Credit Risk

A. Defining the Problem

What is credit risk? It is the risk associated with a loan (or bond) having to do with a borrower's unwillingness or inability to pay.

For example, if a borrower gets into trouble, the likelihood of missing an interest payment or failing to be able to pay back principal goes up. This lowers the market price of a loan or bond. Most loans are not traded, so this change in value is not apparent. Bonds are traded, however, and their price will fall (and spread will rise) in response to such problems. For example, when a rating agency downgrades a firm from, say AAA to AA, the price of their bonds will fall. This leads to losses for anyone who bought the bond while it was still rated AAA.

People call this type of credit risk "spread risk."

Credit risk also arises because borrowers may, in fact, fail to make a payment.

People call this type of credit risk "default risk."

B. Return, Expected Returns, and Profits on Loans

The key thing to remember when you are considering making a loan is that the interest rate is NOT THE EXPECTED RETURN! The interest rate is the MAXIMUM return. You can do worse, but not better, than the return implied by the contractually agreed upon interest rate. Thus, the expected return in always less than the interest rate.

Let's consider just default risk for now. Consider a simple loan to be paid back at the end of the year. Let k be the annual interest rate (including fees), and p be the probability of default. Assume for now that if the borrower defaults, you get zero. Then the expected gross return is:

$$(1-p)(1+k)$$

In practice, recovery is not zero in the event of default. Studies suggest, for example, that banks get about 60 cents on the dollar if a borrower goes bust. Thus, we can alter the formula for the expected gross return to take this into account:

$$E(r) = (1 - p)(1 + k) + p \times 0.6 \times (1 + k)$$

Example. Suppose the one year interest rate on a bank loan is 12% and the probability of default is 10%. What is the expected return?

How do we know if a loan is profitable? We need a required, or break-even, expected return. Such a return could reflect the systematic risk in the loan (recall your CAPM). As an alternative, some banks compute the amount of funding of the loan that comes from their own capital. The required return on the loan is then the weighted average of the bank's borrowing costs (usually very low) and the cost of raising new equity capital (this is usually assumed to be very high; for example 15 - 20%).

We can write down a break-even relationship that says the interest rate on the loan (k) has to be high enough so that the loan's expected return is greater than the return required to compensate the bank for funding the loan (call the required gross return "1+r"). To make things a little more general, let the recovery rate be "s" (for salvage value):

$$1 + r =< (1 - p)(1 + k) + ps(1 + k)$$

Or,

$$1 + k >= \frac{1 + r}{ps + (1 - p)} = \frac{1 + r}{1 - p(1 - s)}$$

So, the required interest rate increases in the required expected return and probability of default, and decreases with the recovery rate.

Example: Suppose that you have made a 1-year loan for $100 with a contractual interest rate of 10%. The required return for this borrower is 6%, the probability of default is 7.3% and the recovery rate is 50%. Compute the expected return on this loan. What is the NPV of the loan? Now, suppose the loan has an interest rate of 12% and everything else stays the same. How profitable is the loan now?

C. Qualitative Aspects of Credit Risk

How can banks reduce the default probability on a loan? The simplest answer is: don't lend the guy too much money! The point here is that the price (interest rate) and the amount borrowed are not independent.

More general question: What borrower and market attributes are related to the probability of repayment?

What about the recovery rate? How can the bank control this? The most important instrument that may be used is priority. Debt obligations are almost always classified by the order in which various classes of creditors get paid if the firm goes bust. The order is:

Senior, secured creditor
Senior unsecured creditor
Junior or subordinated creditors
Preferred equity holders
Common equity holders

Typically, banks hold a senior, secured claim. But that is not the end of the story. Loans are structured to mitigate the credit risk with so-called non-price terms:

Collateral
Covenants
Compensating balances
Loan maturity

This raises many **questions**: On collateral: How valuable is the collateral? Can the bank take possession of that collateral and sell it for a high price? How many legal fees will need to be paid before the bank can get a hold of the collateral? On covenants: What if a borrower breaks a covenant? Should the bank be tough or easy? What are the costs and benefits of each strategy?

People sometimes summarize qualitative aspects with the five "Cs" of credit:

1. **C**haracter: Borrower's reputation for probity and fairness (i.e. past willingness to pay bills can be checked, and this predicts future willingness to pay back the bank.)

