Financial Market Practices

While the practices of financial firms get infinitely complicated, they all revolve around two concepts:

1) The average return on an asset or portfolio, and

2) The variance of the return on an asset or portfolio.

Leveraging:

Leveraging is borrowing money to buy assets. Because you are using other people's money, leveraging can increase your returns dramatically in good times if the asset pays a return greater than your borrowing costs. But leveraging dramatically increases your risk and raises the probability of bankruptcy in bad times if the asset returns fall and you cannot repay your borrowers.

In the example below, there is a Good Outcome (State in economist jargon) where the $1000 investment becomes worth $1200 and a Bad Outcome where it gains no value and is still worth $1000. Each Outcome is assumed to be equally likely. Note: unlike some of the MBS and CDO's in the Financial Meltdown, the Bad Outcome here is NOT that bad. In the Bad Outcome, the investment simply does not go up in value; nevertheless, we will see that if you Leverage like Lehman, you can still go bankrupt.

Example:

a) Q = Price of share = $1000
b) .5 chance Q will equal $1000 and .5 chance Q will equal $1200

Case 1: Zero Leverage

a) Average (or Expected) Return = .5*(1200 -1000) + .5*(1000-1000) = 100
b) Rate or Return 100/1000 = 10%
c) Variance of Return[1] =$.5*(200 - 100)^2 + .5*(0-100)^2$ = 10,000

Case 2: Borrow an additional $1000 at 5% interest

a) Expected Return = .5*(2400 -2050) + .5*(2000-2050) = 150
b) Rate or Return 150/1000 = 15%
c) Variance of Return =$.5*(350 - 150)^2 + .5*(-50-150)^2$ = 40,000

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[1] This is the variance for an asset across time. The general formula is:
$\text{Variance} = P_G \cdot (R_G - E(R))^2 + P_B \cdot (R_B - E(R))^2$ where P_G and P_B are the probabilities of the Good and Bad States and E(R), R_G, R_B and are the expected (average) return and the returns in the Good and Bad States.

The expected return has increased 50%, but the variance (risk) has increased 400% (or 100%, from 100 to 200, if you use standard deviations to measure risk).

This is an example of 2:1 Leveraging (A $2 investment using $1 of your own money). Lehman Brothers was leveraged 33:1 when it went bankrupt.

Case 3: Lehman Brothers Borrows $32,000 at 5%

a) Expected Return = .5*(39,600 - 34,600) + .5*(33,000-34,600) = 1,700
b) Rate or Return 1700/1000 = 170%

c) Lehman Brothers must pay $1,600 on the $32,000 it borrowed in the Good and the Bad State. Even though the asset loses no value in the Bad State, Lehman Brothers is still bankrupt. It must come up with $1,600 in interest, and it only has $1000 of its own money.

Moral of the Story: While leveraging increases the average return for the leverager (from 10% in the unleveraged case to 170% in the Lehman case), it **does not** increase the average return of the underlying project. In our example, the stock (and the firm's underlying projects) have an inherent 10% return, and leveraging **cannot** change that[2]. What leveraging does is transfer some of that return from the lenders (the entities who lent to Lehman) to the leverager. In the Good States, the leverager is getting a 20% return, but only returns 5% to the lenders. The leverager is not exactly stealing the 15% difference from the lenders because, except when the leverager goes bankrupt, the lender gets a sure 5% while the leverager lives in a much riskier world, **but**, and this is key, in a world of his own creation. To get the higher average return, the leverager is raising the risk level of the entire financial system. In my view, excessive leveraging was the single biggest cause of the financial collapse.

Diversification: To understand what diversification does, you need to know what determines the variance of the return on a portfolio of assets. We are going to look at three companies: Swimwear, Inc, Umbrella, Inc, and Ugly Rubber Rain Boots, Inc.

All 3 companies have an average rate of return of 5% that is calculated based on the "fact" that rainy years and sunny years are equally probable and that the companies make a 0% return in their bad years and a 10% return in their good years.

Average Return = .5*Return in Rainy Years + .5*Return in Sunny Years

We are going to invest $1000, which will return $1100 in good years and $1000 in bad years for an average return of $50.

[2] I'm not sure that all practitioners in the financial system realize this.

Variance of each stock = .5*(1100-1050)^2 +.5*(1000-1050)^2 = 2500[3]

Portfolio Averages are easy to calculate. They do what you think they should do. The average return (or rate of return) on a portfolio is simply the average of the elements in the portfolio. So a portfolio made up of 30% Swimwear and 70% Umbrella has an average rate of return = .3*5% + .7*5% = 5%. A portfolio of 30% Ugly Rubber Rain Boots and 70% Umbrella has the same average rate of return.

Variances, however, are hard to calculate because they depend on the Covariance between the elements in the portfolio according to the formula:

Variance of a Two Stock Portfolio (with α percent in Stock 1 and (1-α) in Stock 2) =

α^2Variance of Stock 1 + $(1-\alpha)^2$Variance of Stock 2 + $2\alpha(1-\alpha)$Covariance between Stocks 1 and 2

Using R_R and R_S as the returns in the rainy and sunny years respectively and E(R) as the average return of the stock, the Covariance between 2 stocks equals:

.5*(Stock 1 R_R - Stock 1 E(R))*(Stock 2 R_R - Stock 2 E(R)) +

.5*(Stock 1 R_S - Stock 1 E(R))*(Stock 2 R_S - Stock 2 E(R)]

Covariance (Swimwear, Umbrella) = -2500

Covariance (Swimwear, Ugly Boots) = -2500

Covariance (Umbrella, Ugly Boots) = 2500

Variance of portfolio (.3 Swimwear and .7 Umbrella) = 400

Variance of portfolio (.3 Ugly Boots and .7 Umbrella) = 2500

Why do you think the variances of the portfolios are different even though the average returns are not?

