ETLA ELINKEINOELÄMÄN TUTKIMUSLAITOS
THE RESEARCH INSTITUTE OF THE FINNISH ECONOMY
Lönnrotinkatu 4 B 00120 Helsinki Finland Tel. 601322 Telefax 601753

Keskusteluaiheita - Discussion papers

No. 319

Tom Berglund

EARNINGS VERSUS STOCK MARKET RETURNS; HOW BETAS COMPUTED ON THESE VARIABLES DIFFER*

* Useful comments from Kari Alho and Ralf Östermark are gratefully acknowledged as are John Rogers' efforts to improve the language of the paper.

ISSN 0781-6847 24.04.1990

CONTENTS

BERGLUND, Tom, EARNINGS VERSUS STOCK MARKET RETURNS; How Betas Computed on These Variables Differ. Helsinki : ETLA, Elinkeinoelämän Tutkimuslaitos, The Research Institute of the Finnish Economy, 1990. 12 p. (Keskusteluaiheita, Discussion Papers, ISSN 0781-6847; no. 319).

ABSTRACT: This paper shows that the simple relationship between stock market betas and accounting betas derived by Bowman (1979) is crucially dependent on earnings following a random walk. Under the more realistic assumptions proposed by Beaver, Lambert and Morse (1980), further verified in e.g. Collins Kothari and Rayburn (1987) and in Freeman (1987), it is seen that the covariance between contemporary earnings for the firm and the market may constitute but a relative unimportant part of the market beta. The main reason for this is that since earnings are not traded assets there is no mechanism to force a synchronization in earnings.

KEYWORDS: Accounting beta, earnings process, asset pricing.

EARNINGS VERSUS STOCK MARKET RETURNS; HOW BETAS COMPUTED ON THESE VARIABLES DIFFER

1. Introduction

The most widely used model for the relevant risk of an investment project is still the CAPM by Sharpe (1964) and Lintner (1965). According to this model the only risk that should command a premium from risk averse investors is the risk that cannot be eliminated through diversification. The degree of nondiversifiable risk that an asset carries is measured by the asset´s beta-coefficient ß. The beta coefficient for asset (firm) i is simply:

$$(1) \quad \beta_i = \frac{Cov(r_i, r_m)}{\sigma_m^2},$$

where Cov is the covariance operator, r_i is the return for the asset i, r_m is the return for the market portfolio and σ_m^2 is the variance for the market return.

On a small market, estimation of this coefficient may turn out to be quite difficult even for listed firms, due to thin trading in the stock itself and the small number of firms traded on the exchange[1]. Thus the endeavour to find a method to extract a measure for the nondiversifiable risk based on other information than stock market data seems worthwhile. The most natural source is found in accounting data.

This paper analyzes how the market ß as expressed in (1) is related to changes in accounting earnings. First, the relationship between earnings and returns under some simplifying assumptions is derived. This is followed by a discussion regarding what stochastic process earnings can be assumed to follow. Empirical results that relate to this problem will be briefly surveyed. Finally, the implications of these considerations for the relationship between accounting beta and the stock market ß according to (1) will be considered. A summary concludes the paper.

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[1] See e.g. Berglund, Liljeblom, and Löflund (1989).

2. Returns and earnings

If personal income taxation is disregarded, the value of equity in a firm at time 0 (V_0) according to the well known evaluation formula is the present value of its expected future dividends[2], i.e.

$$(2) \quad V_0 = \sum_{t=1}^{\infty} \frac{E_0\,[d_t]}{(1+\bar{r})^t} \,,$$

in which E_0 denotes expectations formed conditional on the information available at time 0, d_t is the dividend for period t, and $\bar{r}$ is the risk adjusted required rate of return for the firm, which for simplicity is assumed to be constant over time. If we assume that all earnings eventually are paid out to the stockholders as dividends, and that retained earnings in the meanwhile are invested at a constant expected return equal to the required rate, the above formula reduces to:

$$(3) \quad V_0 = \sum_{t=1}^{\infty} \frac{E_0\,[E_t]}{(1+\bar{r})^t} \,,$$

where E_0 denotes expectations conditional on the information available at time zero, E_t is earnings in period t or more exactly: net operating income minus economic depreciation[3] in period t[4].