2. **C**apacity: Projected future income of the borrower. Classic measure is the current and project interest coverage ratio (gross cash flow divided by fixed interest payments).

3. **C**apital: Strength of borrower's balance sheet. Classic measure is the leverage ratio.

4. **C**ollateral: Any credit enhancement offered, including implicit and explicit guarantees. Classic example is the loan-to-value ratio for a mortgage. Good collateral

can be taken away by the lender and resold without a substantial loss in value.

5. **C**onditions: How the business is likely to be affected by changing economic conditions such as a general economic downturn.

Bottom line: A bank should always understand how it is making a profit on each loan. Thus, it must be able to answer the following three questions:

1. What are the risks of this loan?

2. What is the firm being paid to bear this risk? Or, does the risk-adjusted return line up favorably with other deals that might be made?

3. How do the risks of this deal affect our portfolio? In other words, the bank should consider how the risks co-vary with the current loan portfolio.

D. Financial Distress and Default

Bank loans are designed to give the banker increasing levers of control over the firm as the firm gets into hot water. Typically, a default occurs under circumstances such as:

Missed payments
Breached covenant
Bankruptcy
Impairment of collateral securing the loan
Default on other outstanding debt

What happens when a borrower defaults? In cases where the firm's capital structure is simple, there will usually be a "workout" arranged between the bank and the firm. For example, if a small firm gets into trouble, they will often receive some debt relief from their bank, even though the bank could take possession of the firm's assets.

It is important for banks to respond to early warning signals of financial distress such as a broken covenant because when firms get into trouble, they often make very bad decisions. These bad decisions can make things go from BAD to WORSE very quickly. These are often referred to generically as "financial distress costs." Here are the main issues:

Asset substitution: change the nature of the business toward one that is very risky. Why? If the ship is sinking, I might as well roll the dice and hope to get lucky.

Looting/Fraud: Similar problem to asset substitution. Instead of rolling the dice, why not just try to get cash out of the firm quickly and leave the bank holding a worthless claim?

Underinvestment or Debt Overhang: When firms get distressed and have very little equity, they will have little incentive to make profit maximizing investment decisions. The reason is that almost all of the benefits of good decisions will go to the creditor (e.g. the bank), rather than to the owner or shareholder.

Example 1: Asset substitution

To see the basic problem of asset substitution, consider a firm with $1,000 in cash the day before its debt, which has a face value of $5,000, comes due. If the equity holders (or the managers acting on their behalf) do nothing, then the firm will go bankrupt and they will get nothing. What should they do? Suppose the equity holders took the cash and went to Atlantic City. If they win they might get $20,000. In that case they can pay off the $5,000 debt and still have $15,000 left over. If they lose they get nothing but they would have got nothing anyway so they are no worse off from gambling. The bondholders are of course worse off if the gambling is unsuccessful, they get nothing whereas they would have got $1,000 if the equity holders hadn't gambled. The problem is that when the firm is near bankruptcy the equity holders are gambling with the bondholders' money. They will therefore be prepared to invest in risky projects even though they are negative NPV. Although this example may seem rather extreme, something rather like it was done by many Savings and Loans during the 1980s.

Here is a summary of the payoffs:

Firm does nothing

V_{Bonds} = $1,000
V_{Equity} = $0

Firm Gambles:

Probability = 0.02	Payoff = $20,000
Probability = 0.98	Payoff = $0

Questions: What is the expected return on this project? Now, compute the wealth of stockholders and bondholders if the project succeeds and if it fails. What is the expected value of these two quantities?

You should see that the bondholders are much worse off and the equityholders are much better off. Thus even though this is a very a bad project, it's worth doing as far as the equityholders are concerned. The conclusion is: The stockholders of levered firms gain when business risk increases.

Example 2: Under-investment

The problem here is that equityholders have to share rewards with bondholders if the firm has debt outstanding. This holds true generally. However, if leverage is low, most of the rewards from a new investment flow through to the equityholders. However, when leverage is very high, almost all of the rewards go to the bondholder, not the stockholder. Suppose the firm has no cash and has debt with face value of $10,000. If it does nothing, the firm will go bankrupt. Suppose, however, that the firm has the following investment opportunity:

Invest $2,000: Yields $11,000 with certainty
Expected return = -2,000 + 11,000 = +$9,000/2,000 = 450%!

