EFMA Code 740

Estimating the Cost of Equity Capital for European Non-Life Insurance Companies

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Abstract

This paper presents empirical evidence on the cost of equity capital for European non-life insurance companies. Estimates are done by introducing classical methodologies (Capital Asset Pricing Model –CAPM- and Fama-French three Factors –FF3F-), but also by running cross-sectional regressions (Full-Information-Beta - FIB - technique) in order to decompose the cost of capital of European insurance companies in cost of capital by lines of business. This analysis is conducted by using national and Europe-wide stock index in order to highlight the importance, for the insurance industry, of the market integration. Results suggest that multifactor models better explain the cost of capital for multi-business companies and the betas are greatly different across lines.

1. Introduction

The need to find reliable methods to estimate the cost of capital is becoming an important issue in the European insurance industry for several reasons.

First, new capital requirements for financial conglomerates (see European Directive 2002/87) are supposed to increase regulatory capital for parent companies and/or for financial subsidiaries. This new regulation establishes an evaluation of the conglomerate solvency position, calculated offsetting reciprocal raising capital operations often set by cross-sectorial financial institutions. These new rules are supposed to increase the need for capital for institutions within the conglomerate. Therefore the attention paid to the capital management techniques and to the associated costs is increasing.

Second, European insurance industry is facing a new method to determine the solvency requirements known as Solvency II. In 2007 EU countries will adopt a new set of rules inspired by the Basel II Capital Accord. With these new rules the riskier the insurance company is the more capital insurer has to set aside. A stronger link between capital buffer and risk profile will increase the need of capital for insurance companies deeply concentrated on long-tail business, i.e. liabilities and catastrophes, and with aggressive strategies on the asset side.

Third, the International Accounting Standards (IASs/IFRSs framework, see Dickinson 2003) to be applied in the EU require an in-depth knowledge of financial evaluation methods based on fair prices (market prices if assets/liabilities are publicly traded, financial methods otherwise) and discounting cash in/outflows using a proper discount rate (see Girard 2001, 2002). Furthermore, for insurers, International Accounting Standards (Insurance Financial Reporting Standards) will introduce 'discounted' technical provisions, until now not discounted (non-life provisions reported at ultimate claim cost plus loss-adjustment cost) or discounted using a unique discount rate (life provisions), making the implicit assumption of flat yield curve. It is likely the cost of capital will be the discount rate. Therefore estimation methods will be required by new accounting principles as well.

Fourth, the increasing attention to capital management and capital allocation methodologies in the insurance industry (for an overview see Cummins 2000 and, more recently, Natale 2004) are based on an hurdle rate to be used as the cut-off ratio. This ratio is often the cost of capital to be evaluated.

Even thought in terms of classical financial theory insurance companies are not different from other firms, cost of capital research has shown that there is a significant industry factor for insurance (see Fama and French 1997).

Moreover, the European insurance market is composed by few listed multi-business companies and a huge amount of non listed companies (subsidiaries, small regional companies, mutual companies). According to the classical assumptions of capital market equilibrium, listed company market data could be useful for estimates if and only if the risk profile (both on the asset and liability side) of the non listed companies is exactly the same as the profile of the listed ones. In this case, the same firm-specific risk can be diversified and the cost of capital will depend only upon the systematic market risk, equal for both insurance firms. Since it is a rare case, other techniques should be applied.

Likewise little progress has been made in estimating cost of capital for different business lines. This estimate can be a critical input into the capital-budgeting process for a single business line, and a useful method to reduce statistical noise in company-wide beta estimates. The widespread approach for estimating the divisional cost of capital is the *pure-play* technique introduced by Fuller and Kerr in 1981 and tested on the insurance industry by Cox and Griepentrog in 1998. According to this method, analysts usually estimate the beta of a portfolio of firms operating solely in the same line of business as the firm, division or project under valuation. The beta of the *pure-play* portfolio is then used to estimate the investor-required rate of return for each division or for a mutual firm. Since the precision of the beta estimate increases with the number of *pure-play* firms, practitioners prefer to have as many *pure-play* companies as possible. However, in the insurance, industry finding a large sample of publicly traded companies specialized in a single line of business is extremely rare. To solve this problem Kaplan and Peterson (1998) introduced *Full-Information Industry Beta* (FIB hereafter) approach. FIB technique assumes that a firm can be thought of as a portfolio of assets. Thus the company-wide beta (observable) is a weighted average of the business-specific betas (not observable). According to Kaplan and Peterson the weight on each beta is calculated by dividing the market value of the equity of the business unit by the market value of the company's equity. Alternatively, for each firm, industry or division, weight can be calculated as the ratio of industry or division sales to total sales.

In effect, those methods have been rarely implemented due to the large amount of required data. Furthermore, for European insurance companies, very few papers have been presented on the estimation of the company-wide cost of equity capital and none on the divisional cost of capital.

Such deficiency in Europe is mainly due to the lack of data for the European insurance industry. However the recent availability of structured database on balance sheet data and business break-down allows setting up a complete sample of insurance firms for Europe as well.

This paper improves the existing literature in two directions. First, the appropriate market risk premium to be applied in estimates is investigated. None of previous works have tested the best market return index to regress specific firm returns. Second, this paper presents new evidence on estimates of the cost of equity capital by business line for the European non-life insurance companies by using methods never tested on the European non-life industry.

2. Literature review

The cost of capital estimation methods had found several applications in insurance industry.

A wide group of works have been done in the late Seventies and in Eighties especially in US because of the price regulation for several business lines. These works are aimed at finding formulae or logical relationships to be applied by regulators to set fair returns or prices consistent with the market equilibrium. Among others Fairley (1979) applied CAPM to the investment income and profits margins in the US property-liability insurance. He provided empirical justifications to the regulated rates of return and profit margins by using a risk-return model. He argued that, according to the CAPM, only systematic risk should be considered and thus insurance premium rates should take into account only non diversifiable risk. Nevertheless he did not test the model because his main objective was to furnish a theoretical framework to the regulatory environment of the late seventies. Hill (1979) used CAPM argument to derive profit rates which property-liability insurance companies would earn. Hill obtained a formula useful for regulators to set fair profits rates by line of business. Hill and Modigliani (1981) developed some useful accounting relationships for the expected after-tax rate of return on equity for a property-liability insurance company.

