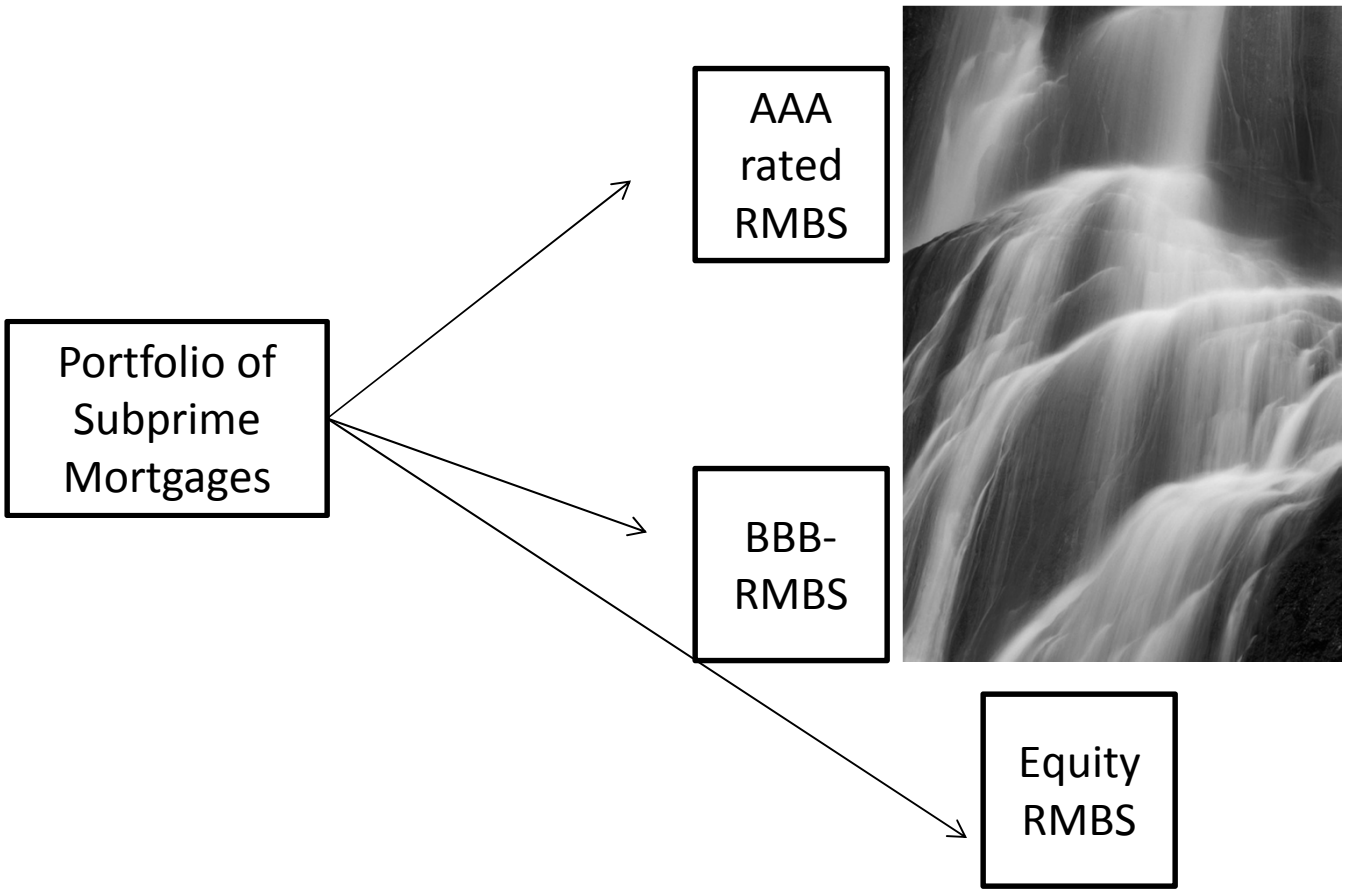
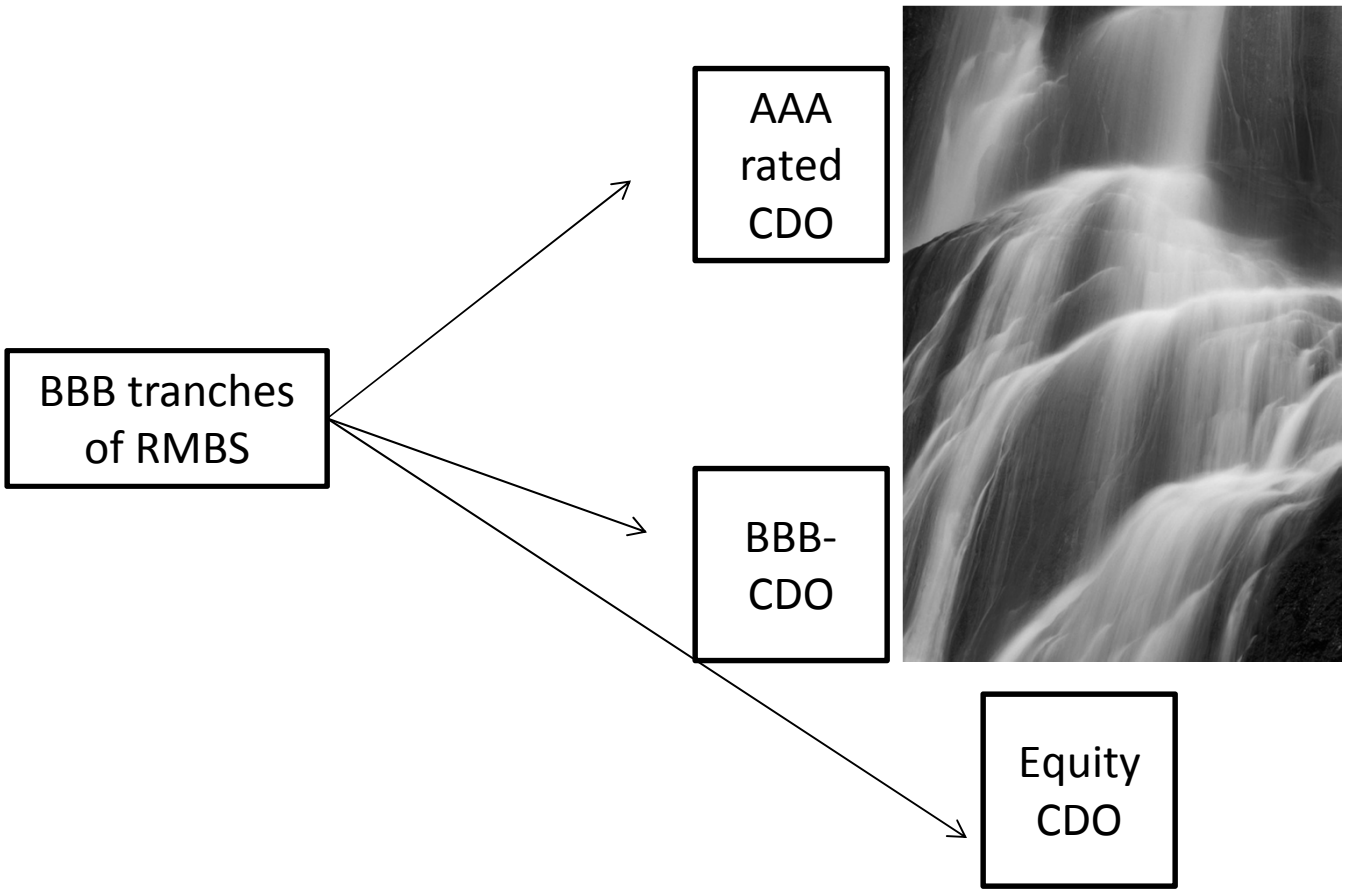
Smithson, Charles. 2009. "Valuing 'Hard-to-Value' Assets and Liabilities: Notes on Valuing Structured Credit Products." *Journal of Applied Finance* 19 (Spring/Summer), pp. 1-12.

