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A comprehensive Theory of the Value of Risk Transfer

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Article abstract

Dans quelle mesure une affaire doit-elle être partagée entre assureur et réassureur ? Voilà la question que pose ici notre collaborateur, M. J.B.M. Murray, qui fait partie du groupe Sodarcan. Nous lui laissons la parole tout en notant ceci dans son texte : la décision dépend de l'importance possible du sinistre, de la fréquence anticipée et de la puissance financière de la société d'assurance intéressée.

Risk adjusted cost

A comprehensive Theory of the Value of Risk Transfer

by

J.B.M. MURRAY[1]

Dans quelle mesure une affaire doit-elle être partagée entre assureur et réassureur? Voilà la question que pose ici notre collaborateur, M. J.B.M. Murray, qui fait partie du groupe Sodarcan. Nous lui laissons la parole tout en notant ceci dans son texte: la décision dépend de l'importance possible du sinistre, de la fréquence anticipée et de la puissance financière de la société d'assurance intéressée.

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In recent years much attention has been directed by risk managers and other management executives to the extent to which the company should self-insure, or retain for its own account, all, or a portion of, an insurable risk. In one extreme if there were no uncertainty as to the amount of losses, that is, if the losses were fully predictable, then management might decide to self-insure, and in the other extreme a large variation in the amount of expected losses would doubtless call for a full insurance program. And in other cases partial retention may be indicated.

A decision as to which of these courses of action should be followed depends upon the incidence of loss, that is, the frequency of loss and the severity of loss, as well as the financial structure of the company.

This article describes a scientific method of evaluating risk retention by utilizing sufficiently precise quantitative formulas to enable reasonably accurate analyses to be made regarding optimum retentions. The method can also be applied to insurance

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companies to assist them in devising optimum retentions for their reinsurance programs.

Risk Adjusted Cost may be defined as the amount in dollars which a business, or an individual, would be willing to pay in order to remove the risk exposure, that is, to transfer it to an insurer. (For ease of calculation Risk Adjusted Cost will usually be expressed in millions or hundreds of thousands of dollars).

The amount of the Risk Adjusted Cost will always be more than the expected amount of losses arising from a set of exposures and less than the maximum possible loss. Its value will therefore depend upon the distribution of losses by size experienced by the risk in the past, and also upon the Risk Aversion Level.

The Risk Aversion Level of a company may be expressed as its degree of financial conservatism, its wish to avoid severe uninsured losses, its aversion to bearing risk on its own shoulders. The Risk Aversion Level therefore depends upon the financial structure of the company. A low Risk Aversion Level (denoted by r) indicates that a company may decide not to insure certain risks, and a high value of r indicates that insurance down to the first dollar of loss will likely by purchased.

It will be seen therefore that r is inversely proportionate to a company's self-insurance capacity or retention. Denoting retention by a capital R we therefore have the approximate relationship

$$R = \frac{1}{r}$$

Thus if the retention is \$150,000 then r will be $\frac{1}{150000} = .0000067$. For ease of working examples we would make $R = 1.5$ (hundred thousands) and $r = 1/1.5 = .667$.

In this connection we use the word retention to mean the amount of unexpected loss which a company can absorb in one year, in other words it is the aggregate retention over all exposures in one year. The expected loss is usually fairly accurately determinate, and as such can be budgeted.

While there is no method of determining retention with absolute accuracy – because it depends upon many factors, some of them purely subjective – there are some general rules which have evolved over the years based upon financial assets, working capital, and the ability to raise capital in the future. The following guidelines were suggested in an article by McIntyre and Kakacek Entitled «Loss Assumption: Pay me Now or Pay me Later» published in *Financial Executive,* April 1977:

1.	Working Capital	1% to 5%
2.	Total Assets	1% to 3%
3.	Earnings/Surplus	1% to 3% of current retained earning plus 1% of average pretax earnings over preceding 5 years.
4.	Earnings per Share	A reduction of 3% to 5% per share
5.	Sales	0.1% to 0.5% of annual sales.

From a consideration of these values management can decide which is most appropriate for the company for the oncoming year. Probably it is advisable to consider a range of values, and it is probably also advisable to review the figures annually when the accounts for the previous financial year are available.