More recently, a second group of empirical works has been published on the topic of insurance company profitability or, synonymously, the insurance cost of capital. Among others Cummins and Harrington (1987) analysed the risk-return relationship of property-liability insurance stocks by using the underwriting-specific CAPM during the period 1970 through 1983. They found inconsistencies with CAPM for the period 1970 through 1980 and consistencies for the next period.

Cox and Griepentrog (1988a) proposed an alternative model to reconcile several versions of CAPM, i.e. a regulatory General CAPM first proposed by Levy in 1980 to take into account market imperfections and regulatory CAPM proposed by Fairley (1979). Cox and Griepentrog developed some relationships among underwriting betas, market returns, book data and statistically tested those on a sample of 21 property-liability (at least 50 percent of revenues from P-L operations) insurance companies during the December 1971 – November 1982 period. Their results are consistent with previous results (negative shift during the study period). Furthermore researchers provided evidence that the General CAPM (with market imperfection) exhibit greater stationarity and stability of results over time than do the regulatory CAPM. This important result is due to the presence of unsystematic risk component in the rate of return of the General CAPM and to the more real assumption of non perfectly diversified investors.

Cox and Griepentrog (1988b) also proposed the pure-play approach developed by Full and Kerr (1981) to estimate the cost of equity capital for no publicly-traded insurers, for lines of business of multi-division insurance companies, and for mutual firms. They tested the pure-play technique on a sample of 56 insurers for the period 1972 – 1981 and found that that pure-play estimates provided poor proxies for an insurance division's actual systematic risk and corresponding cost of equity.

Cummins and Lamm-Tennant (1994) tested the significance of some variables in predicting the cost of capital for a sample of property-casualty insurers from 1981 to 1989. Leverage ratios (the ratios of technical provisions-to-assets and financial debt-to-assets) were statistically significant in explaining differences in costs of capital.

Cummins and Lee (1998) estimated the cost of equity capital by applying the CAPM, the Arbitrage Pricing Theory (APT) of Ross (1976) and a unified CAPM/APT model. They tested three proposed models on a sample of 64 property and casualty insurance companies during the 1988-1992 period and performed also three tests to evaluate the quality of predictions. According to their evidence, the unified CAPM/APT model did not show higher explanation power than both CAPM and APT considered separately. Overall, APT and the unified CAPM/APT performed better than CAPM in estimating the cost of equity capital in their sample.

Kielkhoz (2000) explored the cost of capital for five major insurance markets (UK, USA, France, Germany and Switzerland) by using a simplified version of DCF model and CAPM during the period 1978-1998. He found significant differences between countries both for life and non-life insurers. According to the author, differences mainly reflect different risk-free rates.

Finally the work of Cummins and Phillips (2004) is reported. They provided numerous insights on techniques to estimate the equity cost of capital. Furthermore Cummins and Phillips were the first to investigate both the Fama-French three factor model and the newer Full Information Beta technique. These approaches have been tested on variable samples of property-casualty insurers during the 1997-2000 period with interesting results. First, Fama-French three factors estimates perform better than CAPM estimates. Hence, firm-size factor and financial-distress factor significantly improve predictions of costs of capital. Second, lines of business significantly affect the cost of capital. Therefore a joined use of firm-size and a beta specific for the line is strongly recommended in financial applications of the cost of capital. In general, Full-Information Beta technique is considered reliable to obtain estimates of costs of capital by line.

The work here presented is closely related to this last paper because it performs same methodologies with two innovations. First, I study the effect of the financial integration in Europe and test the proper index to be used for estimates. Second, this work is the first to implement newer methods than CAPM to European insurance industry. No other works have been presented in Europe on this important issue.

3 Data and Cost of Capital Methodologies

Several methods for estimating the cost of capital have been tested on European data.

The first problem to be solved is the question about '*integration versus segmentation*' of European financial markets. Correlations tend to rise with the degree of international equity market integration which has gathered pace in Europe since the mid-1990s (see Fratzschler 2002). Recent papers (see Baca et al. 2000, Cavaglia et al. 2000 and Brooks et al. 2002) have found that, in Europe, industry factors surpassed country effects in importance in the late-1990s, concluding that diversification across industries may now provide greater risk reduction than diversification across countries. It has been also known that equity return correlations do not remain constant over time, tending to decline in bull markets and to rise in bear markets (see Longin and Solnik 1995). According to this empirical evidence an investigation on the market index correlations in European equity markets is performed. This analysis is aimed at identifying the appropriate portfolio to use as the 'market portfolio' in the estimate models tested below.

To test the '*integration versus segmentation*' problem, rates of return for the largest six European market indexes[1] and for EuroStoxx50 are collected from DataStream. Daily prices are

[1] To compute correlation coefficients, I use Euro-denominated daily returns from DataStream. Using Euro-denominated returns has the effect of lumping nominal currency influences into country-specific effects in international index returns. European market indexes are MIB30 (Milan Stock Exchange), DAX (Frankfurt Stock Exchange), CAC40 (Paris Stock Exchange), AMX (Amsterdam Stock Exchange), IBEX35 (Madrid Stock Exchange), FTSE100 (London Stock Exchange).

collected for a nine year period and then transformed to log-rates of return. The risk-free rate adopted is the 1-month Euribor[2]. It is worth highlighting that, for capital budgeting purposes, the choice of the proper risk-free rate should be consistent with the time horizon of the project to evaluate.

To emphasize differences between models I use the same time varying market premium for systematic risk in all models.

