

Measuring Interest-Rate Risk from an Earnings and an Economic Value Perspective

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One of the central issues in asset/liability management at banks and S&Ls is managing interest-rate risk associated with long-lived, nontradable assets and liabilities accounted for on an accrual basis. The two methods for measuring interest-rate risk for these types of assets and liabilities are to measure the sensitivity of *earnings* to changes in rates and to measure the sensitivity of *economic value* to changes in rates. For banks reporting income on an accrual or historical-cost basis, these two methods are not similar:¹ They are based on different concepts, use different inputs, employ different formulas, and yield different results, suggesting different interest-rate-risk strategies.

In the past two years, international and domestic bank regulators have adopted regulations requiring banks to consider interest-rate risk using both methods for measuring interest-rate risk. For example, the Joint Agency Policy Statement on Interest Rate Risk,² states, “The agencies believe that a well-managed bank will consider both earnings and economic perspectives when assessing the full scope of its interest-rate risk exposure.”

These statements are consistent with the Basle Committee on Banking Supervision,³ which states, “Banks should have interest-rate risk measurement systems that assess the effects of rate changes on both earnings and economic value.”

This language was adopted nearly ver-

batim in the recently adopted regulation TB-13A, issued by the Office of Thrift Supervision in December 1998, which states, “Ideally, institutions should have interest-rate risk measurement systems that assess the effects of interest rate changes on both earnings and economic value.”⁴

These regulations raise numerous issues, including the following:

- What does it mean to measure risk from both earnings and economic value perspectives?
- Are risk measures from these two perspectives consistent with one another?
- Will reducing risk from one perspective guarantee that risk will be reduced from the other perspective?
- Do methods exist to analyze both simultaneously?

DIFFERING RISK DEFINITIONS UNDERLIE DIFFERENT RISK CALCULATIONS

As noted above, the calculations of risk from an economic value perspective and an earnings perspective are fundamentally different. Exhibit 1 shows that economic value equals the discounted cash flows associated with a product over the *life of the product*. Consequently, economic value risk is the dispersion of possible economic value outcomes around the mean economic value.

EXHIBIT 1

Calculating Earnings versus Economic Value: An Example

Consider a \$1,000 five-year bank loan that reprices every month with a rate equal to one-month Libor plus 100 basis points (bp). Interest is recalculated and paid monthly. Principal is repaid at the end of five years. For simplicity, we ignore any additional fee revenues or operating costs (including credit) and assume the institution's marginal cost of funds is Libor based.

To calculate the annual earnings on this asset, we must make a funding assumption. Most asset/liability managers would assume this asset is funded with one-month Libor. This would certainly stabilize earnings; that's why most managers assume it. As shown later, this is a critical assumption. The funding that will stabilize economic value risk is quite different.

By construction, this asset has no significant earnings exposure. When rates rise, funding costs rise with revenues and earnings remain at 100 bp times the outstanding balance (\$1,000) times 1 minus the tax rate (in this case 40%), or \$6.

What about the economic value of the asset? For an asset (or liability) in a mark-to-market world, economic value is its price. For assets carried at historical cost and not traded, the term economic value is subject to some interpretation. Nevertheless, the conventional method—and one acceptable to the regulators—is that economic value is the discounted value of an asset's cash flows, discounted at costs of funds derived from the implied forward rates. For banks, this means using forward Libor rates for discounting. Some S&Ls may have slightly higher borrowing rates.

For simplicity, assume implied forward rates are constant at 5.25%. The present value of the cash flows are about \$1,044. Had market rates been 6.25%, the value would have been about \$1,043.

Is there economic value risk? Yes. As we change the yield curve, the product rate and discount rates will change. This illustrates the point: Economic value sensitivity arises even when there is no earnings sensitivity.

In contrast, earnings are net-interest revenues plus direct fees less direct expenses in *specific time periods* multiplied by one minus the tax rate.⁵ Consequently, earnings risk is the dispersion of possible earnings outcomes around the mean earnings in specific time periods.

These definitions are quite different. Exhibit 2 summarizes the key differences. These are vastly different calculations requiring different inputs and generating different outputs.

