Determination of Fair Underwriting Return for Property and Liability Insurance Industry

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Ⅰ. Introduction

There have been substantial debates and controversies about whether to allow for investment income in setting rates for property and liability insurers. The debate began at least as early as 1919 when a resolution was introduced at the National Convention of Insurance Commissioners to determine the extent to which investment income should be considered in ratemaking. After two years' debate the so-called 1921 Standard Profit Formula was adopted by the NAIC. That formula provided that fire insurers were entitled to a 5 percent underwriting profit and no part of investment income should be considered in ratemaking process (Webb, 1979). No explanation was given to indicate how the percentage was derived.

Until late 1960s the rate of return regulation in the industry tended to apply fixed arbitrary rules of thumb to determine a fair profit rate for underwriting. In the last ten years a number of states have begun to consider investment income in addition to underwriting profits in ratemaking. How to consider investment income in ratemaking

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differs among states. Most states adopt somewhat arbitrary methods, a primary example of which sets 5% underwriting profit margin and reduce it by any of investment income earned on unearned premium reserves or loss reserves or both. This method has no theoretical basis and doesn't take account of risk.

A minority of states, among which Massachusetts is a primary example, consider investment income from capital and surplus as well as investment income from reserves. In deciding underwriting profit the Commissioner of Massachusetts used Capital Asset Pricing Model (CAPM) that has received widespread attention in the recent financial areas of academy and practice. CAPM is a major kind of equilibrium pricing model in the recent financial economics. This model assumes a frictionless market or free competition. If, in an effort to promote efficiency, the objective of rate regulation requires the determination of the prices which would prevail under competition, then regulation must be based on some model of the costs of regulated firms. Under competition with free entry, prices just cover all economic costs, including the opportunity costs of investment by suppliers of capital, and a valuation model is required to explain how the market value of the firm, and therefore the cost of capital, reacts to the changes in the prices it charges. In this regard we may properly use the CAPM in determining a regulated or fair rate of underwriting return of the property-liability insurance industry since the model explains what the required rate of return or cost of capital of the firm should be in equilibrium.

There are three major kinds of equilibrium pricing theories in the recent financial economics. They are the Capital Asset Pricing Model (CAPM), the Arbitrage Pricing Theory (APT), and the Option Pricing Model (OPM). CAPM is the most powerful in explaining asset returns in equilibrium. Theoretically it is possible to derive a fair rate of return in property-liability insurance industry using the APT, but in practice it is not plausible to use the APT until the economic meanings are given to the common factors of the model. The OPM is good for pricing contingent claims like the options, but the model is weak in explaining the value of stocks. All those three models can explain the individual stock returns in equilibrium whereas only the CAPM can explain the returns on the stocks as a whole in the market, e.g., E (Rm), since the CAPM alone is based on the optimization principle.

However, the CAPM is not without fault. I will examine the validity of the CAPM in section Ⅱ. The traditional 5% profit rate has no theoretical background and the historical profit rates earned by the insurance industry has been much lower than the traditionally regulated rates. So people began to consider applying the CAPM, the most powerful equilibrium pricing theory, nowadays to insurance ratemaking. There are various models which use the CAPM to determine a fair insurance premium. Among them the Fairley's model is most revealing and succinct while the others give similar results and interpretations. Hence I will discuss the Fairley model extensively in section Ⅲ. All such models including the Fairley's assume the CAPM is "valid". The validity of the CAPM will be examined in section Ⅱ. Even though we accept the CAPM is valid, we should ask whether we can estimate the model parameters appropriately; if not, we cannot use the model for the practical purposes. In the second part of section Ⅲ, I will talk about estimation of the model parameters. In the third part of the section Ⅲ, I will try to extend the Fairley model by including the effects of the taxes, inflation, and the nontraded assets. In the last part of section Ⅲ, I briefly will discuss the model of Kraus and Ross which uses the APT. In the final section the overall conclusion and summary will be given.

Ⅱ. Capital Asset Pricing Model

There are three major pricing theories in the recent financial economics – the Capital Asset Pricing Model (CAPM), the Arbitrage Pricing Theory (APT), and the Option Pricing Model (OPM). All three models are equilibrium pricing models; but the CAPM alone is based on the optimization principle, so can be used for explaining both the return on the securities as a whole and the return on an individual security while the APT and the OPM can be used only for explaining the indivivual stock returns.