The sample of P&C insurance companies consists of 64 publicly listed insurance companies selected from AM Best's Insight Global.

AM Best's Insight Global is a detailed database of all insurance companies worldwide (10.333 insurance companies). Even tough A.M. Best's Insight is deeply concentrated on the US insurance industry (5.365 insurance companies and 2.191 companies in Europe) it provides useful insights about balance sheet data for European companies as well.

To estimate the cost of capital for these companies, monthly rate of returns have been calculated by using monthly stock price data over a six-year period (01/1998 – 12/2003) obtained from DataStream. On this sample regressions are performed to investigate the responsiveness of stock '*i*' to the market risk premium for the last five years. Therefore estimates of coefficients and cost of capital for 2003 are obtained on the first 72 monthly consecutive observations (01/1998 – 12/2003 period). Estimates for 2002 are calculated on 60 monthly consecutive observations (01/1998 – 12/2002 period) and so forth for 2003.

In order to have a suitable time series of stock returns, the usual adjustment for dividend-effect is applied. The information about dividends is limited to the dividend yield and is available once (or more frequently) a year. To correctly estimate monthly returns, I spread the annual dividends for a calendar year across all months of the year so that compounding the monthly return reproduces the annual return[3].

The first model (see Table 1) to be tested is the classical CAPM because this is the most widely used model in such applications. According to this model, if the assumptions of market equilibrium hold, the expected return of a stock depends only on its *beta*, where beta measures the systematic market risk.

[2] For instance, Cummins and Phillips (2004) in their paper used the Standard & Poor's 500 Stock Index as broad market index and a 30-day US Treasury bill yield as free-risk rate.

[3] This adjustment is also discussed in Fama and French (1997, 2002). Authors pointed out that this approach maintains the integrity of the average returns, but it assumes that the capital gain component of monthly returns reproduces the volatility and covariance structure of total monthly returns. The information about dividends and frequency of payments is available in DataStream.

This model can be written as an empirical version of Sharpe (1964) and Litner (1965) and Mossin (1966) security market line. In formulae the expected cost of capital $E(r_i)$ is a function of the risk-free rate (r_f) and the expected return of the market portfolio $E(r_m)$:

$$E(r_i) = r_f + \beta_i^M \cdot [E(r_M) - r_f] \qquad (1)$$

Consequently the first stage regression is:

$$r_{i;t} = r_{f;t} + \alpha_i + \beta_i^M \cdot [r_{M;t} - r_{f;t}] + \varepsilon_{i;t} \qquad (2)$$

where $r_{i;t}$ = the return for firm *i* in period *t;*

$r_{f;t}$ = the risk-free rate in the period *t;*

$r_{M;t}$ = return for the market portfolio in period *t;*

β_i^M = the CAPM market beta coefficient for firm *i;*

α_i = the CAPM alpha coefficient for firm *i;*

$\varepsilon_{i;t}$ = a random error term for firm *i* (normally distributed).

In model (2) and in the following regressions, the market Index is, alternatively, the EuroStoxx50 and the most important national stock Index. To correct for the potential bias created by infrequent trading, a lagged value for the beta term (*sum-beta approach*) is added. This approach has been largely employed in recent works (among others see Fama and French 1992, 1996; Ibbotson, Kaplan and Peterson 1997 and Cummins and Phillips 2004) and thus it is now a standard method. With the lagged term, estimates are expected to be more accurate.

Equation (3) shows the second-stage regression for CAPM.

$$r_{i;t} = r_{f;t} + \alpha_i + \beta_{i;1}^M \cdot [r_{M;t} - r_{f;t}] + \beta_{i;0}^M \cdot [r_{M;t-1} - r_{f;t-1}] + \varepsilon_{i;t} \qquad (3)$$

It is straightforward to note that in the second stage regression the final CAPM beta is the sum of β_{i0} and β_{i1}.

Coefficients are usually estimated by using OLS method on market data for each stock, provided that a long time series are available for risk-free rate and for estimation of market risk premium.

Other more recent models have been tested due to the poor explanatory power of the simple and sum-beta CAPM. Two orders of reasons are generally used to explain its deficiency.

The first is statistical. CAPM is a mono-factor model and in real world several factors affect the expected rate of return. The second is more theoretical because it is strictly related to its assumptions. The CAPM has been often criticized because it is based upon (among others) the ability of all investors to diversify perfectly and to the existence of approximately normal return distributions. Given these assumptions, the risk premium for a firm should reflect only systematic risk and therefore CAPM beta represents the proper risk measure.

Summary statistics in Appendix A strongly reject the assumption of normal distributions of returns for main European market indexes (see Jarque – Bera test). Moreover it is common wisdom that investors are not perfectly diversified. The unsystematic risk component should therefore be included in the individual stock's return variance, receiving positive weight instead of zero weight.

An alternative approach for estimations is the Fama-French three factor model (hereinafter FF3F – see Table 2). Fama and French (1996) argue that the static CAPM is insufficient. In the US market they show that expected returns depend on sensitivities of returns to three factors. FF3F model retains the systematic market risk factor and adds two additional factors which have already demonstrated to be significant in the explanation of stock returns. The corporate capitalization variable (firm size factor) and book-to-market ratio (financial distress factor) are added. These factors have shown to be significant both for industrial firms (see Fama and French 1996) and for American insurance companies (see Cummins and Phillips 2004). The rationale behind these factors is not obvious. According to the Fama and French longstanding empirical evidence (see Fama and French 1993), firms with high book-to market ratios are more likely to be financially distressed and small firms showed higher sensitivity to changes in the economy. The formula for the Fama-French three-factor model is the following:

$$E(r_i) = r_f + \beta_i^M \cdot \left[E(r_M) - r_f\right] + \beta_i^S \cdot \pi^S + \beta_i^{FD} \cdot \pi^{FD} \tag{4}$$

Consequently the first stage Fama-French regression is:

$$r_{i;t} = r_{f;t} + \alpha_i + \beta_i^M \cdot \left[r_{M;t} - r_{f;t}\right] + \beta_i^S \cdot \pi_t^S + \beta_i^{FD} \cdot \pi_t^{FD} + \varepsilon_{i;t} \tag{5}$$

where β_i^S = the beta coefficient for firm *i* for the size factor;

π_t^S = the expected market risk premium for firm size;

β_i^{FD} = the beta coefficient for firm *i* for the financial distress factor;

π_t^{FD} = the expected market risk premium for financial distress.