The realized return on equity in the first period, assuming no dividends and a constant required rate of return will, using (3) and adding and subtracting the expected rate of return, be:

[2] See Williams (1938) and Gordon & Shapiro (1956).

[3] For simplicity we assume that there are neither windfall gains nor losses to the present holdings of fixed capital.

[4] This earnings concept will of course differ from reported earnings. Beaver, Lambert and Morse (1980), and Ohlson (1989) use the concept "ungarbled earnings" to signify the difference compared to earnings computed from reported accounting data, in which modifications based on various considerations not directly derived from the actual economic state of the firm, cannot be completely eliminated.

$$(4)\quad r_1 = \frac{V_1 - V_0}{V_0} = \bar{r} + \frac{E_1 - E_0[E_1] + \sum_{t=1}^{\infty} \frac{E_1[E_{t+1}] - E_0[E_{t+1}]}{(1+\bar{r})^t}}{\sum_{t=1}^{\infty} \frac{E_0[E_t]}{(1+\bar{r})^t}} \equiv \bar{r} + \frac{dE_1 + dE[E_{F1}]}{V_0},$$

i.e. the required return plus essentially two terms: the difference between the realized and the ex ante expected earnings for the first period, denoted by dE_1, and the present value of the changes in expectations for all subsequent periods in response to the additional information received during the first period[5], denoted by $dE\ [E_{F1}]$.

Expression (4) highlights the relationship between stock market returns and the earnings of the firm. The relationship will depend on how a surprise in earnings for the most recent period dE_1 is transmitted into expectations of future earnings $dE\ [E_{F1}]$. Strict proportionality between the surprise and the revision of the expected future earnings would be sufficient to guarantee perfect correlation between stock market returns and the earnings that are realized during the same period.

Claiming strict proportionality for on the one hand the difference between realized and expected earnings, and on the other hand the change in expected future earnings, along with rational expectations, is equivalent to saying that the earnings process has to be a martingale[6] after the elimination of a possible constant multiplicative drift[7]. Last year´s observed earnings are the only information needed to predict future earnings. If the earnings process were not a martingale in this sense, the adjustment of future expectations by the proportion in which realized returns differ from expectations would be irrational.

A special case obtains when investors have static expectations in the sense that the expected value of next year´s, and all future earnings, equal last year´s earnings. If next

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[5] Lipe (1990), p.67, notes that the valuation formula in (3) leads to (4) if the present value of the revision in expected dividends equal the present value of the revisions in future accounting earnings.

[6] Bowman (1979) uses the assumption of a random walk. However the implied constant distribution of the changes in earnings is in fact unnecessary.

[7] The martingale property after the elimination of a constant multiplicative drift (change/ period = λ >0) means that $E_0[E_n - \lambda^n E_0] = 0$ for n=1,..... It is easily seen that this implies: $E\,[E_n] / E\,[E_{n-1}] = \lambda$, i.e. a constant expected growth rate of earnings. On the other hand, using the law of iterative expectations, it is easily seen that a constant rationally expected growth rate of earnings imply that earnings will follow a martingale after the elimination of the drift equal to the growth rate.

year´s realized earnings turn out to differ from last year´s earnings by a factor of k[8], which may be any number, it is easily seen from (4) that the stock market return will differ from the required rate by the same factor.

3. The stochastic process for earnings

A priori, the justification for the assumption that earnings change randomly do not seem to be very strong. In contrast to stock prices, earnings are not prices on traded assets. Consequently the argument employed by Samuelson (1965) to prove that properly anticipated prices should fluctuate randomly is not applicable to earnings. A known increase in next year´s earnings, to e.g. twice their present level, will not automatically lead to a capitalization of the increase in this year´s earnings.