Moral of the Story: Diversification **cannot** raise the average return of a portfolio, it simply lowers the variance. In the real world, diversification is hard to achieve because, contrary to the Swimwear-Umbrella example, the returns on most stocks are positively correlated. So long as the stocks are not perfectly positively correlated[4] diversification helps lower the variance, but it can never lower the variance to zero unless the stocks are perfectly negatively correlated.

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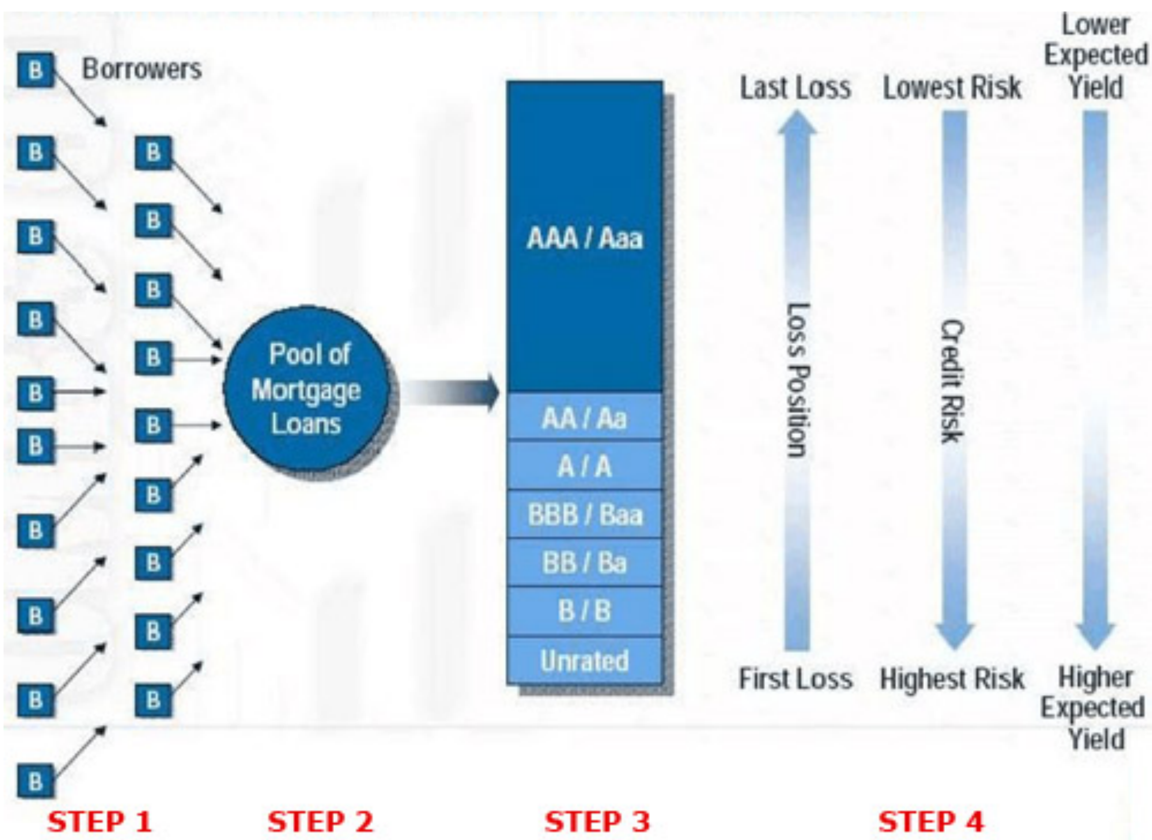
[3] The first term is the good year and the second term is the bad year, which differs between the stocks.

[4] You measure this by the correlation coefficient, which equals $\frac{\text{Covariance(Stock1,Stock2)}}{\sqrt{\text{VarianceStock1} * \text{VarianceStock2}}}$. Perfectly positively correlated stocks have a correlation coefficient =1.

Part of the explanation for the financial meltdown was that market participants failed to appreciate how positively correlated were the returns on Mortgage Backed Securities (MBS's). The forces that resulted in one set of homeowners in one part of the country defaulting on their mortgages was significantly positively correlated with the forces causing other homeowners elsewhere to default. Market participants thought MBS's were like Swimwear-Umbrella, when in fact they were more like Umbrella- Ugly Boots.

Securitization and Tranching: When securitization was first invented, every investor of the MBS got a proportional slice of the returns on the pool of mortgages in the sense that if 10% of the mortgages defaulted and the pool lost 5%[5] of its value, each investor lost 5%. Tranching slices the pool vertically, with the bottom tranche absorbing **all** of the initial losses and the tranches above that only losing money as the losses increase. The top tranche (let's say the top 5%) only loses money once more than 95% of the value of the MBS is lost. See diagram below:



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[5] When a mortgage defaults, the pool does not lose the whole value of the mortgage because the homeowner gives up the house, which still is worth something (here I assume 50% of the mortgage).