The second stage Fama-French regression includes a lagged size factor and a lagged financial distress. As in previous case lagged factors are included to verify if the explanatory power increases. In this case equation (5) varies as follows:

$$r_{i;t} = r_{f;t} + \alpha_i + \beta^{M}_{i;1} \cdot [r_{M;t} - r_{f;t}] + \beta^{M}_{i;0} \cdot [r_{M;t-1} - r_{f;t-1}] + \beta^{S}_{i;1} \cdot \pi^{S}_{t} + \beta^{S}_{i;0} \cdot \pi^{S}_{t-1} + \beta^{FD}_{i;1} \cdot \pi^{FD}_{t} + \beta^{FD}_{i;0} \cdot \pi^{FD}_{t-1} + \varepsilon_{i;t} \quad (6)$$

FF3F model estimates betas by using risk premia calculated on Dow Jones EuroStoxx Indexes. Size factor is the average return of two small portfolios minus the average return of two big portfolios, while financial distress factor is the average return of two value (high book-to-market ratio) portfolios minus the average return of two growth (low book-to-market ratio) portfolios[4].

A more precise model tested is the Full-Information Industry Beta (see Tables 3 – 4) method elaborated by Kaplan and Peterson in 1998. FIB method assumes that a company-wide beta is a weighted average of the betas of the business units. The weight of each beta is usually obtained by dividing the market value of the equity of the business unit by the market value of the company's equity. However, for the insurance industry, divisions are neither publicly traded nor easy to measure by using balance sheet data. Cummins and Lamm-Tennant provided a useful insight in their work (1994) because they estimated costs of capital for long-tail commercial lines and short-tail lines using financial ratios (i.e. policy reserves-to-assets and financial debt-to assets). This method is not applicable in Europe due to differences in accounting principles for assets and liabilities across countries. Thus particular care should be applied in estimating the weight of each division. For each firm, divisional weights are computed as the ratio of division's sales to total sales of each sector for the sample. Therefore, a firm's sector weights sum to one. AM Best's Insight Global provide data for divisions and divisional sales for each firm in the sample. Full-Information Betas are estimated from the following cross-sectional regression:

$$\beta_i = \sum_{j=1}^{n} \beta^{Full}_{j} \, \omega_{i;j} + \varepsilon_i \quad (7)$$

where β_i is the beta company-wide beta, β^{Full}_{j} are parameters to be estimated, i.e. the full-information beta for sector 'j', and $\omega_{i;j}$ is the weight of company 'i' in sector 'j'.

Revenues by line of business are obtained from A.M. Best's Insight in order to respect the breakdown reported in the balance sheet. For the 64 insurance companies I took the reported business lines whose revenues (in sum) are greater than the 80% of the their total sales. Therefore I

[4] Particularly 'Size factor' (π^{S}_{t}) is calculated as follows: ½(Eurostoxx TMI Small Cap;Value+ Eurostoxx TMI Small Cap;Growth)- ½(Eurostoxx TMI Large Cap;Value+ Eurostoxx TMI Large Cap;Growth). Yet, 'Financial Distress factor' (π^{FD}_{t}) is derived as follows: ½(Eurostoxx TMI Small Cap;Value+ Eurostoxx TMI Large Cap;Value)- ½(Eurostoxx TMI Small Cap; Growth + Eurostoxx TMI Large Cap;Growth).

obtained 8 lines of business: 1) Accident&Health, 2) Automobile, 3) Credit, 4) Fire, 5) Liability (non-automobile), 6) MAT, 7) Property, 8) Reinsurance. The remaining negligible part of the portfolio has been divided in: 1) life; 2) life-linked; 3) other (non-life).

Cross-sectional regressions are conducted for CAPM and FF3F models. These are performed in two steps as suggested by Kaplan and Peterson. The first is to obtain beta coefficients for each risk premium for each firm. These are the betas and sum-betas estimated from equations (2), (3), (5) and (6). The second step is to impute each of beta and sum-beta estimates as dependent variables in the cross-sectional regressions by dropping the intercept. In these regressions the weights of each company '*i*' in each sector '*j*' are the independent (explanatory) variables.

4. Integration versus Segmentation

An analysis of the correlation structure amongst European largest market indexes is required because in the absence of the proof of stability or integration a significant lack of information can affect results. If correlations are stable and significantly lower than one a considerable basis risk has to be considered in the cost of capital models and estimates. If correlations are unstable but strongly upwards towards 1, a negligible error should be included in the models to estimate the cost of capital. Thus the pattern of the aggregate correlation between the indexes of the 6 largest European markets and the Eurostoxx50 index has been studied. The question '*integration versus segmentation*' is analyzed as follows.

The first step shows (see graphs in Appendix A) the time-varying correlation between a selected European market index and the Eurostoxx50 index[5] during the 1995-2003 period. Correlations are calculated using rolling windows of 250 and 500 days (approximately one and two years). Graphs indicate that correlations move considerably up through the period.

Then a more formal test (Jenrich test) for a constant unconditional covariance matrix is conducted. Jenrich test quantifies the difference between two matrices via the trace of a relative difference matrix. The relative difference matrix is the difference between the two matrices divided by their sum[6]. Each matrix of 2348 daily returns[7] has been decomposed in both ten and twenty sub-periods[8] and then the sum of adjacent sub-periods have been tested (see table 1 for results). Large

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[5] In this paper the version of the Dow Jones Eurostoxx50 index that includes the UK stock market is used. Dow Jones Eurostoxx50 index is the leading European stock market with one of the most liquid futures contract in the world.