This is clearly a very attractive project. **Question:** The question is, will the firm do the project? If they do it, bondholders get $10,000 for sure. What do the equityholders get? Suppose the equityholders have to put up the money for this project. You should be able to work through the payoffs to see that the equityholders would rather not take this investment. This example illustrates the following principle:

Holding business risk constant, any increase in firm value is shared among bondholders and stockholders.

Thus, only if bondholders are willing to put up most of the money will the firm undertake the investment. However, bondholders may get very imperfect information. They may not be able to tell whether it's this type of project or the type that we had in the previous example. This creates an incentive for the firm and their creditors to restructure the firm's debt so that the equity holders have an incentive to take the good project.

Question: In this example, how could the debt be restructured in a way to make BOTH the debt holders and the equity holders better off?

The Cost of These Conflicts

The more firms borrow, the more likely it is that these conflicts of interest will arise. Stockholders know this and put fine print into debt contracts to prevent situations from arising in which this is likely to occur. It's mainly a problem at high leverage levels, and therefore the fine print attempts to prevent borrowing so that these high debt equity ratios aren't reached. Thus agency costs can potentially be large and help explain why firms don't borrow very much.

Thought-Provoking Questions: In the example, the bank would voluntarily forgive some debt to get the firm moving again. Under what circumstances do you think workouts are common? When do you think you will have a workout vs. bankruptcy?

What is bankruptcy?

When firms get into trouble, there will be an attempt to restructure the claims of creditors. If these fail, then either side (firm or creditors) has a legal right to force the firm into bankruptcy. For example, if a senior secured creditor tries to repossess assets, the firm can get protection from the courts via bankruptcy. Conversely, if the firm misses payments of otherwise violates their contract with creditors, then the creditor can force bankruptcy to try to get its $ back.

In Chapter 7 of the bankruptcy code, the firm is liquidated and its creditors are paid back in order of priority.

In Chapter 11 of the bankruptcy code, the firm is reorganized and continues in operation. Chapter 11 is usually favored by management and equity holders because they stand a chance of getting something out of the process. Often, management will use the threat of Chapter 11 to strengthen its hand in negotiating with tough creditors.

<u>Chapter 11 has a number of advantages:</u>

1. The firm can continue in operation without worrying about losing control of its assets.

2. The firm can get D-I-P financing. That stands for Debtor-in-Possession. It means that the firm can get new borrowing, where the new lender has the highest priority. This allows firms to make investment that may be positive NPV that otherwise would not be possible.

3. US law makes it necessary for an restructuring plan to be agreed upon by ALL creditors. This makes it very hard to construct such plans. Often, there is a holdout problem where some creditors are better off by not agreeing to the plan, thereby dooming it to failure. In Chapter 11, you need just a majority of each class of creditors (2/3 by dollar amount owned).

4. Sometimes a reorganization plan can pass even without agreement of a class of creditors at judge’s discretion. People call this a “cramdown.”

5. Chapter 11 also has tax advantages in some cases.

<u>And disadvantages</u>

1. Legal fees can eat up 2-3% of firm value.

2. Can be slow. 2-3 years is typical.

3. May destroy ability to deal with suppliers, retain employees, etc. Generally, reputation of the firm is harmed.

Discussion questions:

In England, there is no such thing as Chapter 11. If firms get into trouble, they are liquidated and the proceeds given back to creditors in order of priority. What are the advantages and disadvantages of the US system?

It turns out the Chapter 11 is quite uncommon when a firm has a lot of financing from a bank. Why do you think this is so?

E. Quantitative Approaches to Measuring Credit Risk

In recent years, consultants and sophisticated banks have constructed formal models of credit risk. I will describe three well-known and widely used approaches, in increasing order of sophistication.

The first approach (Altman's Z) is a statistical measure of default probability based on studies that link observable characteristics to past defaults. These models are know these days as "credit scoring" models. You may have heard about the FICO score. This is a number created for individuals based on their wealth and credit history used by credit card and mortgage lenders in much the same way as Altman's Z for businesses. (FICO stands for Fair Isaac Company, the firm that has a near-monopoly on this business.)

