ASSESSMENT OF FRICTIONAL CAPITAL COSTS FOR INSURANCE AND REINSURANCE COMPANIES

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ABSTRACT

Despite being key elements of the profit/deficit valuation of an insurance transaction in most economic frameworks, Frictional Capital Costs (FCC) have constantly been used with uncertainties underlying their calculations. In fact, economic presentations are always facing issues on the choice of assumptions, in particular on the assumptions being made for FCC calculations. As some components of the FCC are not directly observable, insurance and reinsurance (hereinafter (re)insurance) companies have to make high-level assumptions and, hence, show unrealistic performance of their activities. In order to reduce the skepticism over the economic presentations of insurance performance, it is therefore important to develop a robust methodology for the calculation of FCC.

In a first section, I propose a model to estimate indirectly Frictional Capital Costs (FCC). In the following sections, this model is applied to the data presented on the Financial Statements of different (re)insurance companies.

As a conclusion of this article, FCC numbers resulting from the application of the proposed methodology and current market practice related to FCC amounts are consistent. Furthermore, difference between insurance and reinsurance companies in terms of Cost of Capital (CoC) and FCC is clarified: Reinsurance companies seem to have higher CoC and FCC. This is certainly due to the higher volatility of the results of such companies as compared to direct insurers. Due to this higher volatility, shareholders of reinsurance groups require higher CoC and FCC as compared to shareholders of insurance groups.

Keywords: Cost of capital; Frictional Capital Cost; Economic Capital; Discounted Distributable Earnings; Required Surplus; Transfer Pricing of Funds; Required Profit; Risk-Free rate

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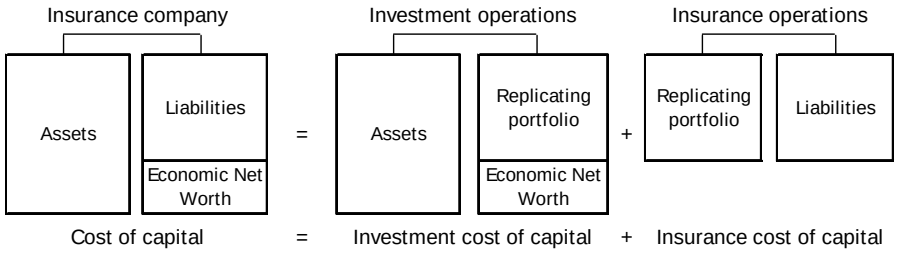
The views expressed in the paper are entirely my own and should not be taken as representing those of my firm.

4. INTRODUCTION

Despite being key elements of the profit/deficit valuation of an insurance transaction in most economic frameworks, Frictional Capital Costs (FCC) have constantly been used with uncertainties underlying their calculations. In fact, economic presentations are always facing issues on the choice of assumptions, in particular on the assumptions being made for FCC calculations. As some components of the FCC are not directly observable, (re)insurance companies have to make high-level assumptions and, hence, show unrealistic performance of their activities. As an example, Swiss Re, Sigma No 3/2005, proposes an economic framework including the Present Value (PV) of future premiums, the PV of investment income, the PV of probable claims, expenses and taxes and the PV of Cost of Capital. The sum of these PVs gives the economic profit/deficit of a new business insurance transaction. In such economic framework, profit/deficit depends therefore on the valuation of Cost of Capital and, hence, on the valuation of FCC. In order to reduce the skepticism over the economic profit/deficit of an insurance transaction, it is therefore important to develop a robust methodology for the calculation of FCC.

According to Hitchcox et al. (2006), the cost of capital can be split as follows:



In the above description, FCC that are discussed in this article correspond to Insurance cost of capital. Therefore, the split of Cost of Capital as described above is re-expressed as:

FCC = Cost of Capital - Investment cost of capital (Base cost of capital)

FCC can encompass many different elements of Cost of Capital, and, generally, include agency costs, regulatory capital costs and double taxation costs. Agency costs typically arise because of divergent management – shareholder objectives and information asymmetry: For example, managers of the firm might know more detail than the shareholders about the core risks which the firm is bearing (e.g. what exact assumptions they have made with regard to the future cost of catastrophe claims or court awards). Also, it is difficult for investors to judge the accuracy of loss reserve estimates, creating an information asymmetry which may raise the cost of capital. Regulatory capital costs correspond to the cost of regulatory restrictions on capital (e.g. fungibility of capital). Double taxation costs correspond to the compensation for corporate tax incurred on the base cost of capital. While it may be easy to estimate the double taxation costs, agency costs and regulatory capital costs are not observable values.

In most of the economic frameworks, FCC are calculated as a percentage of the Economic Capital. As regulatory capital costs and agency costs are not observable values in traditional Financial Statements, (re)insurers are left with high-level assumptions on the necessary percentage. In the industry, generally accepted assumptions on this percentage range from 2% to 5%.

The purpose of this article is to introduce a methodology to estimate the FCC on the basis of the Financial Statements which were published between 2003 and 2006 by Zurich Financial Services, Munich Re, Swiss Re, and Hannover Re. In the first section of the following chapter, a new model to estimate FCC is introduced. In the following sections, this model is applied to the data presented on the above Financial Statements. In the context of the recent development of IFRS accounting, Market Consistent Embedded Values (MCEV) and Economic Value Management (EVM), there are attempts by most of the major (re)insurers to go one step forward and to issue Financial Statements on a pure “economic” basis. These attempts are driven by (re)insurance company management willingness to increase the trust of their investors on (re)insurance stocks and, as a consequence, the value of the companies. The new methodology should help (re)insurance companies to more precisely calculate the assumptions underlying FCC, with which economic performance should be estimated with a further realistic view.