[6] For further details on Jenrich test see Jenrich (1970). This test has an asymptotic chi-squared distribution with the number of degrees of freedom equal to the number of independent elements in the matrix times the number of matrices included in the test minus one. Degrees of freedom for the covariance test are therefore $(p(p-1)/2)+p)*(k-1)=27$.

[7] These series start on 1 January 1995 and end on 31 December 2003.

[8] In the first case the first nine sub-periods are equally long (250 days) while the last one is 98 days-long. In the second case the first nineteen sup-periods are 125 days-long while the last one is 98 days long.

values of χ^2 suggest rejection of the hypothesis that all *k* populations have the same correlation matrix.

Table 1: Jenrich test on the stability of covariance matrices (10 and 20 sub-periods)						
	Eurostoxx50-AMX	Eurostoxx50-CAC40	Eurostoxx50-DAX	Eurostoxx50-FTSE100	Eurostoxx50-IBEX35	Eurostoxx50-MIB30
10 sub-periods	1.159,8	1.191,9	1.038,6	670,62	1.478,6	1.535
20 sub-periods	1.823,6	1409	1.262,2	901,2	1.946,5	1.868,3

Jenrich test strongly rejects the hypothesis of stable covariances in each case. The rejection of the stability requires an empirical analysis of the behaviour of indexes to estimate the bias implicit in the market risk premium in regressions.

Despite the visual result of integration, especially after the announcement date of EMU, cost of capital estimates are performed using both EuroStoxx50 index and the most important country index.

The market index effectiveness is measured by defining a measure of relative performance of regressions, i.e. the *efficiency ratio*. Following some measures of efficiency used by Cummins, Lalonde and Phillips (2004) related to the measurement of basis risk embedded in some catastrophic-loss index securities, the efficiency ratio (ER) is defined as follows:

$$ER = \frac{\rho_{Eu}^2}{\rho_C^2} \tag{9}$$

where ρ_C^2 is the rho-squared for the equations (3) and (6) by using country-indexes and ρ_C^2 is the rho-squared for the regression estimates with Eurostoxx50. The greater the basis error related to the choice of the index, the greater the difference from 1 (or 100%). It is also obvious that an ER greater than 1 means that the cost of equity capital is better explained by European data and therefore regressions on national data are biased. Yet, ER>1 means that non-life insurance companies are more dependent upon European market than national market and this could be considered as feature of the integration. ER<1 means otherwise that the best proxy for the systematic risk premium is still the national market.

5. Empirical Results

The statistical analysis on the largest market indexes highlights a significant rise in the correlations amongst market indexes that can be explained by a structural break reflecting the process of monetary and financial integration in Europe. Not surprisingly this process mainly involves Italy, France, Germany and Spain, minimizing geographical basis errors in regressions for these countries. UK is affected by specific country risk factor but a significant trend towards integration is well-evident. Netherlands shows a more complicate behavior because of the significant weight of worldwide revenues for Dutch firms.

Table 1 shows estimates for CAPM in equation (2) and (3). For brevity insurance companies have been divided in four quartiles using their market capitalization. Estimates of coefficients are hence the average beta for 2003 and for each quartile.

First and not surprisingly CAPM with lagged variables over-performs the simple CAPM with both market indexes. European insurance companies can be divided in three groups[9]. The first (insurance companies in the first quartile) shows the highest R-squared using both indexes and the highest ER with DJ-EuroStoxx Index. This result highlights the well-diversified portfolio of these companies and the consequent minimization of the specific risk. The second and third quartiles show similar behaviors in terms of R^2 but non-well defined tendencies in terms of explanatory Indexes. The fourth quartile shows a great part of specific risk with very poor explanatory power for both Indexes. This could be explained with the tendency to be geographically concentrated or non-diversified in terms of business lines.

Table 2 shows a significant improvement of R^2 for medium and small size insurance companies. In this case both size and financial distress factors add more information to the CAPM models, either in the simple form or in the sum form.

In the FF3F regressions the improvement for insurance companies in the first quartile is almost trivial.

Efficiency ratios remark the tendencies, for bigger insurance companies, to be more geographically diversified (ER>1) and, for smaller insurance companies, to be more local-dependent (ER<1). In the last quartile a great specific error endures and the cost of equity capital for these companies is still greatly dependent upon the country index.

Lastly the two factors act very differently for the four groups. Particularly the size factor is positive related and seems to be explanatory for the mid-size companies, while the financial distress factor is negative related (on average) to the cost of capital. This factor seems to be particularly important only for the second quartile.

In the FF3F case the Lagged Model add explanatory power only for second, third and fourth quartiles. This could be explained with the power of the dimensional factor, more important than other adjustments added in other models.

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[9] Obviously the relationship between predictor variables and their lagged variables is judged by examining the VIF values. Usually with VIF in excess of 10, problems of multicollinearity can affect estimations. For brevity I did not report the VIF values in the tables but they are constantly lower than 2.

Full-Information-Beta decomposition shows interesting results for business lines. First, three business lines (Property, MAT, Fire) seem to be negative in each model. Furthermore the beta for Property line is always significant for confidence level of 10%. This could be explained with the classical econometric theory which identify the non-life business as countercyclical. This is particularly important for Property and less important for MAT and Fire. The lower significance of these two last business lines is due to the small number of insurance companies with MAT and Fire revenues included in the dataset.

The other business lines could be distinguished according to the level of significance. Particularly, Accident&Health is positive and often significant[10] (excluding models # 2, 4, 6, 8); Life is always significant and betas for Life business are particularly stable in the 8 models investigated. Reinsurance is also significant in the third model.