For example, consider the last two lines of Exhibit 2: the scale of the result and the numerical structure of the output. The annual earnings number generated in our simple example was \$6 (Exhibit 1). Earnings risk would be measured relative to the mean earnings in each year or period used to measure risk. This gives rise to a two-dimensional matrix of risk numbers, defined in one dimension by the number of scenarios and in the second dimension by the number of time periods analyzed.

On the other hand, the economic value of the asset was a little more than \$1,044. Risk in this case is measured relative to this much larger number; only a column of numbers is presented.

The implications of this should be apparent. Since the risk measures aren't similar and their structure is different, why should the financial transactions that reduce risk be similar? The answer: They often aren't.

TWO MEASURES LEAD TO CONTRADICTORY RISK-REDUCTION STRATEGIES

For most long-lived assets of banks, few hedges exist that could eliminate the associated interest-rate risk. Even if such hedges do exist, chances are they eliminate either the risk evaluated from an earnings perspective or the risk evaluated from an economic value perspective—but not both. The hypothetical example described in Exhibit 1 can illustrate this conundrum.

Risk from an earnings perspective can be eliminated by funding the outstanding balances with one-month Libor. Since the asset reprices off of Libor and this is assumed to be the marginal cost of funds, from an earnings perspective the institution is indifferent to rates rising or falling. No matter what happens to rates, it always earns 100 basis points times the outstanding prin-

EXHIBIT 2

Comparison of Risk Perspectives: Economic Value versus Earnings

Issue	Risk Perspective	
	Earnings	Economic Value
Funding assumption	Required	Not applicable
Tax rate	Necessary for after-tax earnings	Value always stated on pretax basis.
Modeling horizon	Determined by policy of desired earnings risk horizon	Lifetime of longest surviving product*
New business	Included but not required	Specifically excluded**
Scale of result	Relative to mean earnings	Relative to par balances
Numerical structure of output	Two-dimensional matrix defined by the number of scenarios and number of periods analyzed	Matrix defined by the number of scenarios analyzed

*For administered rate deposits, credit cards, and other products with indefinite maturities, a subjective modeling horizon is required.

**For administered rate products, new business assumptions can be incorporated in the economic value of the products.

capital on a pretax basis. Risk from an earnings perspective has been eliminated. The asset is represented as a one-month asset in a gap report.

Now consider how to hedge the asset if the institution's objective is to minimize risk from an economic value perspective. Risk can be eliminated by funding the asset with a strip of zeros equal to the spread pretax earnings in each month (months 1 through 60) plus a five-year zero for the principal repayment in year five. In this case, this strip of zeros converts to a much longer gap schedule extending out five years.⁶ Its duration is the weighted average of the zeros, where the weights are each cash flow's proportion of total cash flows.

Next, consider what happens to risk from an economic value perspective from purchasing one-month funding. It is essentially unchanged, because the one-month funding has little impact on value sensitivity.⁷

On the other hand, while the strip of zeros eliminates risk from a value perspective, it increases risk from an earnings perspective by adding the risk associated with the strip of zeros.

Some combination of zeros and one-month funding would not reduce risk from both perspectives. As one-month funding was reduced, earnings risk would increase and vice versa. By construction, any transaction that reduced risk from one perspective would have to increase risk from the other, thus, creating a trade-off between these two risk measures.

TRADING OFF EARNINGS RISK AND ECONOMIC VALUE RISK

Since risk measured from an economic value perspective is not the same as risk measured from an earnings perspective, all balances can be evaluated using both risk measures and plotted in a two-dimensional diagram, in which each axis represents one of the risk measures.

First, we must mathematically define the axes. In Exhibit 3, risk from an earnings perspective is represented on the x-axis and risk from an economic value perspective is represented on the y-axis.