5. METHODOLOGY FOR ESTIMATING FCC

5.1 General approach

Definitions:

- DDE_t : Discounted Distributable Earnings (time t)
- DE_t : Distributable Earnings (time t)
- I_t : Yearly Net income (time t)
- RS_t : Required Surplus (time t)
- TPF_t : Transfer Pricing of Funds = Rate of return on invested assets (time t)
- RP_t : Required Profits (time t)
- MC_t : Market capitalisation of a (re)insurance group (time t)
- MVA_t : Market Value of Assets (time t)
- MVL_t : Market Value of Liabilities (time t)
- TVA_t : Tax Value of Assets (time t)
- TVL_t : Tax Value of Liabilities (time t)
- k : Cost of Capital according to the definition of Girard LN (2000), assumed constant over time
- FCC: Rate of FCC
- j_t : Risk free rate (time t)
- T: Tax rate (assumed constant over time)

The proposed methodology is based upon the Actuarial Appraisal Methods for estimating the value of blocks of in-force business (see Girard LN (2000)), in which the key analytical concept is represented by the formula for discounting free cash flow or Discounted Distributable Earnings at time t (DDE_t):

$$DDE_t = \sum_{l=t}^{\infty} \frac{DE_l}{(1+k)^l} \qquad (0)$$

According to Girard LN (2000), the DDE can be reformulated into 3 parts as below. It is important to underline here that the basis for distributable earnings is after-tax statutory income reduced by the increase in risk-based capital requirements, which has to be held by insurance companies for statutory reasons and cannot be distributed in the existing regulatory environments.

$DDE_t = RS_t + (1-T)\,(MVA_t - MVL_t) + T\,(TVA_t - TVL_t)$

The above equation, comprising TVA and TVL, includes an adjustment for the timing of tax payments when the tax basis for assets and liabilities is different from the statutory basis. If TVA and TVL are equal to statutory values of assets and liabilities, respectively, then TVA becomes equal to TVL, and no adjustment for timing is required (see Girard LN (2000)). As such a condition is fulfilled when an insurance company does not hold capital in excess of its Solvency Capital Requirement (SCR - See Filipovic D., et al (2006) for a discussion of optimal capital allocation in a (re)insurance group), I can set $TVA_t = TVL_t$ in the above equation. Therefore, DDE is now made of 2 parts.

$$DDE_t = RS_t + (1\text{-}T)\,(MVA_t\text{-}MVL_t) \quad (1)$$

In the interim, Girard LN (2000) explained that the Required Profit (RP) can be intuitively viewed as an outflow payment amount to shareholders:

$$RP_t = \left(\frac{k}{1-T} - j_t\right) RS_{t-1} + (k - TPF_t)(MVA_{t-1} - MVL_{t-1}) \quad (2)$$

On using equation (1) and (2) and after rearranging the terms, I have:

$$RP_t = \left(\frac{k - TPF_t}{1-T}\right) DDE_{t-1} + \left(\frac{TPF_t}{1-T} - j_t\right) RS_{t-1} \quad (3)$$

Meanwhile, by definition, the FCC correspond to the additional return that the shareholders require for investing in the (re)insurance group. This excess amount of return applies to both DDE and RS (in excess of TPF for DDE and in excess of the risk-free rate for the RS). Hence, the FCC can be obtained from the following equation:

$$\sum_{l=t}^{\infty} \frac{FCC \times \text{Available Capital}_l}{(1+k)^l} = \sum_{l=t}^{\infty} \frac{(k - TPF_l)DDE_l + (k - j_l)RS_l}{(1+k)^l}$$

In order to simplify this equation, I assume the following three points:

1. The available capital (i.e. shareholders' equity to which other elements of capital are added such as senior debt …) is supposed to follow the decrease in reserves in a run-off period. The decrease in reserve could be described as the ratios x_l;
2. In the same way as point 1, during the run-off period, both the RS and the DDE decrease with the reserve decrease ratios x_l. Assumptions for points 1 and 2 are standard in most of the solvency frameworks (see e.g. FOPI 2004 on Swiss Solvency Test); and
3. The available capital equals to the MC. This assumption can be approved by figures available in each (re)insurance company.

Hence, I have the following equation:

$$\sum_{l=t}^{\infty} \frac{FCC \times x_l \times \mathrm{MC_t}}{(1+k)^l} = \sum_{l=t}^{\infty} \frac{(k - TPF_l) \times x_l \times DDE_t + (k - j_l) \times x_l \times RS_t}{(1+k)^l}$$

After rearranging the terms, I have:

$$FCC = \frac{k(DDE_t + RS_t)}{MC_t} - \frac{1}{MC_t \sum_{l=t}^{\infty} \frac{x_l}{(1+k)^l}} \left(DDE_t \sum_{l=t}^{\infty} \frac{TPF_l \times x_l}{(1+k)^l} + RS_t \sum_{l=t}^{\infty} \frac{j_l \times x_l}{(1+k)^l} \right)$$ If I use the following definitions:

$$\bar{j} = \frac{\sum_{l=t}^{\infty} \frac{j_l \times x_l}{(1+k)^l}}{\sum_{l=t}^{\infty} \frac{x_l}{(1+k)^l}}$$: This amount represents the weighted average risk-free rate on the run-off period, and

$$\overline{TPF} = \frac{\sum_{l=t}^{\infty} \frac{TPF_l \times x_l}{(1+k)^l}}{\sum_{l=t}^{\infty} \frac{x_l}{(1+k)^l}}$$: This amount represents the weighted average TPF rate on the run-off period

I have the following final equations:

$$FCC = \left(k - \overline{TPF}\right) \frac{DDE_t}{MC_t} + \left(k - \bar{j}\right) \frac{RS_t}{MC_t} \quad (4)$$

According to this last equation, the FCC correspond to the additional return on both DDE and RS in excess of a weighted averaged TPF for DDE and in excess of a weighted averaged risk-free rate for the RS that the shareholders require for investing in the (re)insurance group over a run-off period.

