Derivative Securities – Fall 2012 – Section 11

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This is the first of two lectures on credit-based instruments. Here we focus on single-name instruments (bonds, asset swaps, and credit-default swaps). Beyond discussing the instruments and their uses, our main task is to price them. We'll do this by expressing the discount rate for risky income in terms of the probability of default and the discount rate for risk-free income.

Since we are considering single-name instruments, the possibility that defaults of separate entities are correlated will not enter our discussion. It will play a central role next week, though, when we'll discuss structured products such as collateralized debt obligations.

The parts of Hull (8th edition) covering this material are Sections 23.1-23.6 and 24.1-24.2.

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Corporate bonds, asset swaps, and credit default swaps. We begin with a discussion about the character and uses of these instruments.

Corporate bonds have been around for a long time. Companies often raise capital by issuing bonds rather than stock, partly because of resulting tax advantages, and partly to avoid diluting the ownership share of existing stockholders. Most corporate bonds are fixed rate bonds, because this is what most investors in bonds prefer – though companies typically prefer to borrow at a floating rate, generally indexed by LIBOR. (Ccompanies swapping floating rate payments they want to make for the fixed rate payments required on their bonds are a major source of the demand for interest rate swaps). Typically, people investing in corporate bonds share the following characteristics:

(a) They have cash to invest.

(b) They are willing to take on some credit risk. In fact they may desire to take on credit risk (and be compensated for it, by higher interest rates) if they have a favorable view of a particular firm's credit worthiness.

(c) They desire to lock into a long-term interest rate. This requires a williness to take on some interest rate risk, and/or a long-term investment horizon.

Asset swaps. Some investors share only properties (a) and (b), i.e. they want to invest and are willing to take on credit risk, but they don't want to take a long-term fixed-interest-rate position. Asset swaps were invented (about 30 years ago) for them. An asset swap is simply a combination of (i) a defaultable bond, and (ii) an interest rate swap, which converts the bond's fixed-rate coupon payments into floating-rate payments. Thus (ignoring the possibility of default) an asset swap looks like a corporate bond with floating-rate payments.

An investor whose primary interest is credit risk will find the use of asset swaps inconvenient, because they require the investment of principal. A credit default swap (CDS) is much more

convenient, because it is a pure play on credit risk (without the need to invest principal, and without taking on interest rate risk).

Credit default swaps were created about 15 years ago and really became popular about 10 years ago. A CDS can be viewed as an "insurance policy" against the default of a particular entity (the underlying).

Here is how such a constract works. As long as the underlying has not defaulted, the protection provider receives a coupon payment on a regular basis (for example, every 6 months) from the protection buyer. If the underlying defaults during the lifetime of the contract, the protection seller must pay the protection buyer the full par value of L dollars, where L is the nominal amount of the contract, in exchange for a bond with a face value L. The protection seller can sell the bond at LR, where R is the recovery rate. Thus the protection seller's loss (upon default) is $L(1-R)$; alternatively (depending on the terms of the contract) the settlement upon default can be in cash. Either way, the owner of a CDS and of a defaultable bond is assured of getting back the face value of the bond, whether there is a default or not. (Note: by market convention, the protection seller is considered to be receiving fixed and paying floating; the protection buyer is considered to be receiving floating and paying fixed).

A CDS is a lot like an asset swap, but without the need to put out cash. While this feature makes it very attractive to some investors looking to take on credit risk, it is an even more important product for investors with a negative view of a firm's credit or who are seeking protection against a firm's default. Before the advent of the CDS, such an investor might have sought to benefit from a firm's possible default by selling short a corporate bond. That that isn't easy: the market for borrowing corporate bonds is extremely thin and expensive. The development of a market for CDS's, like any new forward market, provides liquidity to those wishing to take short positions. (You might wonder why an investor seeking protection against a firm's default could not just sell the asset causing this exposure. But not all assets exposing an investor to losses when a firm defaults are as easy to sell as a corporate bond. Some may be difficult to sell, such as bank loans and extensions of trade credit; others may be impossible to sell, such as counterparty credit exposure on derivatives). CDS's also provide opportunities for investors wishing to express relative value views that one set of credit spreads will widen relative to another set.

In the years leading up to 2007, the growth of the CDS market was explosive. During the 2007-2008 financial crisis it became clear that CDS's could be a source of systemic risk, since the default of a particular firm creates substantial, immediate payment obligations for firms providing protection on it. As a result, there is (based on the 2010 Dodd-Frank act) currently a move toward CDS's being standardized and traded on exchanges. This will eliminate counterparty risk (in much the same way that futures are different from forwards because they eliminate counterparty risk). It will also result in CDS's being more standardized. The detailed terms of the contract will always be important, however. For example, in the recent (summer 2012) European bailout of Greek debt, a crucial question was whether Greece had defaulted or not when its bondholders were asked to accept a "voluntary" change in the terms of the bonds they held. (Besides the precise definition of a default, other details that need to be specified in a CDS contract include: (i) what happens

to the contract if the underlying is bought or is part of a merger; (ii) if settlement is not in cash, which bonds can be delivered to accomplish the settlement [specifying a single bond can lead to liquidity issues].)

The **total return swap** is another derivative instrument that permits investors to take on credit risk without putting up cash or taking on long-term interest rate exposure. Recall that a CDS is like an asset swap without the need to put up cash. A total return swap is instead like a straight investment in a corporate bond, without the need to put up cash. In practice: the investor entering into a total return swap receives all the coupon payments from the bond, and any change in the bond price (positive or negative, so he may owe money due to a change in the bond price); in return, he pays an amount equal to LIBOR times the par coupon of the bond plus a spread. The cash flows are evidently very similar to borrowing at LIBOR and investing in the bond. In particular, the counterparty to the total return swap has something like a short position in the bond. This would be attractive to someone who has a negative view on the credit of the underlying entity, or who seeks protection on a credit exposure to the underlying entity. Total return swaps are in practice far less popular instruments than the CDS, perhaps because asset swap positions are more sought after than fixed rate corporate bond positions (for those investors not willing to put up cash) and perhaps because the reliance on a single bond raises settlement issues unfavorable to the investor similar to those of a CDS with a single deliverable.

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Pricing risky bonds and credit default swaps. We use the same overall framework as in the risk-free case. As usual, a key element is the present value of an anticipated payment. However the relevant discount will be different from the one associated with risk-free payments, because we are now interested in payments that occur only if a default has not taken place. So we are interested in

$$\begin{aligned}\tilde{B}(0,T) &= \text{value today of a note worth one dollar at time } T \text{ if} \\ &\quad \text{no default has occurred, and worth 0 if default has occurred.}\end{aligned}$$

It is customary to assume that

$$\tilde{B}(0,T) = S_T B(0,T) \tag{1}$$

where $B(0,T)$ is the risk-free discount rate, and S_T is the *survival probability*, i.e. the probability that a default has *not* occurred by time t. Note that since $\tilde{B}$ is the value of a tradeable, its value should be the *risk-neutral* expected discounted payoff. In assuming (1), we are in effect assuming that defaults are independent of interest rate movements. Moreover it should be emphasized that S_T is the *risk-neutral* survival probability, not the real-world survival probability.

How can we know S_T (or equivalently, $\tilde{B}(0,T)$)? There are two possible answers. First: we can extract it from the prices of bonds in the market, much as we did in the risk-free setting. Alternative answer: we can try to predict it using market data (such as the stock

price and volatility of the issuer) using an appropriate model to connect equity and credit prices. We'll concentrate for now on the first approach. Toward the end of this lecture we'll turn to the second approach.

[See handwritten notes for continuation.]