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Linking Stress Tests to the Real Economy

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In the current flurry of stress tests, governments, regulators and boards have wanted answers to "simple" questions such as, "What will happen if unemployment rises to 5%, GDP growth falls to –2%, inflation increases to 8% and property prices drop 20%?" For highly structured assets such as commercial real estate we have direct linkages between market variables such as interest rates, rental rates and net income.

But for the other asset classes such as corporate loans, many banks have struggled to answer such questions because their risk models are not written in terms of such real world variables. Instead, they have had to resort to crude measures such as doubling the probability of default with no real justification. Discussed below is a method for **adding real world structural elements to risk models** for almost any asset class.

In summary, the approach is to calculate the client's expected net income in the nominal case and the expected net income in the stressed case, and then use the ratio to adjust the client's probability of default by using the distance to default implied by the Merton model.

The mathematical steps include taking the nominal probability of default (which may have come from any model), transform it into the usual distance to default (D2D), calculate how the D2D will change in a stress, then transform it back to a probability of default. Mathematically this is expressed as follows:

$$D2D_0 = N^{-1}\ P_0 = \frac{Excess_0}{\sigma}$$

$$\therefore \sigma = \frac{Excess_0}{N^{-1}\ P_0}$$

$$P_S = N\ D2D_S = N\ \frac{Excess_S}{\sigma} = N\left\{\frac{Excess_S}{Excess_0} N^{-1}\ P_0\right\}$$

P_0 is the probability of default in the nominal case
$D2D_0$ is the distance to default implied by P_0
$N^{-1}\{P_0\}$ is the inverse Normal function
$Excess_0$ is the net income in the nominal case
σ is the standard deviation of the net income
P_s is the probability of default in the stressed case
$D2D_s$ is the distance to default in the stressed case
$Excess_s$ is the net income in the stressed case

This mathematical machinery is the easy part to implement as it consists of a few lines of Excel. The more difficult part is to estimate Excess_S. This can be done with many refinements and details, but for illustration purposes let us make a few broad assumptions.

Let us assume that the volatility, σ, is fixed, i.e., the underlying volatility is still valid after the stress event. Let us also assume that default is simply a matter of current cashflow rather than also including the effects of the net asset value and value of future cashflows. Using these assumptions, Excess_0 is simply the net free income after paying costs and debt in the unstressed case. In the case of a company, this is obtained from the balance sheet:

$$\text{Excess}_0 = \text{Sales}_0 - \text{OperatingCosts}_0 - \text{Pr incipal}_0 - \text{Interest}_0$$

The next (and practically most difficult) step is to connect changes in sales and costs to changes in real market variables. A simple illustrative model is to link sales to GDP growth and costs to inflation:

$$\text{Excess}_S = \text{Sales}_0\left(1-\alpha+\alpha\frac{\text{GDP}_S}{\text{GDP}_0}\right) - \text{OperatingCosts}_0\left(1-\beta+\beta\frac{\text{Inflation}_S}{\text{Inflation}_0}\right) - \text{Pr incipal}_0 - \text{Debt}\times r_S$$

Here r_S is the interest rate in the stressed case, which may be the same as the unstressed case if the debt is fixed or hedged. σ and β are parameters obtained from the regression of historical balance sheet data against economic variables. They are generally not company-specific because there is rarely enough data for a single company, but they are more likely to have different values for each sector and geography.

Estimation of these correlation coefficients is the most difficult part of the exercise because it requires having historical data on balance sheet variables. In this illustrative example there are only two parameters, α and β, but in an operational model, it is likely that there will be multiple values.

For example, operating costs may be broken out to by staff costs, materials costs, rental costs, late payments, and overhead. Each one of those could be linked to GDP, unemployment rates and inflation. This requires the banking systems to not only capture current balance sheet information in detail but also to capture detailed balance sheet information over time using linkages. The linkages will be from one time step to the next so that you can envision how the internal workings of a business respond to changes in the economy.

This approach is a straightforward, transparent method for linking changes in macro-economic variables to changes in default rates. It can be used in both stress testing and portfolio simulation for almost all types of commercial assets and helps to give an integrated stressing framework with relevance to real-world concerns.

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