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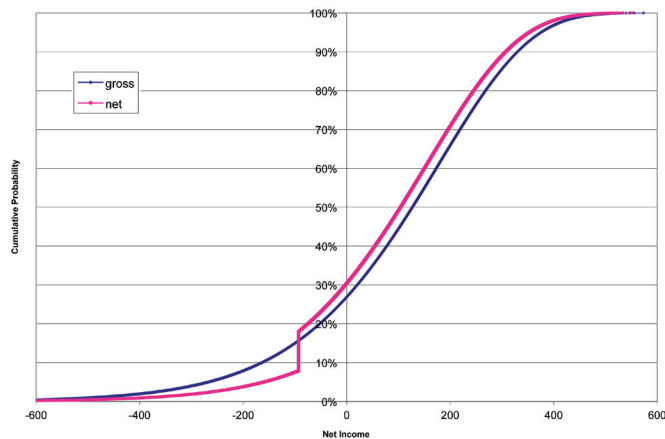
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# Trifurcation: Divide to Conquer Risk

By David Ingram and Daniel Bar Yaacov

**AFTER MUCH TIME SPENT** modeling insurer risks, everything starts to look like a logistic curve. But which logistic curve is better? How does one go about deciding whether one risk mitigation alternative is better than another?

**Chart 1**  
UW income net vs gross



Maybe the answers are all there in the logistic curves. But which of the scenarios really matter? Most reasonable risk mitigation strategies provide benefit in some circumstances, but come at a cost that adversely affects results in other scenarios. Cost/benefit analyses may suggest a range of efficient alternatives ... some less expensive, but offering less protection; others that provide more significant protection, but at a greater cost. If such alternatives lie along the same

“efficient frontier,” how can you choose among them?

A research paper by the authors considers the view of multiple stakeholders to answer this question. **Trifurcation** is the name we’ve chosen for the resulting process, which extracts three important numbers that can easily be used to support bottom-line decision making.

## DIFFERENT STAKEHOLDERS HAVE DIFFERENT PERSPECTIVES

In the context of strategic decisions, it’s important to identify the various stakeholders—and then separate the benefits and costs of alternative strategies in relation to each stakeholder. Consider reinsurance as a risk mitigation strategy: various reinsurance structures may have costs and benefits that would be perceived differently by stockholders, bondholders, policyholders, management and regulators. This isn’t a new insight—what’s new is our method of quantifying these perspectives.

The main idea is to group outcomes based on how they affect each stakeholder. We use the term **tranches** to describe these different layers of possible outcomes. In the general case, we would identify the values of particular output variables that represent crucial thresholds for each stakeholder, and then derive multiple tranches to reflect the various stakeholders’ viewpoints.

To illustrate, let’s consider a simple case—with a single primary stakeholder whose “critical threshold” value for some specific output variable has been identified. This critical value might represent a life-or-death boundary for the viability of the enterprise. (For example, insurance company management might determine that if the firm’s surplus decreases by more than X percent, they will not be able to continue writing new business.)

## THIS LEADS TO A TRIFURCATION OF SCENARIOS

In this simplified case, our analysis yields a division into three tranches: a **trifurcation** of scenario sets for each possible strategy. For each risk mitigation alternative, these tranches can be found by comparing scenarios between the alternate and the current “base strategy”:

- The **Earnings** tranche identifies scenarios where the outcomes before mitigation do not breach the critical threshold. (In the insurer example given above, this tranche corresponds to scenarios where the company’s current strategy results in either a net gain or a loss smaller than the critical X percent of surplus.)
- The **Impact** tranche for each strategy consists of scenarios where this particular risk mitigation strategy provides the desired benefit: outcomes breach

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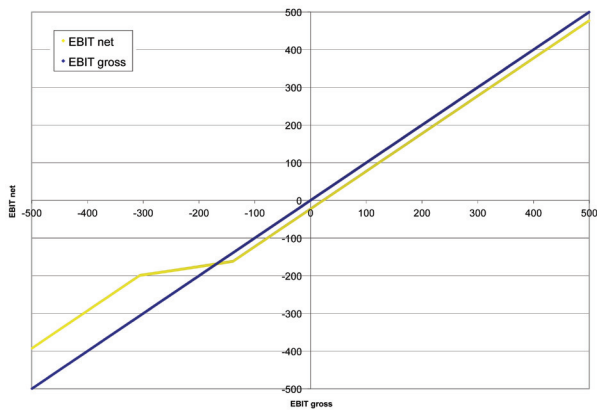
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the critical threshold before—but not after—mitigation. (For our hypothetical insurer, this means scenarios where the “base strategy” loss exceeds the critical threshold, but the alternative mitigation strategy reduces loss below the threshold.)

- The **Estate** tranche corresponds to scenarios where the mitigation strategy doesn’t provide the needed benefit. In these scenarios, the mitigation strategy (e.g., reinsurance) may still provide a benefit—but not enough to satisfy the stakeholder’s needs.