The second approach is a ratings-based model developed by JP Morgan in the mid 1990s, prior to its merger with Chase. This model is called CreditMetrics. It is based on the idea that gains and losses on fixed income securities (loans and bonds) occur, in large part, when companies are up- and down-graded by the ratings agencies. This approach is a close cousin conceptually to the VAR models described earlier for market risk. (JPM was the first to develop a VAR model for market risk). The idea of the model is to construct a pdf for the returns on a loan (whenever I say loan, you can read "bond" if you want) which describes the gains or losses over a fixed holding period. Once you have that pdf, you can then easily compute the VAR with varying levels of confidence, or, you can compute the standard deviation of the return as another measure of risk.

The last model, developed by a consulting firm called "KMV", is an option-based approach in which the value of loans (bonds) depends on the market value of the issuing firm's assets.

Altman's Z

Edward Altman collected key ratios related to leverage, the availability of cash, market value, and profitability and related these to bankruptcies. He used a technique called discriminant analysis that essentially allows you to separate the wheat from the chaff in a systematic way. The idea is to create a score based on a weighted average of variables related to being wheat or chaff (i.e.defaulting or not). Borrowers with a high score are unlikely to default, and those with a low score are more likely to do so. Here is Altman's Z:

$$Z = 3.3\left(\frac{EBIT}{TotalAsset}\right) + 1.0\left(\frac{Sales}{Assets}\right) + 0.6\left(\frac{MarketEquity}{Debt}\right)$$
$$+ 1.4\left(\frac{RetainedEarnings}{TotalAssets}\right) + 1.2\left(\frac{WorkingCapital}{TotalAssets}\right)$$

This is Altman's Z as of the 1970s; he has a proprietary model that uses updated information that he will sell to you at a high price if you really want it. In the original study, a score below 1.8 indicated a high probability of default.

Question: What are the significant weakness in this approach?

<u>Ratings-Based approaches to Credit Risk</u>

The idea of CreditMetrics is that the main gains and losses on a loan occur when the issuing firm is upgraded (gains) or downgraded (losses) by a ratings agency.

We need to know 3 things to construct the pdf for a given loan:

1. What is the current rating of the issuer?

2. Given the current rating, what is the probability over the holding period that a loan moves to a different ratings category?

3. What price will the loan sell for in each of the possible ratings categories (at the end of the holding period)?

Consider an AA-rated loan. From studies done by Moody's using historical ratings changes for a 1-year holding period over the past 75 years, we can get the ratings-migration probabilities, which looks like the following:

Rating in 1 year	Probability
AAA	0.7
AA	90.7
A	7.8
BBB	0.6
BB	0.1
B	0.1
CCC	0.0
Default	0.0

So, for example, the probability that a AA-rated loan remains AA rated after 1 year is 90.7%.

Notice that for a AA-rated loan, there is very little upside. **Question**: The Moody's study seems to suggest the AA-rated borrowers never default. Is this right?

The ratings-migration probabilities look more symmetrical for a B-rated loan:

Rating in 1 year	Probability
AAA	0.0
AA	0.1
A	0.2
BBB	0.4
BB	6.5
B	83.5
CCC	4.1
Default	5.2

Next, we need to price the loan at the end of the 1-year holding period. CreditMetrics does this using the 1-year forward rates for corporate bonds in each ratings category. These forward rates are derived from the yield curve for corporate zero-coupon bonds of different ratings.[1]

Here is an example of 1-year forward rates taken from the CreditMetrics technical document

	1-year	2-years	3-years	4-years
AAA	3.60	4.17	4.73	5.12
AA	3.65	4.22	4.78	5.17
A	3.72	4.32	4.93	5.32
BBB	4.10	4.67	5.25	5.63
BB	5.55	6.02	6.78	7.27
B	6.05	7.02	8.03	8.52
CCC	15.05	15.02	14.03	13.52

How do you use these? Suppose you want to know what a 6%, 5-year coupon bond would be priced at the end of the year if that bond were rated A. Here are the cash flows:

t=	1	2	3	4	5
Payment	$6	$6	$6	$6	$106

At the end of the year (i.e. at t=1), the bond price would the PV of these payments using the 1-year forward rates for A-rated bonds:

$$Price = 6 + \frac{6}{1.0372} + \frac{6}{1.0432^2} + \frac{6}{1.0493^3} + \frac{106}{1.0532^4} = 108.66$$

