

Mortgage Finance

GAZETTE

Risk Management

Stress testing mortgage loan portfolios

Testing the probability of losses within single mortgage loans or whole portfolios is a vital part of risk management. **Dr Chris Marrison** discusses stress testing

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What losses would we have if interest rates went up 3 per cent next year and property prices fell 15 per cent? This is the kind of question that haunts the sleep of board members and gets asked the following day in the risk management committee. The answer typically involves either the waving of arms or several weeks of laborious calculations by analysts in the risk group.

The projection of profitability or loss that could be expected in a single, unlikely, but possible scenario is a stress test. Other stress tests could include an increase in the unemployment rate, or the impact across several properties if a single large tenant defaults. Stress tests fit into the suite of risk measurement techniques for both single loans and for looking at portfolios as a whole.



Dr Chris Marrison

When applied to a whole portfolio, stress tests are one of the main approaches for assessing concentration and contagion risk.

Stress testing has long been used in assessing commercial real estate loans. These are loans to properties with a formal structure of lease agreements and loan covenants. It is, therefore, meaningful to estimate the future cashflows and their response to adverse circumstances. Such tests are standard in the credit assessment of new loans as they go before credit committee, but only a few advanced institutions currently have the ability to stress test across the whole book. A state-of-the-art system can apply a stress simultaneously to all loans in the portfolio and calculate the consequences to the portfolio as a whole.

Examples

To give you an example of how a stress test works, consider a 10-year loan, backed by one property with two tenants with fixed leases—one of which expires in six years. The interest rate is fixed for four years then floats for six years to maturity. This deal is vulnerable to increases in interest rates and falls in rental rates (after the lease expires the new lease will be at the prevailing market rate). It is also vulnerable to falls in property values which could increase the loss after a default. The first graph (Chart 1) shows the net income and debt servicing required as a base-case if all rates stay fixed. There is a small rise in the rental income when the current tenant is replaced and there is a small rise in debt servicing when the loan goes to floating.