1. Definition of the CAPM

Assuming a perfect capital market, the CAPM explains how the returns on the individual securities are determind:

$$E(R_i) = R_i + [E(R_m) - R_i]\beta_i$$

Where $\beta_i = \dfrac{\text{cov}(R_i,\ R_m)}{\text{var}(R_m)}$

E(Ri) = the expected return on the security i

R_f = the return on the riskless asset

$E(R_m)$ = the expected return on the market portfolio

The rates of return on individual stock depend on the riskless return, the excess market return, and the systematic risk of the stock.

The return on the stocks as a whole can also be explained by the CAPM [Friend & Blume (1975)] :

$$E(R_m) = R_f + \alpha C \sigma_m^2$$

where α = the proportion of wealth invested into risky assets by all investors in the market

C = the harmonic mean of the Pratt-Arrow measures of relative risk aversion of all investors in the market

σ_m^2 = the variance of market return

In nly risky asset world, $\alpha = 1$. If we assume constant relative risk aversion of individuals, C will be constant unless the wealth redistribution occurs. Then the rate of return on the market as a whole depends on the variance of the market return. I'll examine the validity of the assumptions and discuss empirical tests of the CAPM below.

2. Validity of the CAPM

The greatest assumption of the Fairley' s model discussed most extensively in this paper is that the CAPM is valid. The CAPM was developed almost simultaneously and independently by Sharpe (1964), Lintner (1965), and Mossin (1966). The model is based on many assumptions which are not necessarily realistic. The key assumptions are as following:

(1) Investors are risk averse who maximize the expected utility of their end-of-one-period wealth.

(2) Investors have homogeneous expectations about asset returns which have joint normal distribution.

(3) There exists a risk free asset such that investors can borrow or lend unlimited amounts at the risk free rate.

(4) All assets are marketable and perfectly divisible.

(5) There are no market imperfections such as taxes, restrictions on short selling or transaction costs.

Much study have been done on this model in the academic world and this model has been used widespreadly in the business world since the model was made. I would like to discuss the validity of this model below.

Most empirical studies proved linear relationship between stock return and market portpolio. However, the empirical studies done by Black, Jensen, and Scholes (1972), Fama and MacBeth (1973), and Friend and Blume (1973) showed that the risk free rate and the slope of security market line SML was smaller than that which would be predicted by the S-L (Sharpe-Lintner) CAPM. In other words, the returns on low beta securities are underestimated and the returns on the high beta securities are overestimated by the original S-L model. Other major empirical studies have shown similar results. These results imply the S-L model is invalid if the measurement error is small and ex post measurement is not much different from ex ante measurement.

These results can be caused from institutional constraints such as taxation, human wealth, and transaction costs or from different rates on borrowing and lending.

Many scholars tried to extend the original Sharpe-Lintner model. For instances, Black (1972) extended the S-L model to the world where there is no risk free rate. He found that in the world with no risk free rate the expected return on the zero beta asset which has no covariance with market return can be replaced for the risk free rate. Merton (1973) extended the original CAPM model to the continuous multiperiod case. Mayers (1973) extended the S-L model to the world with nonmarketable assets. These extended models didn't change the significant nature of the S-L original model. They maintatined linear relationship between risk and return and the beta is still the only measure of risk.

Richard Roll (1977) insisted that the validity of CAPM and efficiency of market portfolio should always be tested jointly. If ex post efficient market portpolio were chosen, the empirical tests using the efficient market portfolio always show that CAPM is valid and all stock returns will exactly lie on the SML. Choosing slightly different market proxies can give very different results. Since market portfolio consists of all the assets in the world, it is impossible to measure the return on the market portfolio; hence, the meaningful tests of CAPM are actually not possible, and the empirical tests done until now are meaningless or misleading. However, Robert Staumbaugh(1981) showed that the empirical test results are not sensitive to the market portfolio proxies chosen. Friend's several other studies also showed the insensitivity and the empirical rejection of Roll's suggestion.