Note that you don’t discount the first payment because we are pricing the bond just before the

[1]There are no zeroes in the corporate bond market, so these are constructed from the yields on coupon bonds using a mathematical procedure know as bootstrapping. You may see some of this in an advanced course on fixed income securities. It is beyond the scope of this class, however.

first coupon payment is made. You can go through this calculation for all possible ratings, giving you the hypothetical price for a bond under all possible circumstances, with one important exception, which is DEFAULT. We have no way to use the forward rates for defaulted bonds. Instead, CreditMetrics uses an assumed recovery rate for defaulted bonds. As noted above, this will depend on the structure of the loan or bond. For the purposes of our example, let's assume that the recovery will be 51.1%.

Exercise: Suppose you have a 5-year B-rated bond paying a 6% coupon (annual payments). Construct the pdf for this loan at the end of a 1-year holding period. How can you use this to construct the VAR with different levels of confidence?

Option-based models of Credit Risk

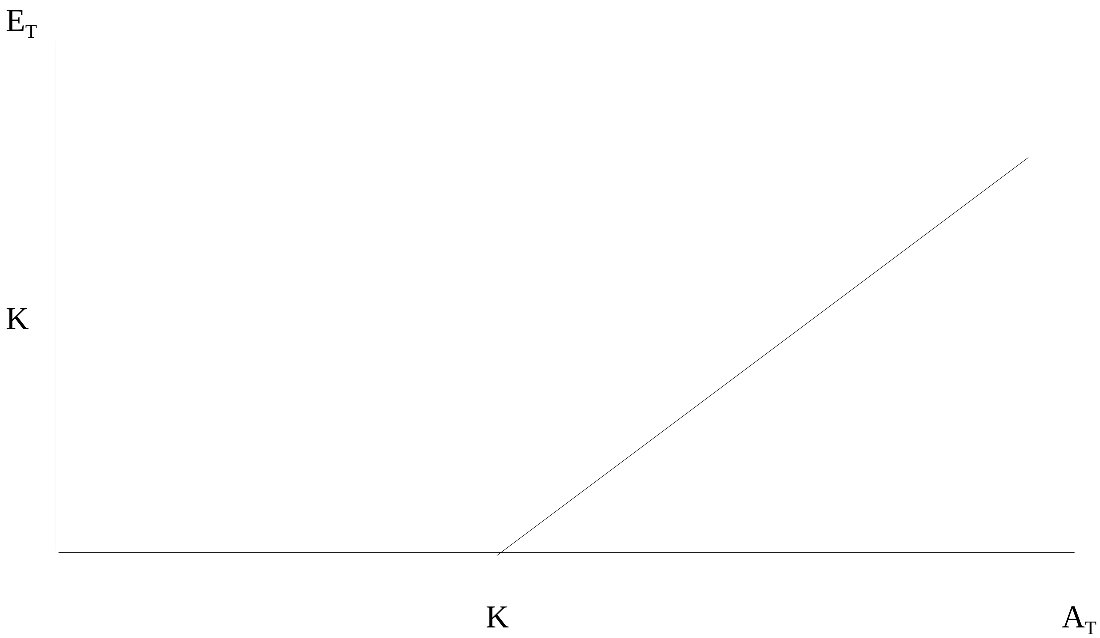
Corporate securities represent claims on the assets of a firm. These claims can be valued using the tools of modern option pricing theory. This approach to thinking about credit risk has the advantage of allowing the FSF to incorporate market information (as opposed to a ratings agency's opinion) into models of debt pricing and risk management.