This second graph (Chart 2) shows the case if interest rates go up 0.5 per

Chart 1

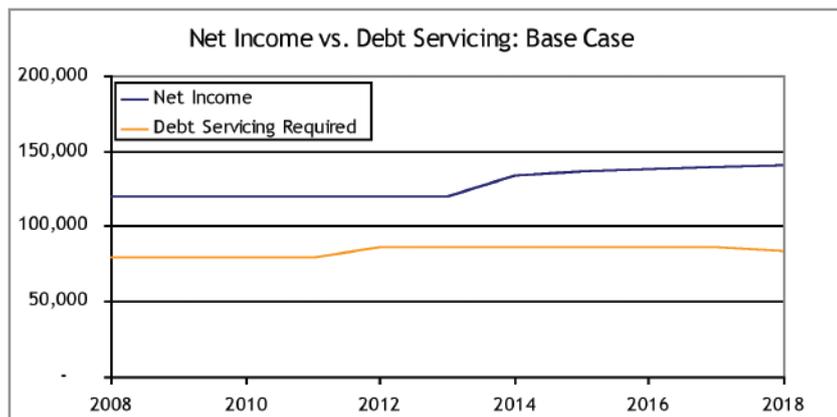


Chart 2

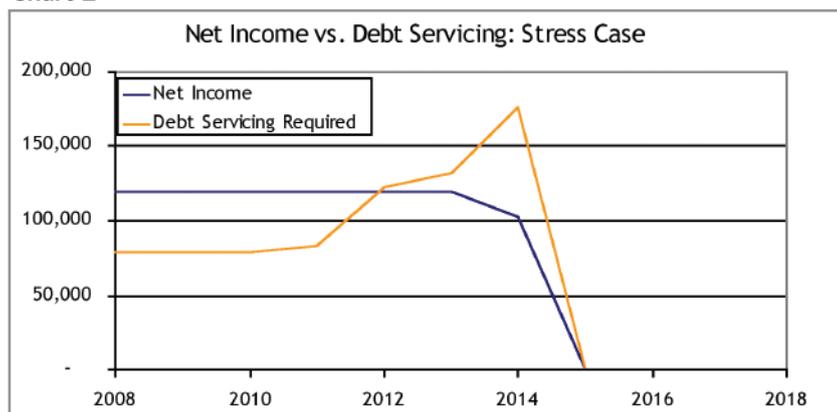


Chart 3

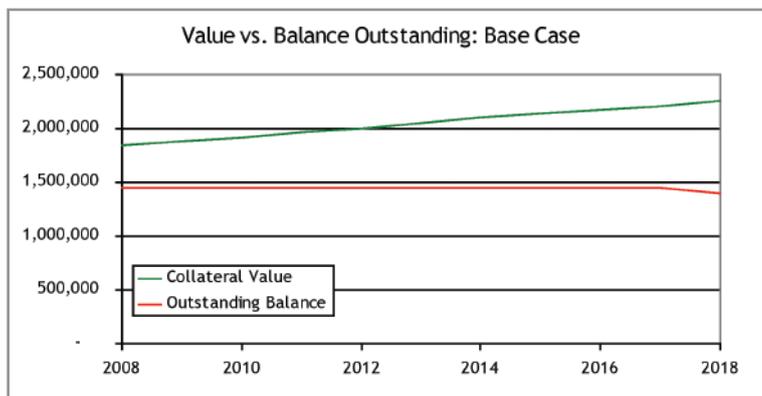
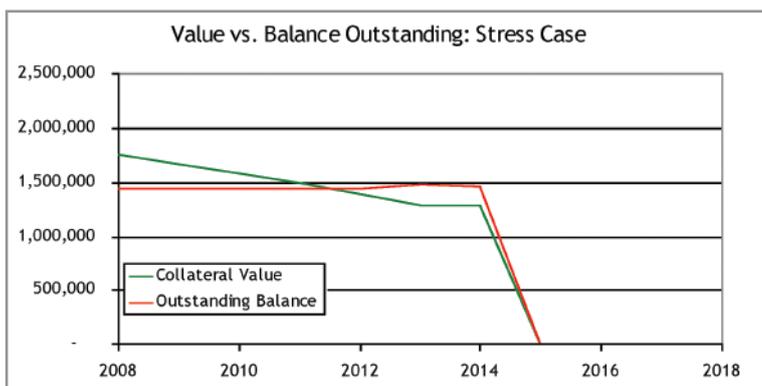


Chart 4



cent per year, from 5 per cent to 8 per cent and market rental rates fall by 5 per cent per year down to 70 per cent. In this case the rise in interest rates causes a payment shortfall, which is then exacerbated in the following year with the need to pay up missed interest. By 2015 the loan is foreclosed.

After foreclosure the concern moves from debt payment ability to the collateral value. Charts 3 and 4 show the base case for collateral value and debt outstanding and the corresponding stress case, including the assumption that values drop by 5 per cent per year, down to 70 per cent. The result is a 13 per cent write-off (including missed interest).

This type of stress testing is helpful when making decisions about new lending, and the same stresses can be applied to the “live” existing portfolio. Rather than looking at the individual cashflows of net income and debt servicing, it is helpful to look at the total shortfall in net operating income across the portfolio, and more

importantly, the total loss in those cases that default. Charts 5 and 6 show the results for a portfolio of 1,000 deals. Each graph shows the result for the base case, the individual stresses, and the combined stresses. The graph of losses shows that the cumulative loss in the combined stress case would be 17 per cent. These results are easy to interpret, and conceptually they are simply the sum of the results for the individual deals. However the difficulty lies in the implementation. Relatively few institutions have the ability to gather together all the deal information needed on the portfolio and then put it into a calculator that can process the thousands of deals in the portfolio.

Retail loans

The examples above illustrate the use of stress testing on commercial loans where there is a clear linkage between market conditions and individual cashflows. For retail loans the link between economic conditions and default rates is more difficult.

Here, the most common type of risk model is a regression that is based on several years of information on hundreds or thousands of defaulted customers. These models relate customer characteristics, such as income and debt levels, to their probability of defaulting during the next year. This gives a reasonable picture of the risk for an individual customer, but does not necessarily help in describing how many assets in a portfolio may simultaneously default in adverse circumstances.

Such adverse circumstances were illustrated by the recent problems in the US subprime lending market. Here, a move in interest rates combined with a negative economic outlook, brought whole swathes of customers to the brink of default. This systemic risk could have been detected and managed if the risk models that the banks had been using had included the components needed for stress testing.

There are a couple of ways of making retail models usable for portfolio analysis and stress testing. One way is to include the macroeconomic circumstances in the original regression. So, instead of just looking at customer characteristics such as income and debt levels, also include macroeconomic variables such as the unemployment and interest rates that prevailed at the time of default. The result is a regression model that has a better fit to the historical data and includes both customer specific factors and systemic factors. The portfolio can then be stressed by recalculating the risk if the level of the systemic factors were to shift.

This process of re-doing the regressions to include the macro variables may not be easy if, for example, the models were supplied by an external vendor or the original data set is not accessible. One alternative, developed by Risk Integrated is a model combining the results from the regression with a structural component. Consider a simple regression which results in the following model:

$$\text{ProbabilityOfDefault} = 5\% - 4\% \times \text{Income}\%$$

Here Income% is the personal annual income, divided by the loan amount. A structural amendment to this model would be to allow the income to increase by inflation and subtract any change in interest rates from their available income:

$$\text{ProbabilityOfDefault} = 5\% - 4\% \times (\text{Income}\% \times \text{RPI} - (r - r_0))$$

Here RPI is the retail price index and r_0 is the current interest rate. This has created a r_0 model that is now sensitive to the macroeconomic