All these business (excluding Reinsurance in models # 6 and 8) are quite stable and tend to minimize the impact of business cycles (values between 0,2 and 0,4). These betas could provide a great diversification impact in terms of portfolio of assets, especially if the level of significance is considered.

Tables 3 and 4 also show other business lines not significant. Nevertheless it is worth emphasizing that Liability exhibits very high values (and significant at 10% level). This could be explained with the common wisdom. Liability (different from MTPL, included in Automobile) is perceived, from financial market participants, as riskier than other business lines and thus greatly affects the overall cost of capital.

Lastly the beta for the Automobile, the most important line in term of revenues, is quite stable (values between 0,35 and 0,45) but never significant. This result could derive from the specific legal framework of the MTPL, greatly dependent upon the national law and therefore difficult to extrapolate in an European model.

6. Conclusions

The new methodology implemented in this paper (Full Information Beta – FIB approach) tries to derive an estimation of the determinants of the cost of equity capital for the European Non-Life insurance companies. This approach is becoming very critical for several reasons. First it is important to define a threshold value for different business unit in the newer capital management and value creation approaches. All these methods give, for example, rewards to managers if the calculated performance (usually risk-adjusted, like RAROC) is greater than the cost of capital. It is

[10] At 5% level.

obvious that this rate should be defined and differentiated according to the risk profile of the business unit.

Second, in a financial conglomerate view, it is important to identify sources of risks or determinants of the cost of capital that can be diversified amongst them. Several authors (among other see Kuritzkes *et al.* 2003 and Kuritzkes A. *et al.* 2001) have already provided estimates of some typical financial conglomerates. Nevertheless the contribution in terms of savings for the overall cost of capital can be calculated only identifying the determinants for each business unit.

Beta coefficients are here estimated by using several market portfolios and several methods. Particularly CAPM and FF3F methods are performed in the simple form and in the sum form to adjust for infrequent trading. Results show significant market integration and more stable cost of capital for big insurance companies, while mid and small listed European companies are still affected by significant specific factors. The FIB method is run on a sample of 64 insurance companies across Europe and betas for each company and each method are greatly affect by the composition of the portfolio.

The main conclusions of the paper are the followings:

1. Sum-Beta methods systematically over-perform simple methods under the CAPM and FF3F methods.
2. The impact of both Financial Distress and Size Factors is not obvious. CAPM and thus systematic risk factor seems to be sufficient for large companies, while mid and small companies need additional factors with not *a priori* determined impact on the overall cost of capital.
3. The cost of capital varies significantly by line of business. Particularly some insurance lines (MAT, Fire and Property) are countercyclical and then they contribute to stabilize the market risk factor, whilst others are positive related to the market risk factor (both national and European) but show significant diversification contributions.

It is also obvious that the by line cost of capital should vary over time. At the moment the data to estimate this effect is not enough, due to the wave of mergers and acquisitions among European insurance companies and banks in the late Nineties.

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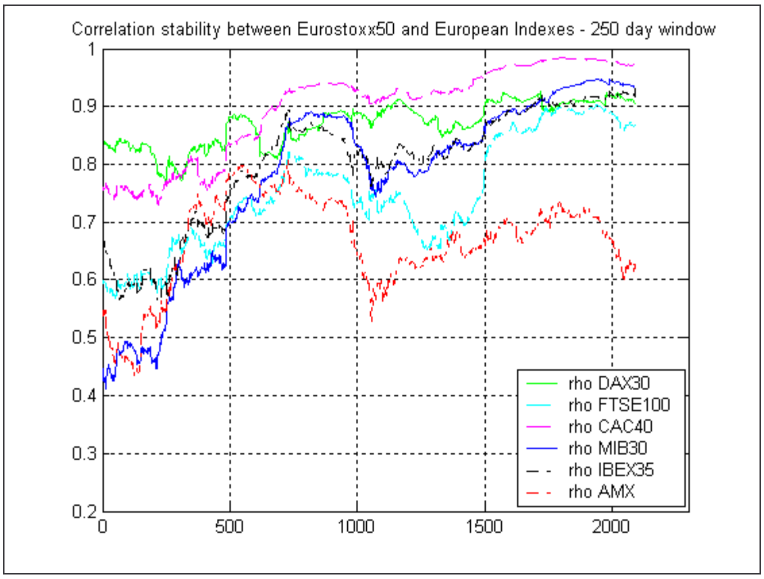
Appendix A



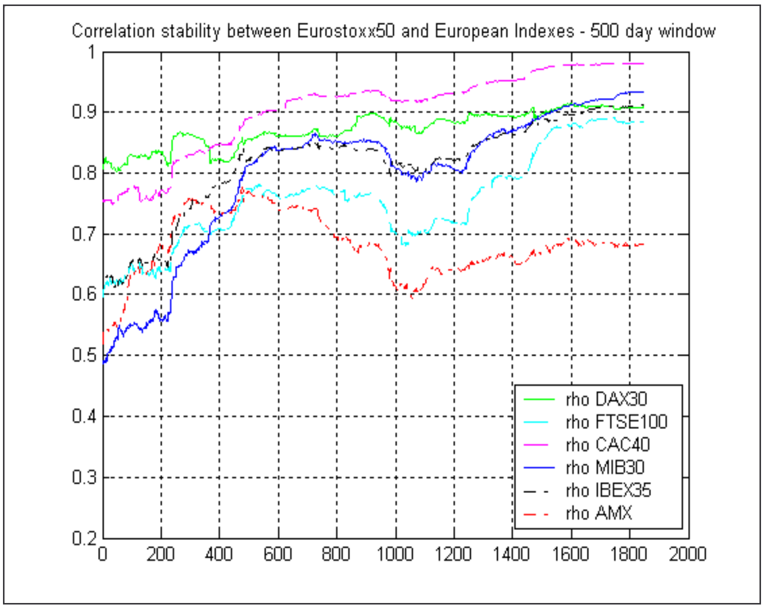


Table A: Summary Statistics for Market Index Returns

	Mean	Std. Dev.	Skewness	Kurtosis	Jarque – Bera	Prob.
Eurostoxx50	0,000316	0,014799	-0,102936	5,787274	764,2038	0,00000
DAX	0,000275	0,016375	-0,224153	5,688477	726,7929	0,00000
CAC40	0,000271	0,014820	-0,075458	5,266849	504,9551	0,00000
MIB30	0,000391	0,014438	-0,176417	5,353894	554,2588	0,00000
FTSE100	0,000256	0,015085	-0,070355	5,132176	446,7045	0,00000
IBEX35	0,000391	0,014438	-0.176417	5,353894	554,2558	0,00000
AMX	0,000570	0,012963	-0,471123	5,946310	936,1253	0,00000