Consider a simple firm with some assets (A) financed by debt (D) and equity (E). From the balance sheet identity:

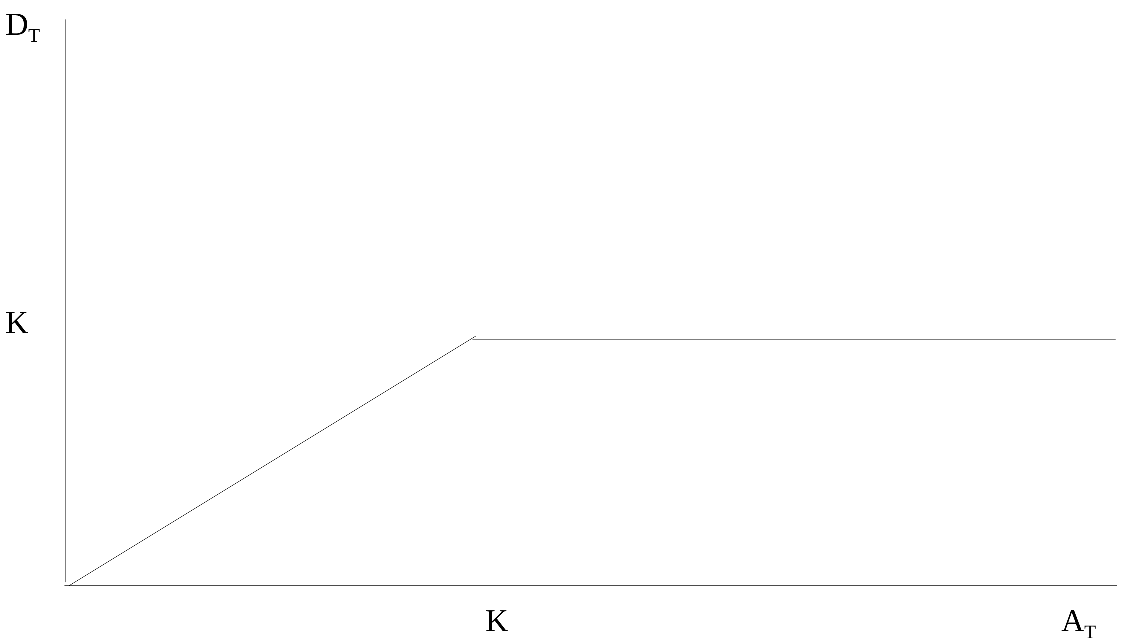
$$A = E+D$$

Let K equal the face value of the debt, and assume that the debt matures at time T and pays no coupons between now and T (this makes things nice a simple). We can graph the payoffs of E and D at the end of time T as functions of the underlying value of the firm's assets (A_T).

Here’s what it looks like:



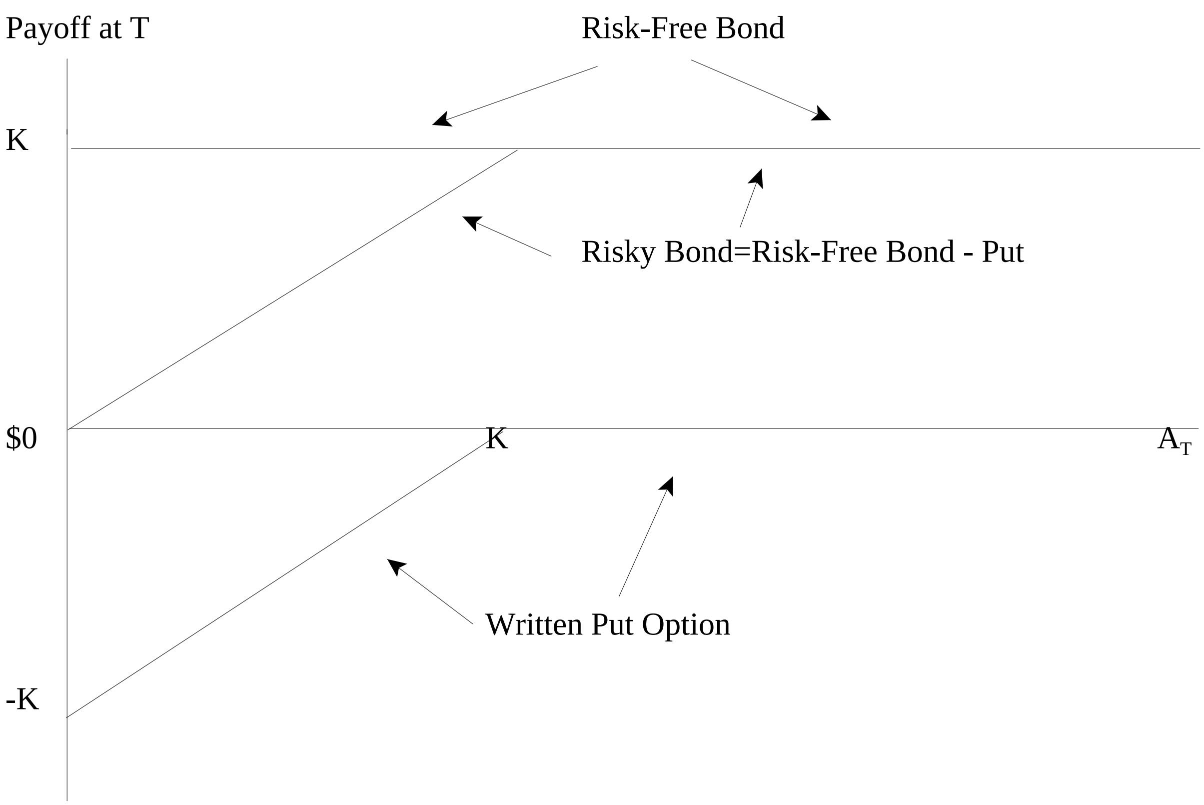
And,



The terminal payoff of equity (E_T) is the same terminal payoff as a call option with an exercise price of K on the assets of the firm (A). In other words, if at T the firm is worth K or more, equity holders get to keep the difference between A_T and K; if A_T is less than K, they default and give the firm's assets to the bondholders. The value of the risky bond is the value of the assets today (A) minus the value of equity today (the call option).

The payoff on the risky bond can also be de-constructed into the sum of two other securities, a safe bond (one that pays K for sure) minus a put option:

To see this, here are the two terminal payoffs:



This equivalence between puts and call is known as "Put-Call Parity." So, a risky bond is the same as a safe bond minus the put option. Why is this? Because the equity holders have the option to sell back the firm's assets to the bondholders at a fixed price (K). They do this opportunistically; that is, they only do this when A_T is less than K.

A (very) short primer on options:

Call options are the option to buy an asset (the underlying) at a fixed price (the exercise price) in the future. Put options are the option to sell an asset at a fixed price in the future.

Option pricing theory tells us that call options depend on the following things:

positively on the value of the underlying asset (A)
negatively on the present value of the exercise price (PV(K))
positively on the volatility of the underlying asset over the life of the option (σ_A)

The intuition for the first two comes from look at the terminal payoffs. The terminal payoff of a call increases in A and decreases in K.

The intuition for the fact that call options increase in value with volatility comes from the fact that the payoff is asymmetrical. Owners of the call option make money on the upside, but do not lose money on the downside (see the picture above for equity). Hence, increasing the spread of possible outcomes for the underlying increases the option's value.

For put options, most of these are reversed (sell vs. buy). They depend:

negatively on the value of the underlying asset (A)
positively on the PV of the exercise price (K)

However, puts also have an asymmetric payoff, so, like calls, they depend positively on the volatility of the underlying asset (σ_A).

Put-Call Parity is an arbitrage condition relating the value of a (European) call in terms of the underlying asset (in this case A), the risk-free bond, and a put option with the same terms, as follows:

$$C(A, K, \sigma_A) = A - PV(K) + P(A, K, \sigma_A)$$

This condition follows from the fact that you can construct the payoff of a call option by combining a long position in the underlying (A), financed by borrowing the PV of K, with the downside risk protection afforded by the put option.

The Black-Scholes model is a mathematical formula that relates the price of European Calls to these key variables. (A European option is one that may only be exercised at expiration. American options can be exercised any time during their life. For calls, as long as there are no dividends, the two are equivalent.)

Here is the Black-Scholes formula, as applied to the value of equity:

$$C = AN(d_1) - PV(K)N(d_1 - \sigma_A\sqrt{t})$$

where A is the market value of the underlying asset; Ke^{-rt} is the PV of the exercise price (face value of debt); $\sigma_A\sqrt{t}$ is the standard deviation of the returns on A <u>over the life of the option</u> (i.e. the time to maturity of debt); N(x) is the cumulative probability of a standard normal random variable (i.e. it's the probability that a normally distributed random variable with mean zero and variance 1 is less than x). And:

$$d_1 = \frac{Ln[A / Ke^{-rt}]}{\sigma_A\sqrt{t}} + \frac{\sigma_A\sqrt{t}}{2}$$

Getting back to debt and equity, we saw that equity is like a call option with an underlying equal to the firm's assets and an exercise price equal to the face value of the debt.