5.2 Application of the methodology to (re)insurance group Financial Statements

Equations (3) and (4) in chapter 5.1 form the basis for the calculation of k, the CoC, in the first step and FCC in the second step.

For the calculations of CoC and FCC, I assume the followings in relation to the Financial Statements disclosed figures:

1. RP is equal to the dividend payments, for it can be intuitively viewed as an outflow payment to shareholders as stated in the previous chapter;

2. The value of Solvency Capital Requirement (SCR) can be used for that of the RS, as by nature the SCR is considered to be the minimum value for the RS. In case the SCR is not available, it can be approximated based upon the rating of the (re)insurance group and MC, as long as MC appropriately reflects the Available Capital of the (re)insurance company and the rating practically represents the level of capital surplus included in the existing market capitalization.

   In case of Swiss Re, which has been rated "AA" (Standard & Poor's), for example, the values of SCR in recent years had been provided as shown in the table 1. Based upon the relationships of MC and SCR in this table, the value of SCR is equal to MC multiplied by a factor comprised between $\frac{1}{2.65}$ and $\frac{1}{3.34}$. Since the rating of AA for Swiss Re represents its capital surplus which is incorporated in the valuation of its MC, the ratios of SCR to MC in AA rated groups should demonstrate similar values.

   In consequence, the value of SCR for a group rated AA can be estimated as below and hence that value can be used for RS:

   $$SCR = \frac{MC}{2.5} = RS$$

   Notes:

   The factor of 2.5 is selected for this paper as a prudent assumption. All the (re)insurance groups used as case studies in the next chapter are rated AA.

   Calculations of division factors for other ratings are explained in the appendix.

Table 1 Unit:m CHF

	MC	SCR	MC / SCR
2006	37'795	11'300	3.34
2005	29'369	9'900	2.97
2004	26'461	10'200	2.59
2003	27'251	10'300	2.65

Source: Swiss Re Annual Reports 2003, 2004, 2005 and 2006

3. Equation (0) requires the calculation of distributable free cash-flows to the shareholders in order to calculate DDE_t. Financial Statements do not provide such free cash-flows but net income. On the basis of net incomes,

we can reformulate equation (0) as all future net income minus the RS can be distributed and we have:

$$DDE_t = \sum_{l=t}^{\infty} \frac{I_l}{(1+k)^l} - RS_t \qquad (0a)$$

In this equation, it is assumed that there is no additional required surplus during the net income projection period. In the context of a stable business mix being maintained in (re)insurance companies, the risks included in the Balance Sheet should remain stable and so should the required surplus do. In this calculation example, this context is employed for simplicity.

Risk-free rate and reserve decrease patterns

Equations (3) and (4) in chapter 2.1 use references to risk - free rates and reserve decrease patterns through j_t and x_l factors. This section explains how these 2 factors are estimated.

For the purpose of this article, risk-free rates per currency and reserve decrease patterns are assumed to be equal elements for all (re)insurance groups taken as case studies and are described in this chapter.

The risk-free rates by currencies can be summarized as follows:

Table 2

	Currency				
	EUR	UK	USA	Canada$	CHF/ JPY
2006	3.90%	4.80%	4.80%	4.20%	2.71%
2005	3.30%	4.10%	4.40%	4.20%	2.22%
2004	3.70%	4.60%	4.20%	4.40%	2.47%
2003	3.70%	4.60%	4.20%	4.40%	2.34%

Sources: ZFS Annual report (CHF/JPY) and Swiss Re European Embedded Value disclosures (EUR, UK, USA and Canada$).

In order to estimate the value of j_t in equation (3) and (4) of chapter 5.1, a weighted average of the above risk-free rates is done for each (re)insurance groups based on either premium or reserves by currency as disclosed in Financial Statements.

The reserve decrease pattern can be chosen as follows:

	Life	Non-Life
1	94%	60.00%
2	87%	45.00%
3	82%	35.00%
4	78%	25.00%
5	73%	20.00%
6	68%	15.00%
7	64%	12.00%
8	60%	9.00%
9	56%	7.00%
10	52%	6.00%
11	49%	5.00%
12	45%	4.00%
13	42%	3.00%
14	38%	2.00%
15	35%	1.50%
16	33%	1.00%
17	30%	0.75%
18	28%	0.50%
19	25%	0.25%
20	23%	
21	21%	
22	19%	
23	17%	
24	15%	
25	14%	
26	12%	
27	11%	
28	10%	
29	9%	
30	7%	
31	6%	
32	6%	
33	5%	
34	4%	
35	3%	
36	3%	
37	2%	
38	1%	
39	1%	
40	0%	

Table 3 - Source: See appendix 9.4

These patterns are supposed to be the same for all the (re)insurance groups chosen as examples.

As it can be read on the above patterns, the liability duration for the life business is assumed to be 11 years while the liability duration for the non-life business is assumed to be 2 years.

Calculation of k

In order to estimate k, I use time-series of TPF_t, j_t, DDE_t and RS_t. On the basis of the Financial Statements from 2003 to 2006, I estimate each of these elements as follows:

TPF_t: TPF_t is taken as equal to the total return on invested assets as per its definition. This element is usually available on Financial Statements.

j_t: j_t is taken as the weighted average of the above risk-free rates on either premium or reserves by currency.

DDE_t: DDE_t is based on Net Income at Group level as disclosed on Financial Statements. The horizon of projection of future Distributable Earnings is estimated as the total liability duration multiplied by 2: This duration corresponds to the average delay for a liability to be paid and the factor "2" is chosen in the context of a run-off of the business, in which earnings are assumed to be distributed over a period equal to twice the liability duration. The total liability duration is estimated as the weighted average of the non-life average duration (2 years – see Table 3) and the life average duration (11 years – see Table 3). The weights are obtained from the life and non-life reserves as at Year-End. On the basis of this method, the full amount of discounted future Net Income is not distributable and the Required Surplus must be subtracted in order to account for solvency requirements (see point 3 of above section).