In conclusion, most major empirical studies showed the original Sharpe-Lintner model is not valid; the intercept of SML was found to be higher and the slope of SML to be smaller than those predicted by the S-L model. This can be arisen from the several reasons described previously, but we can explain this by Black' s zero beta version of CAPM. In the world with no riskless rates at which we can borrow and lend, the return on zero beta assets can replace the risk free rate: $E(r_i) = E(r_z) + \beta_i\ [E(r_m) - E(r_z)]$ where $E(r_z)$ represents the return on the zero beta assets. The SML of this zero beta version has higher intercept, i.e., $E(r_z)$ and flatter slope than the SML of the original S-L model, so this zero beta version coincides with most empirical test results. Since Fairley's model like most other analyses used the original S-L model instead of using Black's zero beta version, it will not fit to the real world well though it can approximate the real situation. Empirical tests of Fairley (1979) which used the S-L model showed good description of reality though the zero beta version would have given the better results. Of course, the Black's version will not describe the real world exactly since the model did not consider taxes, nontraded assets, heterogeneous expectations, etc. The extended model considering these will be much more complicated, but the significant nature of the original model will be maintained.

Ⅲ. Fair Underwriting Return

There are many models or analyses which apply CAPM to derive risk-adjusted rates of return that the capital market requires of stock property-liability insurers. The required underwriting profit margins in insurance premiums for the property-liability insurers that are consistent with those risk-adjusted rates of return are derived. Among those many analyses the Fairley's model seems to be most succinct and revealing, so I will discuss his model extensively though others' model like Hill's (1979) actually give the similar results and interpretations. A distinctive feature of the Fairley's model (1979) is that the required profit margins do not depend on actual investment portfolio.

In this section, firstly, the assumptions, content, and interpretations of the Fairley model are given. Secondly, the issues concerning the estimation of the model parameters will be presented. Thirdly, we will try to extend the Fairley Model by considering the effects of taxes, inflation, and human wealth. Finally, the model of Kraus and Ross which utilizes the APT in deriving fair underwriting return is provided and here, the CAPM and APT are compared.

1. Fairley's model

The aim of the Fairley model was to solve for an underwriting profit rate which reflected the potential investment income available from the timing of the cash flow. Such a profit margin could replace the traditional and arbitrary fixed profit margin per dollar of sales. The traditional profit rate is defined without any reference to the timing of flows. Once the timing of the cash flow is recognized, the problem is to find a profit rate which, when combined with investment income, insures a return on equity which includes the appropriate risk premium. Fairley solved this problem by using the Sharpe-Lintner CAPM.

He used three steps to get the fair rate of underwriting returns for each line of the property-liablility insurance industry. First, he got the rates of return on equity of insurance company as a function of the return on the assets and the return on the underwriting. Second, he gave the model for getting the target rate of return based on the CAPM assuming the CAPM is valid. Third, he equates the rate of return on equity for the insurance company to the target return and solves for the fair rate of return which is sufficient for not penalizing the stockholders of the company such that the stock value of the company do not go down because of inadequate insurance rate. The contents and interpretations of each step are given below.

(i) The rate of return on equity:

$$r_E = p \cdot s + r_A(k \cdot s + 1) \tag{1, a}$$

where r_E = rate of return on equity, r_A=rate of return on asset,

p = underwriting return as % of premium, s = premium to surplus ratio, and

k = average holding period.

We can see from the above that as s increases, it has multiplicative effect on r_E through the effect on asset and underwriting returns.

(ii) Target rate of return on equity:

$$E(r_E)^* = r_f + \beta_E[E(r_m) - r_f] \tag{2, a}$$

$$E(r_E)^* = r_f + s \cdot \beta_E[E(r_m) - r_f] + (k_s + 1)\beta_A[E(r_m) - r_f] \tag{2, b}$$

where $E(r_E)^*$ = target rate of return on equity, β_E = equity beta, β_P denotes underwriting beta and β_A represents asset beta.

The first term of eq.(2, b) represents the compensation for the opportunity cost. Stockholders should earn at least r_f because whenever they pull out money and invest them in the treasury bills, they earn r_f. The second term represents the compensation for the underwriting risk since underwriting adds its own risk to total risk on equity. The third term shows the compensation for the investment risk. When the insurance company invests in the assets in the market, the investment risk represented by β_A will arise. The stockholders should be compensated for that risk.