So, we can apply the B-S model:

$$E = C(A, PV(K), \sigma_A) \qquad (1)$$

and, we can compute D as the difference between a safe bond and the put option::

$$D = PV(K) - P(A, PV(K), \sigma_A)$$

There is one problem, however, which is we *can't observe* A or σ_A directly. We can compute the market value of equity (E), however, using the share price times shares outstanding. We can also observe the <u>face value</u> of debt (K), but clearly this is not the same thing as the market value of debt (D), which is what we are after. We can close the system because there is a link between the volatility of equity and the volatility of assets. Volatility of equity is just the standard deviation of equity returns over the life of the option; this we can measure because we have traded stock prices. The link to asset volatility is as follows:

$$\sigma_E = \sigma_A \times \frac{A}{E} \times N(d_1) \qquad (2)$$

So, since we have 2 equations (1) and (2), and 2 unknowns (A and σ_A), we are home free. Once we have constructed D, we can also compute the required interest rate on this risky debt.

The model can also be used to compute the probability of default, which is the probability that A is less than K at the maturity of the bond. To simply notation, let t = 1 period. Then, according to the B-S model, the underlying asset A_T is log-normally distributed with an expected value of:

$$Ln(A)+\mu_A-(1/2)\sigma_A^2$$

The additional parameter, μ_A, is the expected return on the firm's assets over the life of the option (i.e. to maturity of the debt). We do not need to know this value to price the value of the debt and equity securities, but we do need to know it to construct the probability of default. Typically, people will apply the CAPM to estimate this number. Once we know it, we simply compute the probability that A_T (random) is less than K (a known number); that is the same thing as the probability that $Ln(A_T)$ is less than Ln(K).

$$\text{Prob} [Ln(A_T) < Ln(K)] =$$

$$\text{Prob} [Ln(A_T)-Ln(A)-\mu_A+(1/2)\sigma_A^2 < Ln(K)-Ln(A)-\mu_A+(1/2)\sigma_A^2] =$$

$$\text{Prob} [1/\sigma_A \times (Ln(A_T)-Ln(A)-\mu_A+(1/2)\sigma_A^2) < 1/\sigma_A \times (Ln(K)-Ln(A)-\mu_A+(1/2)\sigma_A^2)]$$

The random variable (the thing to the left of the less than sign) is now standard normal (mean 0, and variance 1). So, the probability of default or expected default frequency (EDF) equals the following expression:

$$EDF = N\left(\frac{Ln(K) - Ln(A) - \mu_A + \frac{1}{2}\sigma_A{}^2}{\sigma_A} \right)$$

So, the default probability increases in K (more leverage, higher default); decreases in A (more valuable assets, lower default); and increases in σ_A (riskier assets, more default).

So, the option approach has accomplished a lot. Here is a quick summary:

1. We have been able to price the debt (D), and can use this to come up with a fair contractual interest rate. This is important to know when you make a loan!

2. For risk managers, we can also compute the expected default probability (EDF). This model also allows you to compute analytically the expected loss conditional on default.

3. In a portfolio, one can infer the *correlation* between returns on bonds (loans) from <u>observable</u> correlations in the returns on equity. (These are observable because equity trades in liquid markets, in contrast to debt.)

<u>Final caveat:</u>

I have, of course, simplified things by having a firm with an incredibly simply capital structure, no coupon payments, one class of debt, etc. One can use these tools, however, to incorporate various class of debt (senior and subordinated), coupon payments, and so on. This is, in fact, what KMV does. They get paid the *big bucks* because the analytics are hard when you have a complex capital structure. You can also make the model more realistic by introducing bankruptcy costs. The model that I have sketched for you assumes that the assets get transferred to the bondholders when there is a default with no losses. If you are interested in more details check out KMV's website at www.moodyskmv.com.

Discussion question: What are the relative advantages and disadvantages of the three approaches to credit risk: credit scoring approach, ratings-based approach, and options-based approach?