TABLE 1

CAPM Beta and Sum-Beta Estimates

	Market Cap Quartile	*Average*	No. Insurers	Average β(country)	Adjusted R^2	Average Sum β(country)	Adjusted R^2
2003	1	16.782.595.212,20	16	0,773735	0,411813	0,868540	0,431625
	2	1.857.243.901,75	16	0,495033	0,233188	0,674045	0,280313
	3	552.235.124,20	16	0,700773	0,225500	1,001146	0,272688
	4	112.951.000,27	16	0,481674	0,155312	0,707207	0,203250
	Total	308.880.403.814,72	64	0,612804	0,256453	0,812734	0,296969

	Market Cap Quartile	*Average*	No. Insurers	Average β(European)	Adjusted R^2	ER(CAPM)	Average Sum β(European)	Adjusted R^2	ER(CAPM)
2003	1	16.782.595.212,20	16	0,904970	0,478813	1,1627	1,075832	0,498752	1,1555
	2	1.857.243.901,75	16	0,651276	0,283319	1,2150	0,861460	0,310781	1,1087
	3	552.235.124,20	16	0,646333	0,216465	0,9599	0,848468	0,254399	0,9329
	4	112.951.000,27	16	0,561321	0,126896	0,8170	0,651212	0,186432	0,9173
	Total	308.880.403.814,72	64	0,690975	0,276373		0,859243	0,312591	

TABLE 2

FF3F Beta Estimates

Country Model			Country	Average β(market)	Average β(size)	Average β(fin. distress)	Adjusted R^2
	Market Cap Quartile						
		Average	No. Insurers				
2003	1	16.782.595.212,20	16	1,0768000	-0,217700	-0,068100	0,4174000
	2	1.857.243.901,75	16	0,8046000	0,236300	-0,260400	0,3672000
	3	552.235.124,20	16	0,7403000	0,341300	0,105730	0,2883000
	4	112.951.000,27	16	0,6660000	-0,193300	-0,089200	0,1964000
	Total	308.880.403.814,72	64	0,82193	0,04165	- 0,07799	0,31733

EU-Index Model				Average β(EU)	Average β(size)	Average β(fin. distress)	Adjusted R^2	ER(FF3F)
	Market Cap Quartile							
		Average	No. Insurers					
2003	1	16.782.595.212,20	16	0,9227000	-0,07720	-0,053800	0,4372500	1,0476
	2	1.857.243.901,75	16	0,7182000	0,20882	-0,282900	0,3788600	1,0318
	3	552.235.124,20	16	0,6640000	0,39590	0,074600	0,2201000	0,7634
	4	112.951.000,27	16	0,5830000	-0,09850	-0,146100	0,1297000	0,6604
	Total	308.880.403.814,72	64	0,72198	0,10726	- 0,10205	0,29148	

FF3F Sum-Beta Estimates

Country Model				Average Sum β(market)	Average Sum β(size)	Average Sum β(fin. distress)	Adjusted R^2
	Market Cap Quartile						
		Average	No. Insurers				
2003	1	16.782.595.212,20	16	1,1153000	-0,4085000	-0,0657000	0,4115000
	2	1.857.243.901,75	16	0,9670000	0,2924000	-0,3647000	0,3956000
	3	552.235.124,20	16	0,8842000	0,3596000	-0,0533000	0,2972800
	4	112.951.000,27	16	0,7495000	-0,2804000	-0,2940000	0,2171200
	Total	308.880.403.814,72	64	0,929000	- 0,009225	- 0,194425	0,330375

EU-Index Model				Average Sum β(market)	Average Sum β(size)	Average Sum β(fin. distress)	Adjusted R^2	ER(FF3F)
	Market Cap Quartile							
		Average	No. Insurers					
2003	1	16.782.595.212,20	16	0,9021000	-0,3383000	-0,0115000	0,433200	1,0527
	2	1.857.243.901,75	16	0,9179000	0,3939000	-0,4365000	0,413800	1,0460
	3	552.235.124,20	16	0,8542000	0,3037000	-0,1359000	0,270300	0,9092
	4	112.951.000,27	16	0,7286000	-0,3391000	-0,4582000	0,173310	0,7982
	Total	308.880.403.814,72	64	0,85070	0,00505	- 0,26053	0,32265	

TABLE 3
FIB Estimates (2003) with CAPM and SUM-CAPM

MODEL 1: Dependent variable β(country) CAPM

	Beta Factor	t	Sig.
ACCIDENT&HEALTH	0,325050793	2,130213631	0,041763096
AUTOMOBILE	0,442738504	0,903814314	0,373540919
CREDIT	0,018797619	0,15130179	0,880785269
FIRE	-0,079631897	-0,405727223	0,687921106
LIABILITY	1,068829866	1,552170153	0,131467743
LIFE	0,359980074	2,412400387	0,022399712
LIFE_LINKED	0,007435685	0,053619775	0,957605781
MAT	-0,14006629	-0,539582152	0,593604498
OTHER	0,196437781	1,31152633	0,199969107
PROPERTY	-1,42224345	-1,654918144	0,108725491
REINSURANCE	0,231912045	1,867713193	0,071938291