(iii) From eq.(1, a), we can derive the following:

$$E(r_E) = s \cdot E(p) + (k \cdot s + 1)\, E(r_A) \tag{1, b}$$

$$E(r_E) = s \cdot E(p) + (k \cdot s + 1)\{r_f + \beta_A[E(r_m) - r_f]\} \tag{1, c}$$

By equating eq. (1, c) with eq. (2, b), we can solve for the following fair rate of return:

$$E(p) = -k \cdot r_f + \beta_P[\mathrm{E}(r_m) - r_f] \tag{3, a}$$

The first term of eq. (3, a) indicates the compensation for the policyholders for using funds at r_f. The larger k leads to larger compensation since larger k means the insurance company holds the policyholder' s funds longer. These funds are compensated at r_f since the policyholders are not supposed to take investment risks. The stockholders are compensated for only systematic risks of underwriting since the unsystematic risks are diversified away in efficient portfolios. The compensation for the investment risk does not appear here since the company will automatically get fair rate of return on risky assets if those assets are priced efficiently in the market. If the asset market is in equilibrium, the assets will be priced efficiently.

The Fairley model assume the investors have one period horizon, so all parameters are supposed to be measured within one period context. However, the actual investors' investment horizons are multiperiod. So we should examine how seriously this assumption restricts the Fairley's model when it is applied to reality. This issue is related to the concept of myopia in the finance literature. Under myopia the investors can make optimal investment decision assuming they have one period horizon even though in reality they have multiperiod time horizon. Certain kinds of investor's utility functions such as log utility function〔$U(w) = lnw$〕 and power utility function〔$U(w) = -w(\gamma^1)$〕 lead to myopia where w denotes final wealth of the investors and γ indicates the measure of risk aversion. People tend to invest larger amount of money into a given risky project as they becomes richer. So we can correctly assume people have decreasing absolute risk aversion. Also people are assumed to invest constant proportion of their wealth into risky assets as they become richer. Hence, they may correctly be assumed to have constant relative risk aversion. Only log and power utility functions exhibit decreasing absolute risk aversion and constant relative risk aversion. Other utility functions do not show those properties. For example, the quadratic utility function exhibits increasing absolute risk aversion and the exponential utility functions show constant absolute risk aversion, both of which are far from reality. Hence, we can assume people have log or power utility functions which lead to myopia. Empirical study by Friend and Blume (1975) showed people have decreasing absolute risk aversion and constant relative risk aversion.

Fairley assumes that risk of underwriting does not vary significantly from firm to firm or at least that the risk of the Value Line sample is close to the average for all firms under regulation. Note that the risk of firms varies considerably from firm to firm since it depends on the firm's leverage, the composition of investment portfolio, and the rate at which a firm pays tax. However, all these sources of variation in firm risk can be controlled for so that they do not affect the measurement of underwriting risk. By controlling for changes in such variable as leverage, we can better measure the constant part of a firm's risk which presumably reflects its underlying business risk. This is very close to the procedure followed in the Fairley model. By accounting for changes in the ratio of assets to equity, the composition of the investment portfolio, and taxation, the Fairly model isolates the risk of underwriting which should be relatively stable across firms and over time.

The probability of insolvency is not considered in the Fairley model. It is clear that the proper treatment of insolvency risk in the context of the CAPM is extremely difficult and not yet well advanced according to Fairley (1979). To consumers, insolvency can give rise to nonpayment of debt while in practice state guarantee funds almost always protect the policyholders from nonpayment of claims. The actual insolvency has arisen rarely, and that came mostly from incompetence or fraud and not from variability of investment and underwriting. Though few insolvencies occurred in the past, thers's no guarantee that would be the case in the future. However, a model with no consideration of insolvency can describe the reality quite well under present situation.

The extensions of the Fairley's model are given by Modigliani and Hill (1981). Fairley considered only single tax rate case. All reported income of the firm is taxed at a certain single corporate income tax rate. However, investment income is taxed at different rates.

Hill and Modigliani extended the Fairley model to the model which considers lower tax rate on capital gains than on dividend income. Fairley didn' t consider nonmarketable assets and inflation. When Modigliani and Hill considered those, the results of Fairley' s model were quite robust.