In fact, there are many reasons to believe that earnings should not fluctuate completely randomly. Among the reasons for why we would expect a deviation from randomness are:

1. Most firms occasionally make losses and still they are not forced into liquidation. If earnings followed a random walk, observed negative earnings should imply expected negative future earnings and in that case liquidation would be in the interest of both the shareholders and the debt holders of the firm. In other words, the fact that firms are allowed to continue after an observed loss implies that investors expect earnings to recover, which is not consistent with earnings following a random walk[9].

2. Standard microeconomic theory tells us that high profits, if not a consequence of monopoly power, are temporary. A firm which is making high profits will catch the

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[8] $E_1 = k E_0 = k E_0[E_1]$

[9] Ball and Watts (1972) note that the assumption of earnings following a random walk imply that all firms eventually will fail. Under rationality, given that earnings follow a martingale, this failure should occur when earnings for the first time turn negative.

attention of other entrepreneurs which will enter the market In the absence of considerable entry barriers competition will drive down profits to a normal level.[10]

On the basis of these considerations it seems that a stochastic process for earnings should include a mean reverting tendency. In the case of exceptionally low earnings investors normally expect an improvement and in the case of exceptionally high earnings investors normally expect a decrease in earnings.

The conclusions drawn in empirical studies on the stochastic process followed by earnings have changed as the research has progressed. Early work, e.g. Ball and Watts (1972), indicated that earnings do in fact follow a random walk. These results were later questioned by less straightforward results, which on the one hand revealed that earnings do not follow a random walk, but on the other hand any alternative models with more predictive power proved difficult to construct, see e.g. Albrecht, Lookabill and McKeown (1977). In a paper by Brooks and Buckmaster from 1976 it is shown that, as expected on the basis of the a priori arguments above, exceptionally high or low earnings seem to be subject to a mean reverting process.

Since then, a more analytical approach based on the seminal paper by Beaver, Lambert and Morse (1980), which explicitly takes into account the information content of earnings for predicting future earnings, led to the claim that the null hypothesis of earnings following a random walk was not what we normally would expect from the earnings process. Thus, the question became why previous tests failed to reject this null hypothesis. Freeman, Ohlson and Penman (1982) p. 643 write:

"The variability in the (first) differences of earnings is too large to be compared to the variability in the expected differences in earnings. Thus, the null is difficult to reject because of the substantial noise relative to the amount of data that is typically available. The problem is amplified in that the distribution of differences in earnings is not normal, and a few outliers can swamp the analysis. It follows that the null will generally not be rejected unless the basic hypothesis is modified."

The problem with the amount of data refers to the fact that reliable independent observations are produced once a year, and even if reliable quarterly reports were available, 5 years would produce only 20 observations. Given the conditions cited above

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[10]Lev (1983) in discussing the economic rationale for expecting different stochastic processes for earnings in different firms, notes that the degree of competition will affect the persistence of earnings changes. In line with this argument the empirical results reported by Lev (1983) reveal that the magnitude of the barriers to entry seem to have a significant effect on the serial correlation of earnings.

the deviations from a null hypothesis of randomness has to be substantial to be detected with statistical tests on such a small number of observations.

Freeman, Ohlson and Penman (1982) themselves show that the book rate of return for the company tends to follow a mean reverting process, and that since earnings are related to the book rate of return this intertemporal pattern can be used to forecast earnings. Furthermore they show that when the book rate of return is close to its average a simple earnings trend model has predictive power with respect to earnings changes. These results indicate that the absence of serial correlation in previous studies may be a consequence of a non-linear serial correlation pattern which is negative for large changes and positive for small changes. When a linear serial correlation coefficient is estimated over large as well as small changes, these differences will cancel.