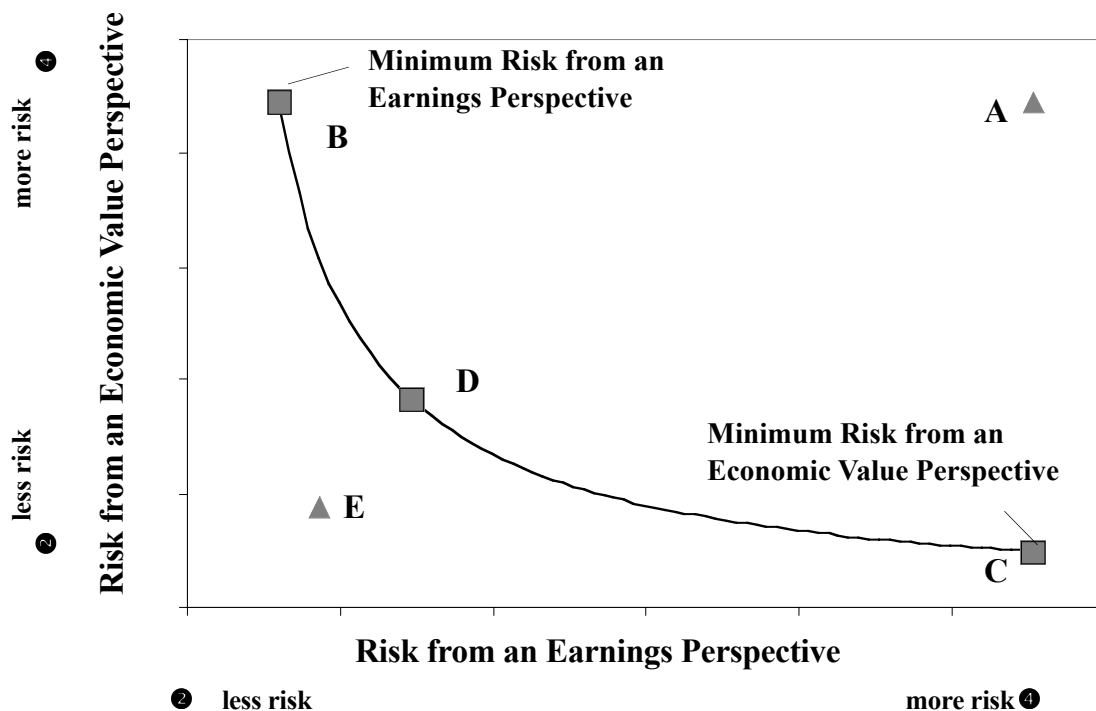
In this example, we define risk from an economic value perspective as the standard deviation of economic values. Defining risk from an earnings perspective is a little bit more difficult, because to represent it on a single axis requires aggregating risk measured in multiple time periods. Again, to simplify the discussion, we define risk measured from an earnings perspective as a weighted sum of each year's standard deviation of earnings.⁸

An unhedged product such as a loan can be represented in Exhibit 3 by the triangle at Point A.

Point B represents the risk after searching for a hedging transaction that *minimizes* risk only from an earnings perspective. In this illustrative diagram, risk is significantly reduced from an earnings perspective, having been moved from Point A to Point B. However, this hedge does not significantly affect risk from an economic value perspective.

EXHIBIT 3

Trade-off between Hedging Earnings Risk and Economic Value Risk



- Point A Risk of unhedged position.
- Point B Minimum feasible risk from an earnings perspective (that is, hedges selected solely to reduce earnings risk).
- Point C Minimum feasible risk from an economic value perspective (that is, hedges selected solely to reduce economic value risk).
- Point D Hedge that simultaneously reduces risk from both an economic value and earnings perspective.
- Point E An infeasible hedge. It is outside the feasible hedge solutions.

This graph depicts a trade-off between hedging from an economic value perspective and an earnings perspective. Most banks currently use a model to help find hedge solutions (or gap schedules) than are in proximity of Point B. Regulators are pushing banks to consider both perspectives. It is important to explicitly recognize that hedging from one perspective could increase risk from the alternative perspective.

Point C represents the risk after searching for a hedging transaction that *minimizes* risk from an economic value perspective. This hedge significantly reduces risk from an economic value perspective but does not reduce risk from an earnings perspective.

Point D represents the risk after searching for a hedging transaction that reduces risk from both perspectives. But, at Point D, risk measured from an earnings perspective is higher than at Point B, and risk measured from an economic value perspective is higher than Point C. Also, as indicated by the line in Exhibit 3, there are many alternative hedges from which to choose. The *optimal* hedge is one based on senior management preference to increase risk from one perspective in order to reduce

risk from the alternative perspective. According to a survey reported in *Bank Accounting & Finance*,⁹ risk managers at banks give greater preference to reducing risk from an earnings perspective. This would imply a point on the line closer to B.