2. Estimation of Model Parameters

In order to apply the Fairley model to insurance rate regulation, we should estimate accurately the model parameters such as k, r_f, β_p, s and $E(r_m)$. k and r_f are rather easy to measure while there are much debate on measuring β_P and $E(r_m)$. k can be interpreted as the average amount of investable funds created by the cash flow per dollar of annual premium. k is a kind of leverage and fund generating ratio and can be estimated by liabilities to premiums ratio for each line. r_f can be measured by 90 day Treasury bill rates. They are closely tied to expectation about inflation over the shortrun future. To the extent that Treasury bills embody expected inflation, their use insures that the real value of the risk premium is maintained.

There are much debate on calculating β_P. The required premium rate tends to be very sensitive to measurement of β_P. There are two major methods to calculate β_P. The first is the backout method. From $\beta_E = (1 - t)[\beta_A(k \cdot s + 1) + s \cdot \beta_P]$, we can solve for β_P; namely, β_P can be expressed with all remaining parameters since we can't observe β_P directly. We can measure all parameters except β_P. t is the tax rate at which an insurance company pays. k is liabilities to premium ratio. s is the premium to surplus ratio. Since there are no underlying theory determining the value of s, there are debate on determing the value of s. Even though overall p/s ratio is 1.5, it does not mean we can apply this ratio 1.5 to each line of the company. Measuring β_E is relatively easy. We can get the returns of equity for the publicly traded insurance companies. Since β_E = cov (r_E, r_m)/var(r_m), if we get r_E from the publicly traded companies, we can get the value of cov (r_E, r_m) and can get var(r_m) from the market. Among thousands of insurance companies, only 22 companies are publicly traded. So we can do the above procedure for only 22 companies. We use their β_E for the rest of industry. That's a great jump. We can measure β_A by averaging betas for the different securities in company portfolios. Betas for the portfolios can be estimated using a subsample of the Value Line companies for which portfolio composition is available. Since we can compute β_E and β_A for only Value Line compaies, we can estimate β_P only for these companies. We use the average β_P of these companies for the rest of the companies. That may be a great jump. However, if we can control for each firm's leverage, the composition of investment portfolio, and tax rate, the underwriting risk of each firm will become similar after controlling for those factors. Then we can properly use β_P of the Value Line companies for the rest of the companies in the property-liability insurance industry.

The second method to calculate β_P is the regression method. By regressing book underwriting return on excess market return, we can get β_P ; $p_t - r_{ft} = \alpha + \beta_P[r_{mt} - r_{ft}]$ where $p_t = 1 - CR_t$. CR_t represents combined ratio. The problem here is that we should regress reported book number on the market number. The underwriting systematic risk should reflect the risk as it is assessed by market participants. Unfortunately, market return on underwriting activities are not observable. At the same time, underwriting profits reported by insurers are not necessarily equal to the way market participants assess those profits, their variablity, and the systematic portion of the risk. It follows that evaluation of the systematic risk of underwriting, which is not based on market returns but on reported profits, may result in biased estimates of the coefficients. Straight-forward application of time series regression of reported underwriting profits against the rate of return on the market portfolio leaves something to be desired.

There are two different teachniques to estimate $[E(r_m) - r_f]$. The first is to utilize realized rates of return on stocks and fixed interest rates, while the second will attempt to develop direct ex ante measures. Common stocks on the NYSE are used as a principal proxy for the market portfolio of risky assets partially because of the importance of these stocks in the actual market portfolio, but more pragmatically because of the lack of data on returns for most other risky assets. The value weighted arithmetic average of realized rates of return on NYSE common stocks can be used for $E(r_m)$. We can estimate r_f by 90 day Treasury bill rate. If there are sampling or measurement errors, β_P will be a biased estimates of true β_P. Also we can expect this ex post measures would be different from the ex ante measures. Jensen showed that if β_P and r_f are constant or stationary over time, then the ex post vs. ex ante measure problem becomes irrelevant. However, β_P is not stationary over time. Of course, in the Fairley model like others', ex ante concept is used. Measuring this ex ante concept by ex post estimates may give rise to biased results.

An alternative way to assess the market excess return is to develop ex ante measures of the expected returns on risky assets. We can survey the expected returns of the market participants directly. According to Friend the use of direct ex ante measures can increase measurement errors greatly. The measurement errors arising from using realized returns can largely be avoided by grouping technique. However, the measurement errors arising from using ex ante data are very difficult to control.