Figures 1 to 4

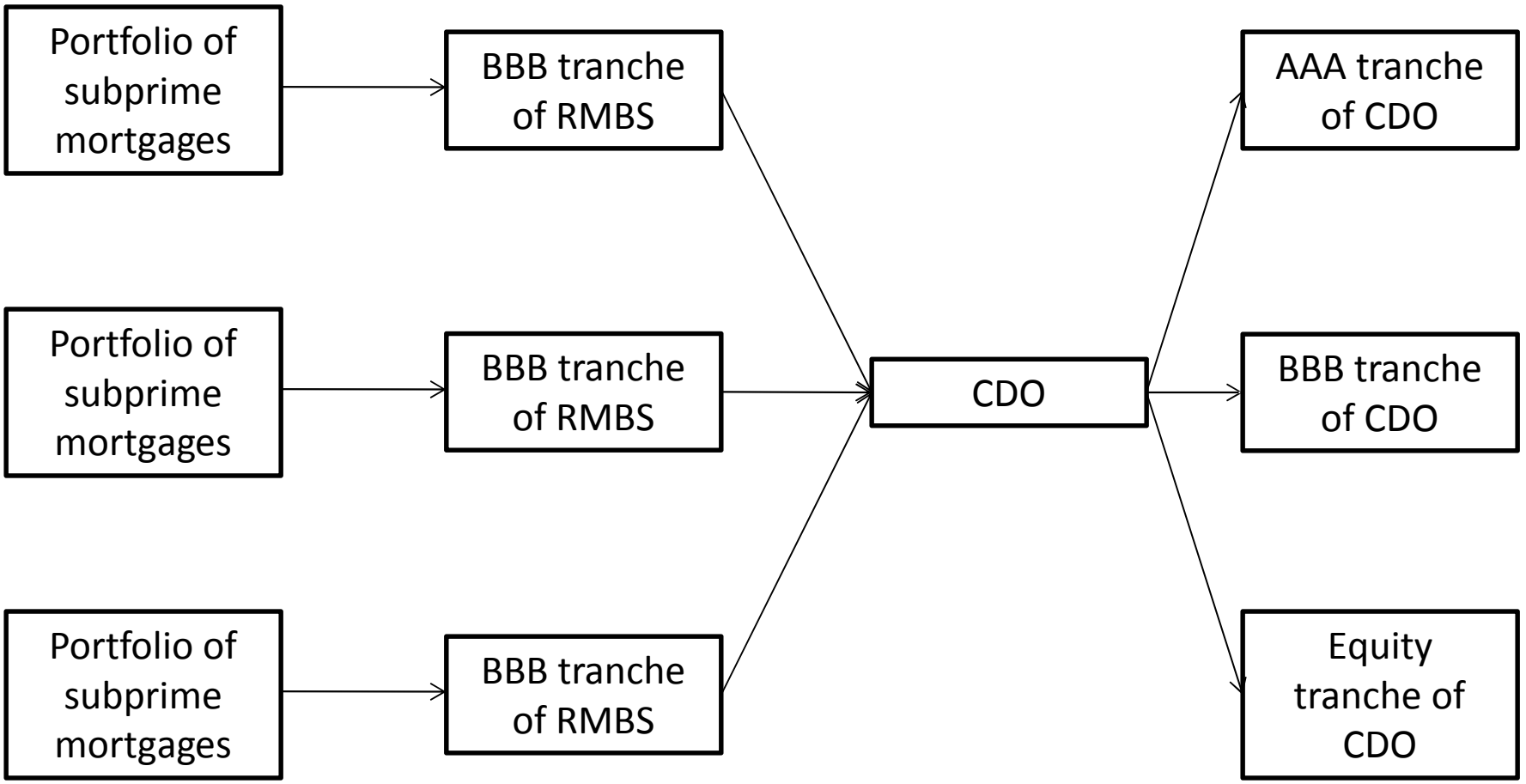
Three Securities Instead of One



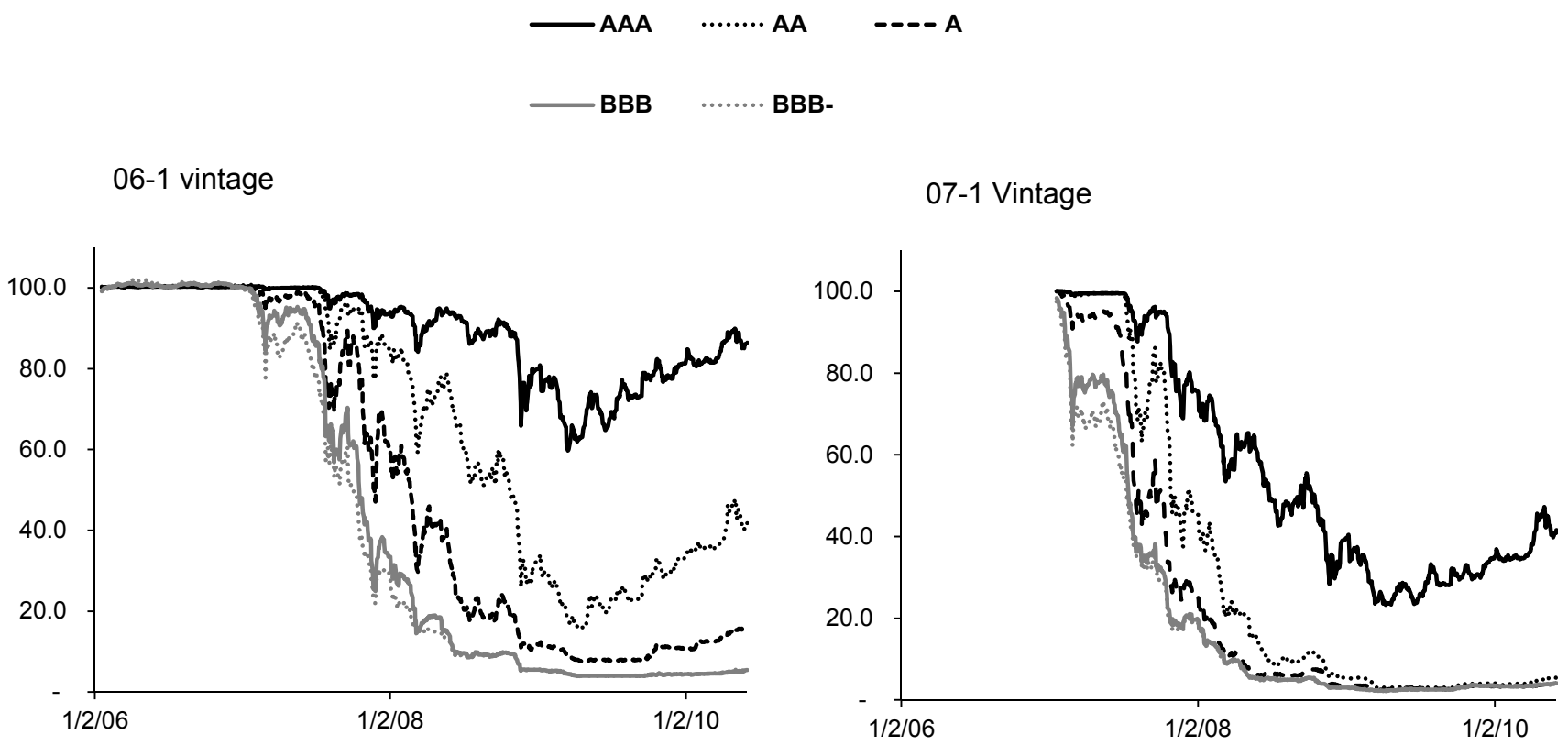
CDOs from Tranches



Mortgages to CDOs



ABX Indices by Vintage



Sources: Markit Group Limited/Haver Analytics