RS_t: See above section (assumption described in point 2).

On the basis of these assumptions and of the equation (3), it is possible to estimate a Required Profit $\overline{RP_t}$, which is a dependent variable of k. This required profit corresponds to what the shareholders would theoretically expect as dividends from the company. These theoretical dividends can be compared to the actual dividends paid to the shareholders. The CoC should correspond to the point where the variable $\overline{RP_t}$ is the closest to the actual paid dividends for a certain value of k. It is possible to find this value of k on using the method of the least squares as per the following function:

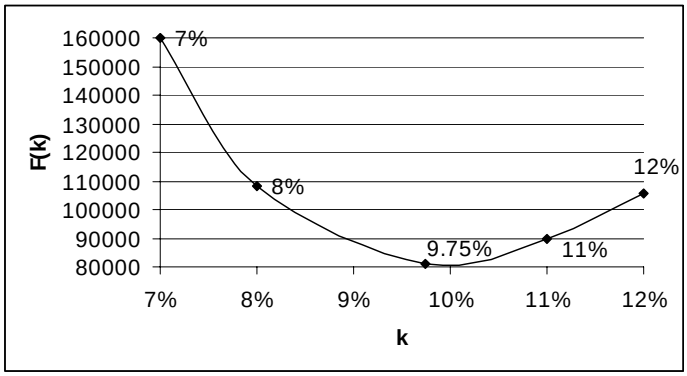
$$F(k) = \sum_{t=2004}^{2006} \left(\overline{RP_t} - Dividends_t \right)^2 \qquad (5)$$

As an example of this approach, the case study Munich Re (see chapter 6.1) provides the following information:

Year-End	Actual dividend	Estimated Required Profit $\overline{RP_t}$				
2006	988	801	780	**741**	660	597
2005	707	970	923	**849**	719	628
2004	457	425	444	**455**	444	423
	k	12%	11%	**9.75%**	8%	7%
	F(k)	105'390	89'751	81'071	108'191	160'150

(in mEUR)

The actual dividends paid in 2006, 2005 and 2004 are 988 mEUR, 707 mEUR and 457 mEUR. The application of the methodology shows that there is a minimum of the function F(k) for the value k = 9.75%.



This value of k corresponds to the CoC required by shareholders as the expected amount of required profits match more closely the actual paid dividends.

Calculation of FCC

Once k is found, FCC can be calculated with the equation (4) of chapter 5.1. It is important to underline that this methodology allows to find specific FCC for each Year-End from 2003 to 2006. In the next Chapter, I discuss the differences of FCC among different years and also explain some challenges this method faces.

6. CASE STUDIES

6.1 Munich Re

In this chapter, I apply the methodology to the specific case of Munich Re. The following elements of the methodology need to be determined on the basis of each published Financial Statement of Munich Re from 2003 to 2006 in order to estimate the CoC: RS, future Net Income seen at each Year-End and for all future development years up to the horizon of projection (for the purpose of DDE calculation) and RP. On the table below, k, DDE and $\overline{RP_t}$ are resulting from the application of the formulas described in the previous chapter (see notes to the table below).

			Net Income (3)								
Year-End	k (1)	RS (2)	N	N+1	N+2	N+3	...	N+ horizon of projection (4)	DDE (5)	RPreal (6)	$\overline{RP_t}$ (7)
2006	9.75%	11'960	3'472	2'669	2'669	2'669	2'669	2'669	3'221	988	741
2005	9.75%	10'520	2'696	2'669	2'669	2'669	2'669	2'669	3'885	707	849
2004	9.75%	8'320	1'839	2'669	2'669	2'669	2'669	2'669	5'229	457	456
2003	9.75%	8'840	-517	1'839	2'669	2'669	2'669	2'669	1'597	286	

(in mEUR)

Net Income available on Financial Statements

Net Income based on actuarial judgement

(1) The CoC is the value which minimizes equation (5), i.e. the difference between RP real (see note (6) below) and $\overline{RP_t}$ (see note (7) below) estimated on the basis of equation (3).

(2) RS is estimated using the equation: $RS = \frac{MC}{2.5}$. MC is available on the Financial Statements as shown below.

(3) Net Income (I_t) are available directly on Financial Statements until development year 2006 (N for 2006, N+1 for 2005, N+2 for 2004 and N+3 for 2003) and need to be estimated for further development years. Assumptions related to future Net Income are provided below.

(4) The horizon of projection needs to be estimated on the basis of the claims duration (see table 3 of the previous chapter). Assumptions related to the non-life vs life business mix of Munich Re are provided below.

(5) DDE can be estimated on using equation (0a).

(6) RP real is available directly on the Financial Statements.

(7) $\overline{RP_t}$ is calculated on the basis of equation (3).

Once these elements are determined, the CoC is estimated in the first step on minimizing equation (5). In the second step, the FCC for each year are calculated.

In order to estimate RP, MC, RS and I_t (as shown on the table above), the following extract of Munich Re Group Financial Statements (year-end 2006) provide the information below:

		2006	2005	2004	2003	2002
Earnings per share	€	15.12	11.74*	8.01	-2.25	1.64**
Dividend per share	€	4.50	3.10	2.00	1.25	1.25
Amount distributed	€m	988	707	457	286	223
Share price at 31 December	€	130.42	114.38	90.46	96.12	114.00
Munich Re's market capitalisation at 31 December	€bn	29.9	26.3	20.8	22.1	20.4

* Adjusted owing to first-time application of IAS 19 (rev. 2004)
** Taking into account the capital increase in November 2003.