3. Extensions of Fairley Model

In order to include the effects of taxes, inflation, and nontraded assets into the Fairley model, we will rephrase the original model:

$$E(p) = -k \cdot r_f + \frac{E(r_m) - r_f}{\sigma^2 m} \operatorname{cov}(p,\ r_m)$$

where $\frac{E(r_m) - r_f}{\sigma^2 m}$ represents the market price of risk (MPR).

We can use the framework of Friend & *et al.* (1976) to derive E(p) under uncertain inflation:

$$E(p) = -k \cdot r_f + \sigma_{p\pi} + \left[\frac{E(r_m) - r_f \sigma_{m\pi}}{\sigma_m^2 - \sigma_{m\pi} / \alpha}\right](\sigma_{pm} - \sigma_{p\pi} / \alpha)$$

where π indicates rate of inflation and is the ratio of risky assets to total wealth and $\sigma_{p\pi}$ = cov(p, π), $\sigma_{p\pi}$= cov(r_m, π). From the above equation, we can see the original model understates MPR if an uncertain inflation is expected and there are positive correlation between market return and rate of inflation. Also we can see the original model overstates the risk of underwriting if uncertain inflation is expected and $\sigma_{p\pi} > 0$. Empirically, $\sigma_{p\pi} \approx 0$ relative to σ_π^2, so usual measure of MPR is virtually unaffected by inflation.

Assuming the tax rate of t_c on corporate income and t_p on riskless interests, then MPR become $\frac{(1-t_c)(1-t_p)E(r_m)-(1-t_p)r_f}{(1-t_c)^2(1-t_p)^2\sigma_m^2}$.

We should replace MPR of the original model by the above MPR when we consider two kinds of tax rates.

If the underwriting returns of companies are correlated with nontraded human wealth, the underwriting return becomes riskier and the MPR will change. In this case, according to Friend and *et al.* (1976) the MPR become

$$\left[\frac{R}{W*}+\beta_{hm}\frac{H}{W*}\right] C$$

where

R = total value of all risky assets,

W = tax adjusted sum of all wealth,

$$\beta_{hm}=\frac{\mathrm{cov}(r_h,\ r_m)}{\mathrm{var}(r_m)},$$

r_h = return on human wealth

H = total value of human wealth in the market

C = harmonic mean of investors' measure of relative risk aversion.

When we consider human wealth in the market, we should replace the MPR of the original model by the above new MPR. The empirical studies done by Fama and Schwert(1977) showed the return on human capital is very weakly correlated with return on the market portfolio. So, including the effects of human capital into the original Fairley model will not change the model significantly. The same is true for the case of uncertain inflation.

4. Kraus and Ross' Model

This model can be used to explain individual stock return. Based on such assumptions as 1) the return generating function $r_i = \beta_{i1}\delta_1 + \cdots + \beta_{ik}\delta_k + \varepsilon_i$ and 2) perfectly competitive market, it gives k factor equilibrium model:

$E(r_i) = \lambda_0 + \lambda_1\beta_{i1} + \cdots + \lambda_k\beta_{ik}$ where λ_i represents the common factors in the economy. When r_f exists, $\lambda_0 = r_f$.

Applying the APT, Kraus and Ross(1982) found the competitive premium by considering the covariance of the loss, L, with the systematic risk factors which are priced in the economy:

$$P = \frac{E[L] - \Sigma_i \lambda_i \beta_i^L}{1 + r_f}$$

Specializing to the CAPM model of Sharpe and Lintner yields

$$P = \frac{E[L] - \lambda\beta^L}{1 + r_f}$$

where $\beta_i^L = \dfrac{\mathrm{cov}(L_i,\ R_m)}{\mathrm{var}(R_m)}$, $\lambda = (E_m - r_f)$, r_f =risk free rate,

E_m = expecred market return

If the beta coefficient is redefined as the beta coefficient of losses per premium dollar, i.e.,

$$\beta_L = \frac{\mathrm{cov}\left(\frac{L}{P},\ R_m\right)}{\mathrm{var}(R_m)}$$

then the expected underwriting profit becomes

$$U = \frac{P - E[L]}{P} = -r_f - \beta_L(E_m - r_f)$$
$$= -r_f + \beta_P(E_m - r_f)$$

where β_P represents beta of underwriting profits.

This is Fairley's and Hill's estimate of the fair profit rate while the reserves to premium ratio, k, is assumed to be one in the Fairley's case.