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Chart 5

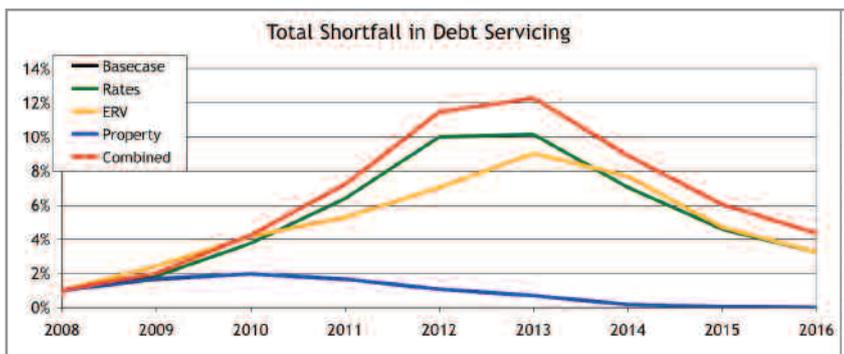
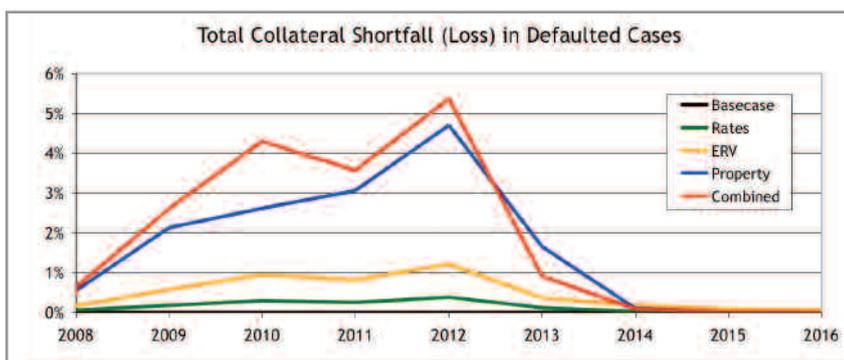


Chart 6



variables of inflation and interest rates. Similar but slightly more complex factors can be used to take into account unemployment rates. This model could now be used for stress testing. This is a very simple illustration of a linear model, but it illustrates how structural systemic components can be combined with an existing regression model.

Models like this which explicitly include real economic variables are well suited for stress testing and can be combined with models from other asset classes, such as commercial real estate, to give a picture of the portfolio's overall risk. Structural models like this also easily lend themselves to being used in simulation, as discussed below.

Basel and economic capital

Stress testing has the great advantages of being easily understood and allows the portfolio to be assessed in almost any combination of extreme circumstances. However, it should be seen as only one of the quantitative tools used for assessing the risk of

loans and portfolios. Along with stress testing, risk managers should be looking at the Basel and economic capital. Unlike stress testing, the capital metrics explicitly include a measure of probability. Basel capital is itself based on the concept of a 99 per cent worst case economic downturn, but the actual economic variable that causes the stress is not specified. Basel capital has the advantage of being widely understood in an organisation and being relatively uncontroversial compared with economic capital.

Economic capital takes into account the differing correlations between assets in the portfolio. It gives greater weight to assets that are part of a risk concentration, and reduces the capital for assets that tend to diversify the portfolio. There are two practical difficulties with including correlation in the assessment of risk. The first is that as the composition of the portfolio changes, the portfolio correlations change. Therefore, adding a new loan may change the economic capital allocated to all previous loans. This is typically solved

by assuming that the portfolio is fixed from one year to the next. The other key difficulty is quantifying the correlation, especially the correlation in extreme circumstances. Given these uncertainties in the assumptions for economic capital, any assessment of the portfolio's risk should be backed-up by stress testing.

Portfolio analysis

Conducting risk analysis at portfolio level is partly a methodology problem, but also an IT problem. The portfolio analysis requires a risk engine that can process all the assets and it requires a clean centralized database containing information on all the assets. This can be difficult to pull together, but the good news is that once the information is collected, it can be used for dozens of different reporting purposes, requiring much less arm waving or late nights.

The portfolio analysis reveals vulnerabilities to future changes in the reigning macroeconomic conditions. This can guide the institution in the structure of new lending. For the current assets the institution can try to change the way they are structured, for example, by providing incentives to customers to change to fixed rate loans. Another alternative is to deal with the portfolio's risk at a macro level, for example, by securitization or buying a large swap that will pay the institution at the same time that interest rate movements increase loan defaults.

To manage the portfolio efficiently and ensure a good night's rest, the board and senior management need through risk measurement reports for their loan books. Risk management at the portfolio level is far beyond the realm of the intuition that may work for individual loans--especially given the changing nature of financial instruments and concentration risk. It is good practice, the regulators like it, and it helps you sleep. Let the machines take care of the stress. ■