On the basis of the above figures and as described in chapter 5, I can obtain the MC, the RS and the Net Income (I_t) for each year between 2006 and 2003:

	Required Profits (dividend distributed)	Market Capitalisation (1)	Required Surplus (=(1) / 2.5)	Earning per shares (2)	Number shares (3)	Net Income =(2) * (3)
2006	988	29'900	11'960	15.12	229'600'000	3'472
2005	707	26'300	10'520	11.74	229'600'000	2'696
2004	457	20'800	8'320	8.01	229'600'000	1'839
2003	286	22'100	8'840	-2.25	229'600'000	-517

(in mEUR)

For the future projection years, I define the I_t as the average of the I_t between 2006 and 2004 i. e: 2 669 mEUR.

In addition to the observable I_t on the above Financial Statements, the calculation of DDE seen as at 2003 to 2006 requires the estimation of I_t for future years. As an example, for the DDE calculation seen as at year end 2003, an actuary would have had access only to the I_t on the Financial Statement of 2003 (i.e. -517 mEUR) and assumptions in relation to I_t for projection years beyond 2003 would have had to be estimated. Therefore, for the purpose of DDE calculation seen as at year-end 2003 to 2006, the following assumptions on future I_t were made.

		Year-End			
		2006	2005	2004	2003
Net Income	N+4 and after	2'669	2'669	2'669	2'669
	N+3	2'669	2'669	2'669	2'669
	N+2	2'669	2'669	2'669	2'669
	N+1	2'669	2'669	2'669	1'839
	N	3'472	2'696	1'839	-517

(in mEUR)

Generally, the year 2006 is considered exceptional for reinsurers due to the absence of major Natural Catastrophes and results on this year can not be expected on a regular basis. That is why the above assumptions are made.

As an example, for the calculation of DDE seen as at Year-End 2006, it is assumed that Munich Re will have the following I_t :

- For the calendar year 2006 (N), the I_t equals 3 472 mEUR. This corresponds to the foreseeable I_t seen as of Year-End 2006 with the information available as at 2006.
- For the calendar year 2007 (N+1), the I_t equals 2 669 mEUR.
- For all subsequent calendar years (N+2 …), the I_t equals 2 669 mEUR.

Example of calculation of DDE on the basis of the above figures for k=9.75% and a horizon of projection of 7 years:

$$DDE_{2006} = 3472 + 2669\sum_{i=1}^{6}\frac{1}{(1+9.75\%)^{i}} - 11960 = 3221$$

The equation above is based on an assumed horizon of projection of 7 years. This horizon of projection needs to be determined on the basis of the business mix (life vs non-life) and of the standard liability durations (see table 3). For this purpose, the Financial Statements as at Year End 2006 provide the following elements:

Gross provisions by type

	Reinsurance		Primary insurance		Total	
All figures in €m*	31.12.2006	Prev. year	31.12.2006	Prev. year	31.12.2006	Prev. year
Life and health segment						
- Disability claims provision	2'309	3'071	793	751	3'102	3'822
- Provision for other benefit cases	2'061	2'300	1'451	1'242	3'512	3'542
Property-casualty segment (claims reserves)						
- Case reserve	19'618	20'833	3'747	3'463	23'365	24'286
- IBNR reserve	16'110	16'420	987	1'310	17'097	17'730
Total	40'098	42'624	6'978	6'766	47'076	49'380

* After elimination of intra-Group transactions across segments

On the basis of these elements, life and non-life reserves compare as follows:

	Non-life			Life		
	Case Reserves	IBNR	Total	Disability	Other	Total
2006	23'365	17'097	40'462	3'102	3'512	6'614
2005	24'286	17'730	42'016	3'822	3'542	7'364

(in mEUR)

On the basis of these reserves and of the average assumed non-life and life liability durations (2 years and 11 years – see chapter 5.2), I have a liability duration of 3.3 years for Munich Re at Year-End 2005 and 2006.

Therefore for year end 2003 to 2006, I estimate an **horizon of projection of 7 years** (2 multiplied by 3.3 as per the described methodology – see chapter 5.2).

Finally, in order to apply equation (3) and (4) and in addition to the above elements, the tax rate, TPF and risk-free rates need also to be determined:

- As Munich Re Group is a German Reinsurance company, the **tax rate is: T=40%**.
- The Financial Statements as at Year End 2006 to 2003 provide the following information on the average return on investments (TPF):

Return on investment	
2006	5.00%
2005	5.90%
2004	4.50%
2003	4.30%

- The Financial Statements provide also the Gross Premium split by country which allows the calculation of the overall risk-free rate applicable to Munich Re. The result is:

Weighted risk-free rate	
2006	4.21%
2005	3.66%
2004	3.93%
2003	3.94%

On the basis of the above elements, I can determine k, the CoC which minimizes equation (5):

- **Cost of Capital = 9.75%**
- Differences:

	Required Profits (dividend distributed)	$\overline{RP_t}$
2006	988	741
2005	707	849
2004	457	455

(in mEUR)

From these figures, I can see that:

- 2005 was a specific year: Due to Katrina and Wilma, the RP as calculated were higher than the one distributed.
- 2006 was also a specific year: The absence of major Natural Catastrophes allowed higher dividends.

The Discounted Distributable Earnings calculated on the basis of the above Cost of Capital are:

DDE_t	
2006	3'221
2005	3'885
2004	5'229
2003	1'597

(in mEUR)

Finally, the application of the methodology leads to the following FCC:

	FCC	$\overline{TPF}$	$\overline{j}$
2006	2.73%	5.00%	4.21%
2005	2.93%	5.15%	4.12%
2004	3.45%	5.03%	4.09%
2003	2.62%	4.92%	4.07%

In order to estimate $\overline{TPF}$ and $\overline{j}$, it is necessary to make an assumption on future TPF and Risk-Free rate. For the purpose of this article, I have assumed that the latest known TPF and j (as at Year-End 2006) will remain the same for all future years.