It may help to view the tranches graphically. One way to do this is to plot the base strategy against the alternative on a scatterplot (in the graphs below, the alternative strategy is an aggregate stop-loss reinsurance cover, while the base case corresponds to no reinsurance):

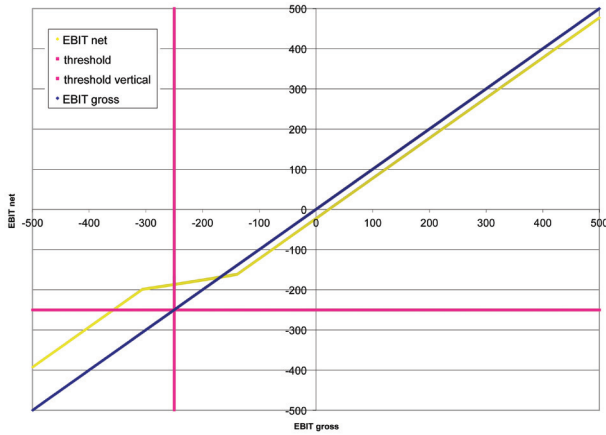
**Chart 2**  
EBIT gross vs net



The dark line shows the “Without Reinsurance” values, which by definition are on the diagonal of this graph because the results without reinsurance do not change. The light line shows the values for the “With Reinsurance” situation, where the results are different with and without reinsurance.

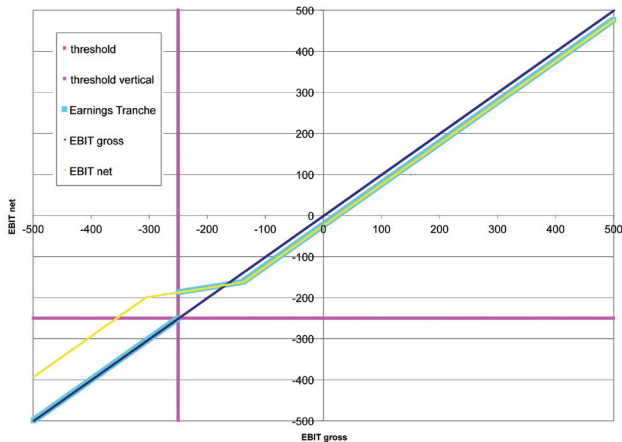
We can then add the critical threshold on each axis:

**Chart 3**  
EBIT gross vs net



Now each tranche can also be plotted. For example, in the plot below the Earnings tranche appears in light blue:

**Chart 4**  
EBIT gross vs net- Earnings Tranche

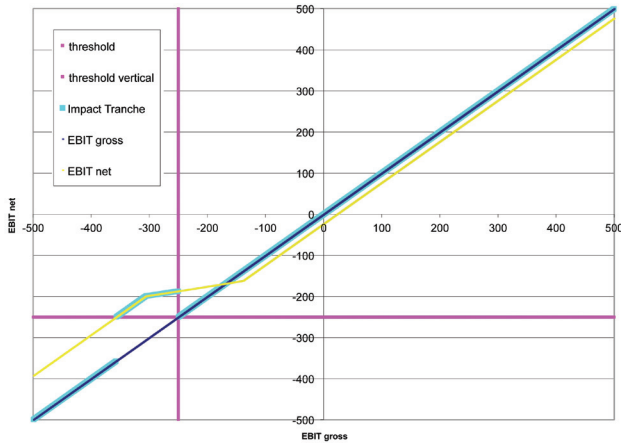


The Earnings tranche is equal to the scenarios from the “With Reinsurance” example that fall above the threshold. While the Chart 5 on page 8 shows the Impact tranche:

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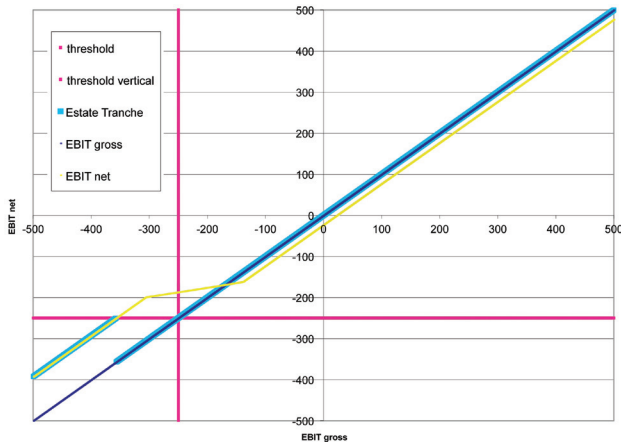
**Chart 5**  
EBIT gross vs net- Impact Tranche



The Impact tranche is equal to the scenarios from the “With Reinsurance” example where the “Without Reinsurance” values are below the threshold, but the “With Reinsurance” values are above the threshold.