Point E represents an outcome that doesn't exist. It is outside the feasible hedge solutions.¹⁰

The graph in Exhibit 3 illustrates the potential measurement issues confronting banks and S&Ls. If unaware of the trade-off between reducing risk from the two perspectives—economic value and earnings—these institutions may take actions that increase risk from the perspective they are not considering.

METHODS AND SYSTEMS TO ANALYZE RISK FROM BOTH PERSPECTIVES

As described in *Bank Accounting & Finance*,¹¹ most models that measure risk from an earnings perspective are oriented toward planning and budgeting forecast horizons and include new business assumptions. Consequently, their time horizon is limited, ranging from one to five years. Earnings (or net-interest margin) sensitivities are generated by comparing results across a limited number of shock, or “economist-designed,” alternative interest-rate scenarios.¹² In some earnings-based models, existing positions can be analyzed over long-term horizons using shock scenarios.¹³ As discussed below, these scenarios cannot be used to generate value sensitivity with any degree of accuracy, because they cannot reliably value the impact of embedded options.¹⁴

Measuring risk from an economic value perspective for products with path-dependent embedded options (for example, mortgages and deposits) requires stochastic generation technology (for example, Monte Carlo analysis, lattice models, etc.). Several vendors now incorporate this technology in their software;¹⁵ more of them use it to some extent, particularly for mortgages.

Risk measured from earnings and economic value perspectives can be analyzed simultaneously and hedges can be designed accordingly. However, this capability requires a good deal of customized software. To my knowledge, it does not exist in any commercially available products. As of this writing, to this author’s best knowledge, there is only one known implementation of a model that analyzes risk from both perspectives for an entire balance sheet.¹⁶

A CRITICAL BALANCE: EARNINGS AND ECONOMIC VALUE RISK

In the past two years, international and domestic bank regulators have adopted regulations requiring banks to measure interest-rate risk from both earnings and economic value perspectives. For banks reporting income on an accrual or historical-cost basis, these two methods are not similar: They are based on different concepts, use different inputs, employ different formulas, and yield different results, suggesting different interest-rate-risk strategies. Banks make trade-offs between hedging from both perspectives: efficient hedges imply that risk cannot be reduced from one perspective without increasing it from

the other. Institutions that are unaware of this trade-off between reducing risk from an economic value perspective and from an earnings perspective may take actions that unknowingly increase risk.

ENDNOTES

The views stated in this article are those of the author and do not necessarily reflect those of Deloitte and Touche, LLP. The author thanks Raymond Hawkins from Bear Stearns.

¹For income statements measured on a market-value basis, these two measures are equivalent.

²Comptroller of the Currency, *Interest Rate Risk: Comptroller’s Handbook* (June 1997): 8.

³Basle Committee on Banking Supervision, *Principles for the Management of Interest Rate Risk* (September 1997): 17.

⁴Appendix B, Section C in TB-13A.

⁵There are also deferrals to consider, particularly purchased servicing, past purchases of options, and mortgage origination fees.

⁶The accounting for this transaction is to create an asset that amortizes as the zeros run off. This would create some intermittent earnings flows, but they would be fixed and insensitive to changes in rates.

⁷This assumes one-month Libor funding always has a par value.

⁸Weights can be chosen to reflect senior management’s risk preferences between reducing risk from an earnings perspective and reducing risk from an economic value perspective.

⁹Thomas H. Payne, J. Howard Finch, and John G. Fulmer, “Banks’ Use of Derivatives to Manage Interest-Rate Risk: A Survey,” *Bank Accounting and Finance* (Winter 1998-99): 62.

¹⁰One can always get a Point E by selling part or all of the business.

¹¹Dennis E. Bennet, “Using Monte Carlo Analysis to Simulate Income and Market Value,” *Bank Accounting and Finance* (Winter 1996-97): 51.

¹²These types of models are often called earnings-at-risk or NIM models.

¹³Citigroup’s domestic retail banks use this technique and called it spot measure of earnings-at-risk (SMEAR).

¹⁴For example, an out-of-the-money cap will have zero value if valued using the current forward-rate curve, even though it will still have positive economic value.

¹⁵Examples include Risk Management Technology’s RADAR model, Bancware’s OEV generator, and QRM.

¹⁶Bank America’s Corporate Treasury incorporated an accounting earnings and economic value measure in its Monte Carlo model of its domestic balance sheet before its merger with NationsBank.