Example of calculation:

$$FCC_{2006} = (9.75\% - 5\%)\frac{3221}{29900} + (9.75\% - 4.21\%)\frac{11960}{29900} = 2.73\%$$

Generally, FCC are taken between 2% and 5% on the market. For Munich Re, a cautious assumption on **the FCC would be 3.45%**.

6.2 Other (re)insurance groups

For all other (re)insurance groups, please refer to Appendix for details of assumptions.

7. CONCLUSION

The following table summarizes the FCC and Cost of Capital (CoC) of the (re)insurance company taken as case studies:

		CoC	FCC
Insurer	ZFS (USD)	6.57%	1.95%
Reinsurer	Munich Re (EUR)	9.75%	3.45%
	Swiss Re (CHF)	12.46%	3.91%
	Hannover Re (EUR)	11.72%	4.51%

According to Swiss Re, Sigma No 3/2005, the Cost of Capital (CoC) for an insurance company should be around 7% (in 2002) and the FCC should be around 2%. This confirms the proposed approach in the case of ZFS Group where the Cost of Capital is estimated to be 6.57% and FCC to be 1.95%.

As a conclusion of this article, FCC numbers resulting from the application of the proposed methodology and current market practice related to FCC amounts are consistent. Furthermore, difference between insurance and reinsurance companies in terms of CoC and

FCC is clarified: Reinsurance companies seem to have higher CoC and FCC. This is certainly due to the higher volatility of the results of such companies as compared to direct insurers. Due to this higher volatility, shareholders of reinsurance groups require higher CoC and FCC as compared to shareholders of insurance groups.

8. DISCUSSION

As discussion points, I would like to summarize the limitations of the presented method:

- Additional required surplus is assumed not to be necessary: This limits the application of this methodology to (re)insurance groups which business has not changed significantly over the observation period.
- The available capital is assumed to be equal to the Market Capitalization. When applying this methodology to a (re)insurance company, I would advise to estimate the "real" available capital (e.g. in a solvency 2 framework).
- As for any Embedded/Appraisal Value calculations, assumptions of future Distributable Earnings are essential to estimate the DDE. In this article, rough estimates are proposed which should certainly be refined.

I would also like to stress the differences that still exist in the presentation of Financial Statements across (re)insurance groups. These differences did not facilitate the survey necessary for this article. Hopefully, the wider application of IFRS may reduce the differences in the presentation of Financial Statements in the future.

The proposed methodology is a first step towards the quantification of FCC for economic frameworks. This methodology could be used for justifying FCC ratios related to economic performance calculations of (re)insurance transactions.

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9. APPENDIX

In Appendix 6.1 to 6.3, results and calibrations for each case study are provided in the same format as given in chapter 3.1.

9.1 Case study: Swiss Re

Swiss Re Group is a Swiss Reinsurance company. Therefore, the **tax rate is: T=21.3%**.

On the basis of Swiss Re Financial Statements, I can define the following elements of the above presented methodology:

m CHF	Required Profits (dividend distributed)	Market Capitalisation (1)	Required Surplus (*)	Earning per shares (2) (**)	Number shares (3)	Net Income =(2) * (3)
2006	896	37'795	11'300	8.99	358'246'445	3'222
2005	497	29'369	9'900	4.68	310'454'545	1'453
2004	341	26'461	10'200	8.00	310'392'962	2'483
2003	310	27'251	10'300	5.48	310'375'854	1'701

(*) Required surplus are provided in the Annual Reports under the section “Risk and Capital Management”.

(**) Earnings per share at Year-End 2006 were exceptionnally high in the absence of major Natural Catastrophes. For the purpose of this article, the published Earnings per share of 13.49 was reduced by 50%.

In 2006, the number of shares of Swiss Re increased due to the acquisition of GE Insurance Solutions.

For the future projection years, I will use an average Earnings per share of 5 CHF. On multiplying 5 CHF by the number of shares, I have a Net Income after 2006 of 1791 mCHF.

For the purpose of the DDE calculation at year-end 2003 to 2006, the following assumptions on future Net Incomes were made.

mCHF	2006	2005	2004	2003
N+4 and after	1'791	1'791	1'791	1'791
N+3	1'791	1'791	1'791	3'222
N+2	1'791	1'791	3'222	1'453
N+1	1'791	3'222	1'453	2'483
N	3'222	1'453	2'483	1'701

For the horizon of projection, the Financial Statements as at Year-End 2006 provide the following elements:

	Reserves	
mCHF	Non-life	Life
2006	80'391	59'519
2005	59'014	43'746
2004	62'135	43'239
2003	63'474	37'244

On the basis of these elements and of the average assumed non-life and life liability durations (2 years and 11 years), I have a liability duration of 5.3 years for Swiss Re at Year-End 2003, 5.7 years for Year-End 2004 and 5.8 years for Year-End 2005 and 2006.

Therefore:

- for year end 2003 and 2004, I estimate an **horizon of projection of 11 years**.
- for year end 2005 and 2006, I estimate an **horizon of projection of 12 years.**

The Financial Statements as at Year End 2006 to 2003 provide the following information on the average return on investments (TPF):

Return on investment	
2006	5.30%
2005	5.70%
2004	5.80%
2003	5.10%

The Financial Statements provide also the Gross Premium split by country which allows the calculation of the overall risk-free rate applicable to Swiss Re. The result is:

Weighted risk-free rate	
2006	4.57%
2005	4.13%
2004	4.11%
2003	4.00%

On the basis of the above elements, I can determine k, the Cost of Capital which minimizes equation (5):

- Cost of Capital = 12.46%
- Differences:

m CHF	Required Profits (dividend distributed)	$\overline{RP_t}$
2006	896	510
2005	497	580
2004	341	563

From these figures, I can see that:

- 2004 was a specific year: The dividend per share was one of the lowest in the Swiss Re history.
- 2006 was also a specific year: The absence of major Natural Catastrophes allowed higher dividends.