Once the aggregate retention is determined the total must then be allocated to the different exposures. In the past this has often been a difficult procedure, but in recent times a method has been developed which for each exposure indicates an optimum course of action – either retention, partial retention or transfer to an insurer.

Example:

	XYZ Manufacturing Co. Ltd.
Assets	$14,911,992
Retained Earnings	$ 3,600,062
Pre-tax Earnings	$ 2,114,482
Earnings per Share	$ 2.10 on 460,000 shares
Working Capital	$ 2,693,946
Estimated Sales	$64,500,000

The application of the above guidelines to this company produces:

Assets 2% = $298,240 = (2.9824 X $100,000)
r = 1/2.9824 = .335

Retained Earnings 2% + Pretax Earnings 1% = $93,146
r=1/.93146 = 1.074

Working Capital 3% = $80,818
r = 1/.80818 = 1.237

Earnings per Share 5% = $48,300
r = 1/.483 = 2.07

Sales 0.3% = $193,500
r =1/1.935 = .517

Thus Risk Aversion Levels of .335 to 2.07 (hundred thousandths) are indicated. After due consideration to this range of values for r it may be decided to examine the Risk Adjusted Cost corresponding to Risk Aversion Levels .5, 1.0, 1.5, 2.0 and 2.5.

Assuming the following probability distribution of losses by size:

RANGE OF LOSS (HUNDRED THOUSANDS) LOW HIGH	PROBABILITY P
.5 to 1.0	.0105
1.0 to 2.0	.1833
2.0 to 3.0	.4441
3.0 to 4.0	.2846
4.0 to 5.0	.0740
5.0 to 6.0	.0035

the Risk Adjusted Cost is calculated as follows for Risk Aversion Level 2.0 (hundred thousandths):

RANGE OF LOSS (hundred thousands) LOW TO HIGH	PROBABILITY p	CONTRIBUTION TO EXPECTED LOSS $p\left\{\frac{/\text{HIGH} + /\text{LOW}}{2}\right.$	CONTRIBUTION TO RISK ADJUSTED COST $p\left\{\frac{e^{r/\text{HIGH}} - e^{r/\text{LOW}}}{r(/\text{HIGH} - /\text{LOW})}\right.$
.5 to 1.0	.0105	.007875	.049043
1.0 to 2.0	.1833	.274950	4.326713
2.0 to 3.0	.4441	1.110250	77.457844
3.0 to 4.0	.2846	.996100	366.782404
4.0 to 5.0	.0740	.333000	704.683789
5.0 to 6.0	.0035	.019250	246.274570
TOTAL:	1.0000	2.741425	1399.574363

[e is the base for natural logarithms = 2.718282 approximately.]

The Risk Adjusted Cost is then:

$$\frac{1}{r}\log 1399.574363 = 3.621962 \text{ hundred thousands}$$
$$= \$362,196.20$$

and the Expected loss = 2.741425 hundred thousands
= $274,142.50

This is a relatively simple case where the loss size distribution represented aggregate loss per annum. In the more usual case it is better to analyse frequency and severity separately and then combine them into aggregate loss. In that event the calculations are necessarily more complicated but the procedure is virtually the same. (Note that in the above example we assumed there was no possibility of a loss exceeding $600,000. In practice such a contingency would be included where applicable).

Similar calculations would be carried out for the other Risk Aversion Levels then a Risk Profile Curve can be plotted. For the following curve we assumed the following values:

and a premium quotation of $75,000.

r	Risk Adjusted Cost
.0	.375
.5	.400
1.0	.480
2.0	1.050
3.0	3.275

The Risk Profile Curve crosses the premium line at r = 1.625. This analysis thus indicates that:

