NII and NPV Simulation:
Are the Two Methods for Measuring IRR Consistent?

By E. Mays, Senior Financial Economist
(202)906-5729

The two most common targets of interest rate risk management at depository institutions are net interest income (NII) and net portfolio value (the economic value of equity). Typically, regulators concentrate on the potential volatility of net portfolio value (NPV) as a measure of the institution's risk. Although managers of institutions have begun increasingly to subject their portfolios to NPV scenario analysis, most place primary focus on the stabilization of near-term NII. These two approaches are often viewed as completely different ways to measure interest rate risk and managers sometimes question the relevance of NPV analysis to risk management.

In this Risk Management Release, we discuss the link between NII and NPV, and show that analyzing the effect of interest rate changes on the market value of a portfolio is consistent with analyzing the effect of rate changes on the net interest cash flows generated by that portfolio.

The Link Between NII and NPV

NPV is equal to the estimated market value of an institution's portfolio of assets, less the market value of its liabilities. The market value of any financial instrument may be estimated by summing the discounted present value of its future cash flows. Thus, NPV is the net present value of all future cash inflows from assets, minus the net present value of all future cash outflows from liabilities.

Most savings institutions are exposed to rising interest rates (i.e., when interest rates increase, NPV and NII both fall). Although an increase in interest rates does not always result in an immediate decline in interest income, NPV is instantly impacted.

Rising market interest rates cause investors to increase the yields they demand on financial assets, and as a result, the prices at which assets may be sold immediately declines. For a given change in rates, the decline in price for any particular financial asset is greater the further in the future the asset's cash flows will be received (that is, the longer the duration of the asset).

Because most savings institutions' assets are longer-term than their liabilities, the result is that when rates rise, asset values decline more than those of liabilities, and NPV falls. Over time, the decline in the market value

Office of Thrift Supervision
Risk Management Division

Anthony G. Cornyn, CFA
Director, Risk Management

Donald Edwards
Radu Filimon, Ph.D.
Arthur Hogan, Ph.D.
Eberhard Irmler
Robert Kazdin
Elizabeth Mays, Ph.D.

Office of Thrift Supervision
1700 G Street, N.W.
Washington, D.C. 20552

of the portfolio will be reflected in NII. Because the liabilities are shorter term than the assets, they will reflect the higher market interest rates more quickly than the asset portfolio, and NII will be squeezed. The change in interest cash flows over the remaining life of the portfolio, discounted to the present using market interest rates, will be exactly equal to the decline in NPV.

Consider a bank with no equity and $100 in assets. Assume the assets consist of a $100 five-year fixed-rate loan, with a yield to maturity of 10 percent, that pays interest semiannually at a rate of 10 percent and principal at maturity. Assume further that the asset is funded with a one-year, 10 percent CD. The CD pays interest semiannually and principal at maturity. In the current rate environment, the asset and liability are both worth par, or $100, and NPV is equal to zero.

Now suppose market interest rates increase by 100 basis points, and the required yield on the two financial instruments increases to 11 percent. Under this scenario, the fixed-rate loan still pays interest at 10 percent. When its cash flows are discounted by 11 percent, the market value of the loan is $96.23, a loss of $3.77 from par.

The CD, on the other hand, continues to pay a rate of 10 percent for the first year. When it "rolls over," however, it must pay the market rate of 11 percent. Assuming the CD continues to fund the asset for its remaining term of four years, the stream of cash flows, when discounted at 11 percent, would have a value of $99.07, a loss of only $.93. Looking at the net effect of the rate shock on both sides of the balance sheet, we see that NPV after the rate shock would be equal to $-2.84 ($96.23-$99.07).