The Discounted Distributable Earnings calculated on the basis of the above Cost of Capital are:

m CHF	DDE_t
2006	2'346
2005	3'250
2004	3'046
2003	2'687

Finally, the application of the methodology leads to the following FCC:

	FCC	$\overline{TPF}$	$\overline{j}$
2006	2.80%	5.30%	4.57%
2005	3.47%	5.39%	4.48%
2004	3.91%	5.48%	4.40%
2003	3.78%	5.39%	4.31%

In order to estimate $\overline{TPF}$ and $\overline{j}$, it is necessary to make an assumption on future TPF and Risk-Free rate. For the purpose of this article, I have assumed that the latest known TPF and j (as at Year-End 2006) will remain the same for all future years.

For Swiss Re, a cautious assumption on **the FCC would be 3.91%**.

9.2 Case study: Hannover Re

Hannover Re Group is a German Reinsurance company. Therefore, the **tax rate is: T=40%**.

On the basis of Hannover Re Financial Statements, I can define the following elements of the above presented methodology:

m EUR	Required Profits (dividend distributed) (*)	Market Capitalisation (1)	Required Surplus (=(1) / 2.5)	Group net income
2006	193	4'231	1'692	514
2005	157	3'610	1'444	49
2004	121	3'467	1'387	280
2003	115	3'343	1'337	355

(*) In 2005, Hannover Re did not distribute any dividends due to Katrina and Wilma. For the purpose of this article, I decided to "smoothe" this effect and defined the potential dividend as the mean of the dividend distributed in 2004 and 2006.

Group Net Income will be used as Distributable Earnings.

For the future projection years, I use the average of the Group Net Income between 2003 and 2006 i.e. 300 mEUR.

For the purpose of the DDE calculation at year-end 2003 to 2006, the following assumptions on future Net Incomes were made.

mEUR	2006	2005	2004	2003
N+4 and after	300	300	300	300
N+3	300	300	300	514
N+2	300	300	514	49
N+1	300	514	49	280
N	514	49	280	355

For the horizon of projection, the Financial Statements provide the following elements:

	Reserves	
m EUR	Non-life	Life
2006	11'734	7'437
2005	12'513	7'063
2004	8'820	6'306
2003	8'397	4'930

On the basis of these elements and of the average assumed non-life and life liability durations (2 years and 11 years), I have a liability duration between 5.25 and 5.75 years. Therefore, I estimate a **horizon of projection of 11 years**.

The Financial Statements as at Year End 2006 provide the following information on the average return on investments (TPF):

Return on investment	
2006	5.00%
2005	4.80%
2004	5.00%
2003	5.10%

The Financial Statements provide also the Gross Premium split by country which allows the calculation of the overall risk-free rate applicable to Hannover Re. The result is:

Weighted risk-free rate	
2006	4.46%
2005	3.99%
2004	3.99%
2003	4.03%

On the basis of the above elements, I can determine k, the Cost of Capital which minimizes equation (5):

- **Cost of Capital = 11.72%**
- Differences:

m EUR	Required Profits (dividend distributed)	$\overline{RP_t}$
2006	193	123
2005	157	130
2004	121	143

From these figures, I can see that 2006 was a specific year: The absence of major Natural Catastrophes allowed higher dividends.

The Discounted Distributable Earnings calculated on the basis of the above Cost of Capital are:

mEUR	DDE_t
2006	623
2005	599
2004	642
2003	754

Finally, the application of the methodology leads to the following FCC:

	FCC	$\overline{TPF}$	$\overline{j}$
2006	3.89%	5.00%	4.46%
2005	4.07%	4.96%	4.36%
2004	4.22%	4.97%	4.29%
2003	4.51%	5.00%	4.23%

In order to estimate $\overline{TPF}$ and $\overline{j}$, it is necessary to make an assumption on future TPF and Risk-Free rate. For the purpose of this article, I have assumed that the latest known TPF and j (as at Year-End 2006) will remain the same for all future years.

For Hannover Re, a cautious assumption on **the FCC would be 4.51%**.

9.3 Case study: Zurich Financial Services Group

Zurich Financial Services Group (ZFS) is a Swiss insurance company. Therefore, the **tax rate is: T=21.3%**.

On the basis of ZFS Financial Statements, I can define the following elements of the above presented methodology:

mUSD	Required Profits (dividend distributed)	Market Capitalisation (1)	Required Surplus (=(1)/2.5)	Group net income
2006	751	38'946	15'578	4'527
2005	513	30'701	12'280	3'214
2004	330	23'943	9'577	2'587
2003	143	20'691	8'276	2'009

Group Net Income will be used as Distributable Earnings.

For the future projection years, I will use the Group Net Income of 2005 i. e. 3 214 mUSD.

For the purpose of the DDE calculation at year-end 2003 to 2006, the following assumptions on future Net Incomes were made.

mUSD	2006	2005	2004	2003
N+4 and after	3'214	3'214	2'587	2'009
N+3	3'214	3'214	2'587	2'009
N+2	3'214	3'214	2'587	2'009
N+1	3'214	4'527	2'587	2'009
N	4'527	3'214	2'587	2'009

In its recent years, ZFS has gone through a significant increase of its business size and the above assumptions tries to reflect the changes of ZFS Group.

For the horizon of projection, the Financial Statements provide the following elements:

	Reserves	
mUSD	Non-life	Life
2006	80'203	160'445
2005	73'956	145'968
2004	72'047	174'115
2003	65'012	158'406

On the basis of these elements and of the average assumed non-life and life liability durations (2 years and 11 years), I have a liability duration between 8.4 (for year-end 2003 and 2004) and 8 years (for year-end 2005 and 2006). Therefore, I estimate an **horizon of projection of 17 years for year-end 2003 and 2004 and 16 years for year-end 2005 and 2006**.