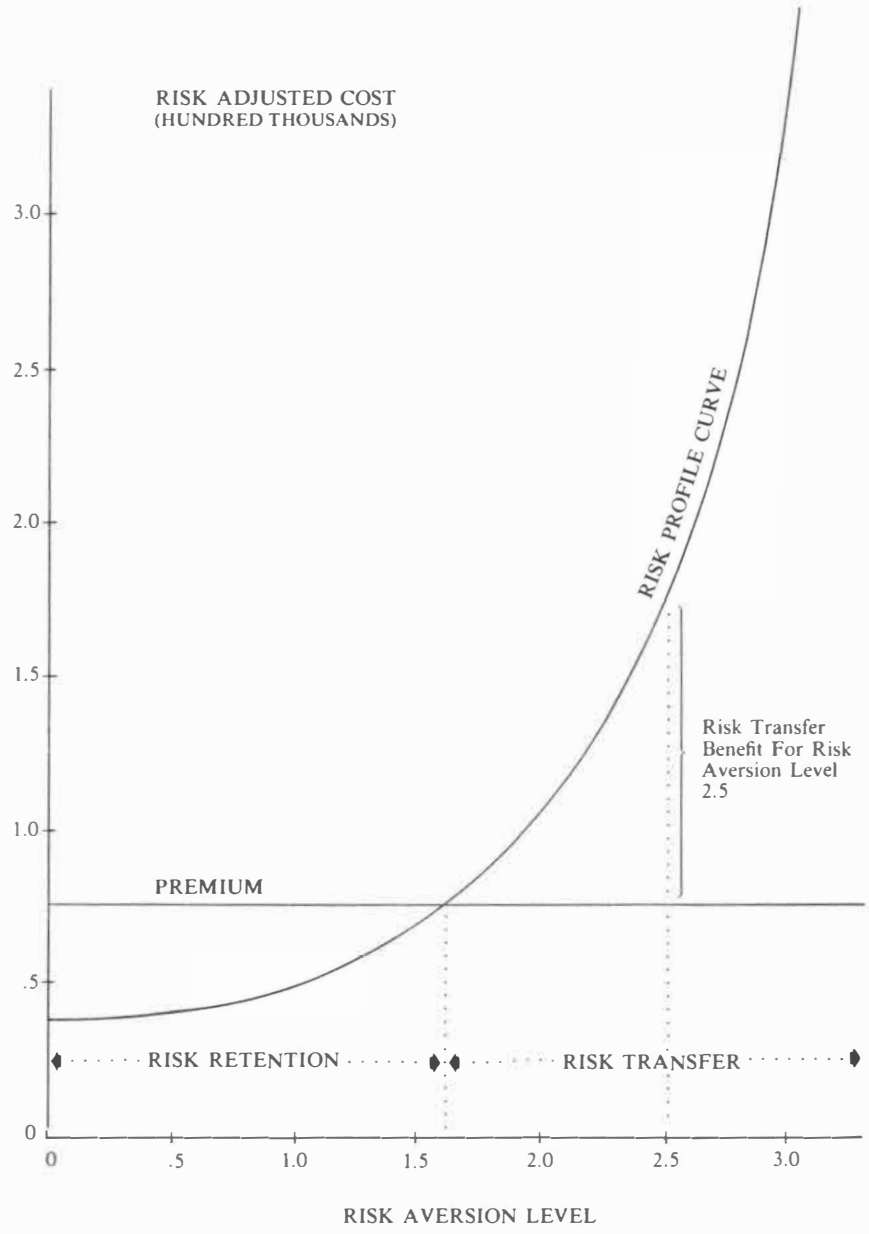
(1) if the Risk Aversion Level is less than 1.625 the risk should be retained.

(2) if the Risk Aversion Level is greater than 1.625 the risk should be insured, and

(3) if the Risk Aversion Level is 2.5 then the Risk Transfer Benefit is:

$$1.73 - .75 = .98 = \$98{,}000$$

The above example was based on full retention, but the method can be extended to deal with partial retentions, that is, different sizes of deductible. Alternative retentions are evaluated and the optimum retention can be selected. This is important because all companies have some partial retention ability, and for each type of exposure there is an optimum level of risk.


RISK ADJUSTED COST
(HUNDRED THOUSANDS)
3.0
2.5
2.0
1.5
1.0
.5
0
RISK PROFILE CURVE
Risk Transfer
Benefit For Risk
Aversion Level
2.5
PREMIUM
RISK RETENTION
RISK TRANSFER
0
.5
1.0
1.5
2.0
2.5
3.0
RISK AVERSION LEVEL