MODEL 2: Dependent variable β(country) CAPM-SUM

	Beta Factor	t	Sig.
ACCIDENT&HEALTH	0,288129807	1,87915402	0,070307402
AUTOMOBILE	0,392085573	0,796553673	0,432183354
CREDIT	0,174374479	1,396774832	0,173079812
FIRE	-0,076324362	-0,387001396	0,70158066
LIABILITY	1,129989855	1,633080349	0,113264271
LIFE	0,389725122	2,599151477	0,014543453
LIFE_LINKED	0,024273884	0,174198954	0,8629195
MAT	-0,089335776	-0,342492943	0,734449974
OTHER	0,157947715	1,049464141	0,302632185
PROPERTY	-1,502321424	-1,739673296	0,092521446
REINSURANCE	0,217188446	1,740707734	0,092337

MODEL 3: Dependent variable β(European) CAPM

	Beta Factor	t	Sig.
ACCIDENT&HEALTH	0,338840962	2,25480814	0,031867767
AUTOMOBILE	0,404799871	0,839100627	0,408276781
CREDIT	0,026031914	0,212759558	0,833003023
FIRE	-0,069828548	-0,361261648	0,720522545
LIABILITY	1,13548304	1,674376651	0,104809748
LIFE	0,320240465	2,179158882	0,037588139
LIFE_LINKED	0,009190989	0,067298908	0,946805603
MAT	-0,084881987	-0,332033	0,74225228
OTHER	0,184357225	1,249838553	0,221351251
PROPERTY	-1,481068206	-1,749924835	0,090707214
REINSURANCE	0,2573216	2,104286569	0,044137964

MODEL 4: Dependent variable β(European) CAPM-SUM

	Beta Factor	t	Sig.
ACCIDENT&HEALTH	0,295226353	1,935408413	0,062744981
AUTOMOBILE	0,355947887	0,726882	0,473125465
CREDIT	0,186138144	1,498725758	0,144752598
FIRE	-0,064850976	-0,330528701	0,74337669
LIABILITY	1,170784852	1,700800663	0,099681554
LIFE	0,341432437	2,288870806	0,029558315
LIFE_LINKED	0,015435506	0,11134493	0,912109907
MAT	-0,040836253	-0,157367632	0,876045699
OTHER	0,13102251	0,875071386	0,388725249
PROPERTY	-1,494677352	-1,739785087	0,092501498
REINSURANCE	0,237936022	1,916869957	0,065155135

TABLE 4
FIB Estimates (2003) with FF3F and SUM-FF3F

MODEL 5: Dependent variable β(Country) FF3F

	Beta Factor	t	Sig.
ACCIDENT&HEALTH	0,316866192	2,048323372	0,049676645
AUTOMOBILE	0,450538449	0,907223868	0,371765678
CREDIT	0,065629953	0,521067516	0,606276192
FIRE	-0,09129391	-0,458817085	0,64978588
LIABILITY	1,192339847	1,707974934	0,098326122
LIFE	0,343923089	2,273437124	0,030585294
LIFE_LINKED	0,006938488	0,049353678	0,960975796
MAT	-0,16580204	-0,630034756	0,533605069
OTHER	0,206212285	1,358054553	0,18491919
PROPERTY	-1,53875474	-1,766129996	0,087900813
REINSURANCE	0,211543146	1,680492292	0,103603658

MODEL 6: Dependent variable β(Country) FF3F-SUM

	Beta Factor	t	Sig.
ACCIDENT&HEALTH	0,263401574	1,678476581	0,103999896
AUTOMOBILE	0,417475651	0,8286823	0,414052846
CREDIT	0,199536535	1,561667728	0,129214227
FIRE	-0,070122401	-0,347399233	0,73080012
LIABILITY	1,19970692	1,69406825	0,100967735
LIFE	0,37077283	2,416038333	0,022215205
LIFE_LINKED	0,022982181	0,161146263	0,873095603
MAT	-0,125391578	-0,469696483	0,642084607
OTHER	0,156636294	1,016879247	0,317619994
PROPERTY	-1,549134672	-1,752736947	0,090214843
REINSURANCE	0,171121375	1,340034968	0,190639818

MODEL 7: Dependent variable β(European) FF3F

	Beta Factor	t	Sig.
ACCIDENT&HEALTH	0,338571965	2,225632731	0,033973921
AUTOMOBILE	0,372179025	0,762104263	0,452151939
CREDIT	0,064227798	0,518555	0,608005568
FIRE	-0,076212843	-0,389498536	0,699753122
LIABILITY	1,261611122	1,8377517	0,076364543
LIFE	0,303628658	2,041005919	0,050444458
LIFE_LINKED	0,005228846	0,037821648	0,970089049
MAT	-0,1015599	-0,392443184	0,697600424
OTHER	0,204112024	1,366945373	0,182146318
PROPERTY	-1,566357106	-1,828200965	0,077823758
REINSURANCE	0,237080997	1,915200301	0,065376098

MODEL 8: Dependent variable β(European) FF3F-SUM

	Beta Factor	t	Sig.
ACCIDENT&HEALTH	0,258153286	1,619396258	0,116187639
AUTOMOBILE	0,415698365	0,812295005	0,423240543
CREDIT	0,219624996	1,692101964	0,101345995
FIRE	-0,062695474	-0,30576433	0,761968285
LIABILITY	1,299987752	1,807064083	0,081138297
LIFE	0,315751692	2,025443629	0,052112257
LIFE_LINKED	0,01359815	0,093861474	0,925864702
MAT	-0,09065721	-0,334294972	0,740562627
OTHER	0,127314405	0,813641491	0,422480917
PROPERTY	-1,657333617	-1,845933541	0,075133207
REINSURANCE	0,164845225	1,270769546	0,213910486