Table 1. Net Interest Income After 1 Percent Increase in Rates

Payment	Interest Income	Interest Expense	Net Interest Income
1	$ 5	$ 5.0	$ 0.0
2	5	5.0	0.0
3	5	5.5	-.5
4	5	5.5	-.5
5	5	5.5	-.5
6	5	5.5	-.5
7	5	5.5	-.5
8	5	5.5	-.5
9	5	5.5	-.5
10	5	5.5	-.5
Present Value			-2.84

Now, let's take a look at NII. Had market rates not increased, the institution's interest income would have been $0 since it was paying 10 percent on the loan and its funding cost was 10 percent. Table 1 shows the institution's NII after the 100 basis point rate increase. For the first two payments (one year), NII is not impacted. After the CD resets to the market rate of 11 percent at the end of the first year, the institution's NII is $-.5 in each subsequent semiannual period. The present value of the NII stream, discounted at the market rate of 11 percent is $2.84. Note this exactly equals the decline in NPV that resulted from the rate increase.[1]

As the example suggests, minimizing the exposure of NPV to interest rate shocks is consistent with reducing the volatility of future NII over the life of the portfolio. A strategy that minimizes the volatility of near-term NII, however, may or may not reduce the interest rate volatility of NPV. In the example, one-year NII is immunized from changes in rates since the institution's liability does not reprice for one year. If short-term NII is immunized but NPV is negatively impacted in a particular interest rate scenario, longer-term NII will clearly be negatively affected.

1 This result holds true for an institution with equity if the value of equity is included in the future cash flows, and is discounted at an appropriate rate.

Why Changes in NPV Are Not Always Reflected in NII

While changes in NPV are driven by expected future NII, they do not provide a perfect forecast of future NII. There are a number of reasons for this. First among them is the fact that an institution may significantly alter its portfolio composition. NPV analysis estimates the effect of rate changes on the current portfolio at a point in time. Subsequent modifications in the composition of the portfolio will cause the relationship between changes in NPV and future changes in NII to be altered.

For example, suppose NPV analysis indicates that an institution's portfolio will decline in value by $1 million if interest rates increase 100 basis points then remain constant. If the institution did not make any future changes to the portfolio, then over the remaining life of the portfolio, it could expect to experience declines in income equal to $1 million on a present value basis.

If, however, the institution makes any significant changes in the types of assets or liabilities it holds, the institution's net income stream could differ significantly from that projected based on the NPV analysis. One typical example is the institution that, when faced with a rate increase, attempts to bolster near-term income by obtaining shorter-term deposits or borrowings which typically are lower cost than longer-term funds. Through this strategy, institutions can increase income in the short term, but at the cost of increasing risk to future rate increases.

A second assumption on which exact consistency between changes in NPV and changes in future NII depends, is that after the interest rate shock, rates remain constant. If, after rates increase, they subsequently fall, the full decline in NII projected by the NPV analysis for the original rate increase will not be borne out. Institutions sometimes minimize the importance of analyzing the risk to long-term income and NPV by counting on future rate changes to be favorable ones.

If rates remain stable or fall, institutions can "ride out" the rate shock with little or no effect on NII; if rates rise further, the damage to NII will be worse. A lesson of the thrift crisis is that trusting interest rates to return to more favorable levels within a reasonable time interval may be wishful thinking.

Even though any change in NPV that results from an interest rate shock may not be fully reflected in NII for the reasons discussed above, NPV analysis does tell us the direction an institution's long-term NII is heading unless other factors intervene. Because none of us can predict the future course of interest rates, it is important for managers to consider the effect of rate changes on NPV when making portfolio decisions.

* * *

Bank Regulators Adopt NPV Emphasis in Capital Regulation

The bank regulatory agencies (FDIC, OCC, and Federal Reserve Board) have amended their capital standards to specify that they will "include, in their evaluations of a bank's capital adequacy, an assessment of the exposure to declines in the economic value of a bank's capital due to changes in interest rates."

They have also published a proposal to adopt a supervisory model to measure IRR based on the decline in the economic value of a bank. The banking agencies' focus on economic value (as opposed to NII) is comparable to the OTS' NPV approach. After they gain experience with the proposed model, they intend to adopt a rule that would establish a capital charge for interest rate risk based on the level of a bank's measured interest rate exposure.