And finally the Estate tranche:

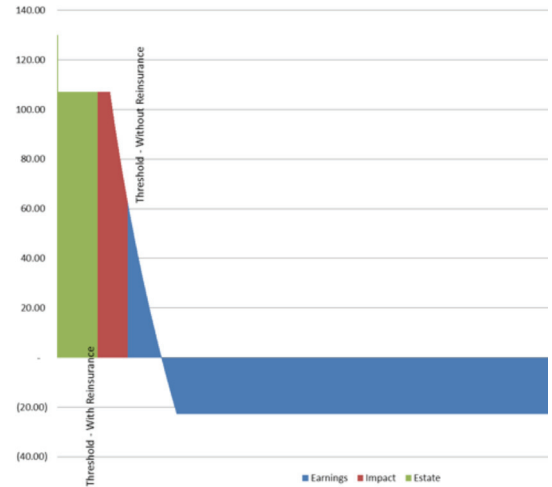
**Chart 6**  
EBIT gross vs net- Estate Tranche



The Estate tranche is equal to the scenarios from the “With Reinsurance” example where the values are below the threshold both “With” and “Without” reinsurance.

Having obtained the trifurcation tranches, we can compare the change in the expected value of scenarios in each tranche separately, as compared to the expected value of the corresponding “base strategy” tranches for each scenario in each tranche.

**Chart 7**  
Trifurcation of Differences



This gives us the ability to look at how the benefits, usually decreases in net losses, compare between the Impact tranche and the Estate tranche.

The graphs on page 9 compare alternative reinsurance structures in terms of “efficiency”—the relative portion of the benefit going to the Impact tranche. A fully or 100 percent effective risk mitigation would be one that has benefits that fall solely within the Impact tranche.

Example 1: Stop loss with 10% Limit ... Proportion of benefit in Impact tranche is maximized when the reinsurance attaches at 88% loss ratio (Chart 8).

Example 2: Stop loss with 20% limit is more expensive, but provides more protection. Because of the higher cost, the highest proportion of benefit to the Impact tranche is seen with an attachment point more likely to provide benefit: in this case, at an 83% loss ratio. (Chart 9).

From the primary stakeholder's point of view, the desirable strategies provide most benefit to the Impact tranche, while strategies that primarily benefit the Estate tranche could be considered inefficient. In the example above, the insurer's top management may be most focused on the Impact tranche; but profit center managers and rating agencies that value stability of results may also see benefit in reinsurance to protect the Earnings tranche. Regulators and policyholders may well desire significant protection for the Estate tranche.

### THREE TRANCHES ARE JUST THE BEGINNING...

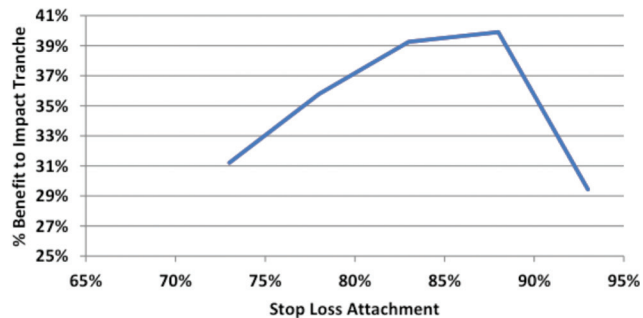
The Trifurcation approach can be used in many settings, including

- Selecting among reinsurance strategies
- Assessing mitigation alternatives
- Setting risk tolerance levels
- Designing internal reinsurance structures.

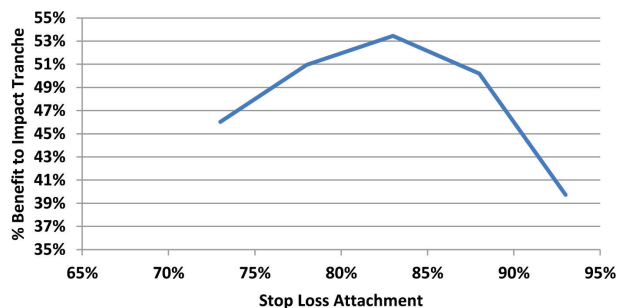
Franchise value calculations can be directly tied to the Trifurcation approach to see how different strategies play out in terms of their effect in different tranches. But in some contexts—for example, risk mitigation decisions made by a single division rather by the firm as a whole—franchise value may be a less meaningful metric, whereas the Trifurcation approach still holds.

And of course Trifurcation is just the beginning. In a more complex ERM setting, we can help you consider the crucial thresholds for more than one stakeholder, and then derive multiple tranches to reflect the various stakeholders' viewpoints.

**Chart 8**  
Efficiency of Alternatives



**Chart 9**  
Efficiency of Alternatives



### FURTHER READING

**Trifurcation: An Approach to Analyzing the Impact of Risk Treatment Alternatives.** Daniel Bar Yaacov and David Ingram, 2012. Available at <http://www.erm-symposium.org/2012/research-papers.php> and awarded “Best Paper: Practical Risk Management Applications” at the 2012 ERM Symposium sponsored by the Joint Risk Management Section of the Casualty Actuarial Society, the Society of Actuaries and the Canadian Institute of Actuaries.

**Managing the Invisible: Measuring Risk, Managing Capital, Maximizing Value.** William Panning, 2006; available at [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=913682](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=913682)

**Sustainability of Earnings: A Framework for Quantitative Modeling of Strategy, Risk, and Value.** Neil Bodoff, 2011; available at <http://www.actuarial-foundation.org/programs/actuarial/erm.shtml> ■