Empirical tests of Ross and Roll(1980) support the APT and they found as many as four common factors are significant and unsystematic risk, σ, has no explanatory power. Also they insist the APT is more testable than the CAPM since in the APT no special role is played by the market portfolio which is almost impossible to measure exactly. Roll(1977) insists that using the proxy for the market portfolio which is closely related to but is slightly different from the true market portfolio can give rise to significantly different results. Hence the use of the proxy market portfolio in testing the CAPM can not be justified. However, Staumbaugh (1981) showed the test results are not sensitive to choosing the proxies for the market portfolio.

Though Roll and Ross (1980) insist the APT is less restrictive than the CAPM, the APT seems to be more restrictive in the sense that the APT assumes homogeneous expectations on every β_{ij} while the CAPM assumes that just on β_i. Also, Roll and Ross didn't give any economic meaning to the common factors, so the 3 or 4 common factors which they found significant in each test group can't be used for any predictive purpose since we don't know the economic meaning of the common factors. In addition we don' t know the common factors are identical for each group. Dhrymes & *et al.* (1982) found the number of common factors increased as the sample sizes of test group increased. Also, they found the unsystematic risk, σ, was as important as the beta coefficient.

The APT has several advantages such that it doesn't make any assumption on the return distribution and it holds in both single and multiperiod and it does not require market portfolio to be mean variance efficient. However, any person can not give clear economic meaning to the common factors; namely, we don't know what the 3 or 4 common factors are, whether they are weather, GNP, wealth or what? Moreover, we may have to use different factors for explaining different individual stock returns since the 3 or 4 common factors in each group of Roll and Ross' tests (1980) may differ from group to group. CAPM, at least, has a predictive power since its value can be expected by an adaptive scheme. But the APT don't have such predictive power, nor the explanatory power of returns because we don't know the exact meaning of common factors. In sum the APT seems to have less power in explaining individual stock returns than the CAPM.

V. Conclusion

Even nowadays in the U.S. many states do not consider investment income and use arbitrary fixed profit rates in insurance ratemaking. Most states which consider investment income in ratemaking still adopt somewhat arbitrary method, a primary example of which sets 5% underwriting profit margin and reduce it by any of investment income earned on reserves. This method has no theoretical basis and does not consider the risk associated with returns. A few states like Massachusetts began to use CAPM to determine fair underwriting profit. The CAPM is an equilibrium pricing theory in recent financial economics. Among three most persuasive pricing models the CAPM is the most powerful in explaining the return on the risky assets in equilibrium. However, the CAPM has been found to be inconsistent with most empirical studies. So, the original Sharpe-Linter model will not give the precise answer when it is used for determining fair underwriting rates while the model may approximate the reality.

I suggested the Black's zero beta version would better fit to the reality since the new version can explain why empirical intercept of SML is higher and the slope is flatter than that of the original SML. We tried to extend the Fairley model by considering the effects of inflation, taxes, and human wealth on the market price of risk. We showed the Fairley model would not be affected significantly when we include the effects of uncertain inflation and human capital. The empirical studies by Fairley (1979) and Hill(1979) showed the traditionally regulated profit rates were too high comparing to the rates suggested by the CAPM. The rates given by the models using the CAPM have been consistent with the historical rates experienced in the property-liability insurance industry. This implies the CAPM can give quite precise answer for determining the fair underwriting profit rates. However, we know the answers given by CAPM would not be the exact ones considering the CAPM is inconsistent with most major empirical tests. Myers and Cohn (1982) suggested discounted cash flow model. This is also based on CAPM and hence it's subject to the similar criticisms. But it has a stronger point than the Fairley model in that it considers the commitment of the stockholder equity to insurance business while the premium to surplus ratio does not appear in the Fairley model.

In order to get over or compensate for the defects of using CAPM, Dr. Cummins of University of Pennsylvania suggested the use of consumption based CAPM developed by Breeden (1979). According to that model, the relative return on the assets depends on the covariability of the return with the return on the market portfolio. According to Dr. Cummins, this model seems more relevant to insurance retemaking than the S-L CAPM because what the insurance company tries to do is to try to smoothe the people's consumption over time. People do not want the consumption of this period is high and the consumption of that period is low. A few states began to consider applying this model in determining the insurance premium.

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