The Financial Statements provide the following information on the average return on investments (TPF):

Return on investment	
2006	5.10%
2005	5.60%
2004	5.90%
2003	4.90%

The Financial Statements provide also the Reserves split by country which allows the calculation of the overall risk-free rate applicable to ZFS. The result is:

Weighted risk-free rate	
2006	4.30%
2005	3.80%
2004	4.09%
2003	4.08%

On the basis of the above elements, I can determine k, the Cost of Capital which minimizes equation (5):

- **Cost of Capital = 6.57%**
- Differences:

mUSD	Required Profits (dividend distributed)	$\overline{RP_t}$
2006	751	684
2005	513	542
2004	330	396

The Discounted Distributable Earnings calculated on the basis of the above Cost of Capital are:

mUSD	DDE_t
2006	19'027
2005	22'244
2004	18'154
2003	13'259

Finally, the application of the methodology leads to the following FCC:

	FCC	$\overline{TPF}$	$\overline{j}$
2006	1.63%	5.10%	4.30%
2005	1.95%	5.17%	4.23%
2004	1.93%	5.27%	4.21%
2003	1.82%	5.22%	4.19%

In order to estimate $\overline{TPF}$ and $\bar{j}$, it is necessary to make an assumption on future TPF and Risk-Free rate. For the purpose of this article, I have assumed that the latest known TPF and j (as at Year-End 2006) will remain the same for all future years.

For ZFS, a cautious assumption on **the FCC would be 1.95%**.

According to reference 4, the Cost of Capital for an insurance company should be around 7% (in 2002) and the FCC should be around 2%. This confirms the above approach where results are consistent with reference 4 (Cost of Capital of 6.57% and FCC of 1.95%).

9.4 Reserve decrease pattern – Non-Life

According to its Annual Report 2006 (page 184 and 185), the Munich Re cumulative payments and reserve triangles (accident year x development year) are the following:

Payments (€m)	Development year									
Accident year	N	N+1	N+2	N+3	N+4	N+5	N+6	N+7	N+8	N+9
1997	2'802	5'099	5'960	6'493	6'795	7'053	7'187	7'499	7'456	7'556
1998	2'961	5'272	6'040	6'720	7'215	7'448	7'831	8'025	8'188	
1999	3'402	6'498	7'889	8'848	9'356	9'825	10'172	10'331		
2000	3'403	6'040	7'267	8'046	8'595	9'114	9'432			
2001	3'371	6'469	8'059	8'944	9'567	10'030				
2002	3'802	6'721	7'987	8'674	9'058					
2003	3'920	6'173	7'102	7'530						
2004	3'730	6'492	7'421							
2005	3'366	6'845								
2006	3'245									

Reserves (€m)	Development year									
Accident year	N	N+1	N+2	N+3	N+4	N+5	N+6	N+7	N+8	N+9
1997	4'762	3'672	2'084	1'531	1'262	1'225	1'050	832	814	747
1998	5'304	3'370	2'285	1'702	1'501	1'491	1'240	1'387	1'268	
1999	6'437	4'171	3'040	2'447	2'168	1'754	1'645	1'513		
2000	6'194	4'374	3'451	3'077	2'602	2'439	2'088			
2001	8'031	6'130	5'053	4'118	3'725	3'337				
2002	9'479	6'054	5'041	3'135	2'679					
2003	8'273	5'791	4'104	3'553						
2004	7'510	4'909	3'983							
2005	8'921	5'441								
2006	7'338									
Total	72'249	43'912	29'041	19'563	13'937	10'246	6'023	3'732	2'082	747

On adding the 2 triangles, it is possible to calculate the triangle of ultimate losses:

Ultimate (€m)	Development year									
Accident year	N	N+1	N+2	N+3	N+4	N+5	N+6	N+7	N+8	N+9
1997	7'564	8'771	8'044	8'024	8'057	8'278	8'237	8'331	8'270	8'303
1998	8'265	8'642	8'325	8'422	8'716	8'939	9'071	9'412	9'456	-
1999	9'839	10'669	10'929	11'295	11'524	11'579	11'817	11'844	-	-
2000	9'597	10'414	10'718	11'123	11'197	11'553	11'520	-	-	-
2001	11'402	12'599	13'112	13'062	13'292	13'367	-	-	-	-
2002	13'281	12'775	13'028	11'809	11'737	-	-	-	-	-
2003	12'193	11'964	11'206	11'083	-	-	-	-	-	-
2004	11'240	11'401	11'404	-	-	-	-	-	-	-
2005	12'287	12'286	-	-	-	-	-	-	-	-
2006	10'583	-	-	-	-	-	-	-	-	-
Total	106'251	99'521	86'766	74'818	64'523	53'716	40'645	29'587	17'726	8'303

On dividing the total reserves per development year by the total ultimate losses per development year, the reserve decrease pattern can be obtained:

	N	N+1	N+2	N+3	N+4	N+5	N+6	N+7	N+8	N+9
Pattern	68.0%	44.1%	33.5%	26.1%	21.6%	19.1%	14.8%	12.6%	11.7%	9.0%

Example: 44.1% = 43912 / 99521

Slight adaptations of the above patterns are done to obtain the proposed non-life reserve decrease patterns.

9.5 Ratio of SCR to MC for different ratings

For the purpose of this paper, the ratio of MC to SCR is taken as a constant of 2.5 (see chapter 5.2). This constant is valid for (re)insurance groups rated AA.

In order to derive a similar constant applicable to (re)insurance groups rated differently from AA, the reader is invited to read the document of Standard and Poor's "Insurance Ratings Criteria, Property/Casualty Edition". This document provides insights on how ratings are derived based on the Standard and Poor's definition of Capital Adequacy Ratio.