As pointed out by Beaver Lambert and Morse (1980) the martingale assumption for earnings also implies that information other than that regarding realized earnings is worthless in trying to forecast future earnings. However, in general it seems plausible that easily identifiable changes in business conditions may cause revisions in earnings forecasts, without necessarily affecting this year´s earnings. This is clearly seen in a simple example which could be taken from any highly capital intensive industry: A company´s announcement of a plan to substantially increase its production capacity is likely to affect the profits of the other makers of that product by the time the project is running, which may be several years from now. However, the effect on this year´s and next year´s earnings may be quite small.

Several studies, including Beaver, Lambert and Ryan (1987), Collins, Kothari, and Rayburn (1987), Freeman (1987), and Collins and Kothari (1989) have shown that changes in stock prices, not related to changes in reported earnings, will predict changes in future earnings. This clearly indicates that there are sources of information that can be utilized to improve upon forecasts of future earnings based exclusively on reported earnings[11].

Expectations of the future earnings of a firm are likely to change, on the one hand, in response to changes in macro economic and industry specific expectations, and on the other hand, in response to long-run changes in the individual firm. e.g. mergers or spin-offs[12]. The ß-coefficient of the firm will crucially depend on how changes in macro

[11] The role of additional information is explicitly analyzed in Lipe (1990).

[12] An interesting discussion of the characteristics of the firm, which on the basis of economic theory are expected to affect the time series properties of earnings, can be found in Lev (1983).

economic expectations will affect expected future earnings of the individual firm. Since there are no forces that would cause an exact synchronization in the response to a change in macroeconomic expectations between, on the one hand, the earnings of an individual firm and, on the other hand, the average earnings for all firms, these adjustments in forecast future earnings may in fact not affect the interfirm covariances between the earnings for the same period very strongly.

4. Accounting betas versus stock market betas

Returning to the definition of the ß-coefficient, the simple result derived by Bowman (1979), given the assumption that earnings follow a random walk, is the following:

$$(5) \quad \beta_i = \frac{V_m}{V_i}\, \beta_i^A,$$

where V_m is the value of the market, V_i the value of the firm, and β_i^A the accounting beta, defined as:

$$(6) \quad \beta_i^A = \frac{Cov(E_i, E_m)}{\sigma_{Em}^2},$$

where E stands for earnings, and the subscript m for the market as whole. According to expression (5) the ß computed from stock returns simply equals a scale factor times the accounting ß. However, when the assumption that changes in earnings are independent over time is discarded, this simple relationship is no longer valid.

Aggregating expression (4) over all firms the realized market return can correspondingly be written:

$$(7) \quad r_{m1} = \overline{r_m} + \frac{dE_{m1} + dE\,[E_{Fm1}]}{V_{0m}},$$

where the subscript m signifies aggregation over all firms with a weight proportional to their market value. Substituting expression (4) and (7) into expression (1) yields:

$$(8) \quad \beta_i = \frac{E_0\left[dE_{i1}dE_{m1} + dE_{i1}dE_1[E_{Fm1}] + dE_{m1}dE_1[E_{iF1}] + dE_1[E_{iF1}]\,dE_1[E_{Fm1}]\right]}{V_{i0}V_{0m}\sigma_m^2}$$

First of all we note that the expectations that appear in the numerator within the brackets are formed at time 1. At time 0 these expectations are random variables, as are the realizations for the first period. The numerator in expression (6) is the expectation of the first term within the brackets in the numerator of (8). By setting expression (5) equal to (8) it is seen that Bowman's assumptions imply that:

$$(9)\quad E_0\left[dE_{i1}\, dE_1[E_{Fm1}] + dE_{m1}\, dE_1[E_{iF1}] + dE_1[E_{iF1}]dE_1[E_{Fm1}]\right] = \kappa E_0\left[dE_{i1}dE_{m1}\right],$$

$$\text{where}\quad \kappa = \left[\frac{V_{0m}^2\sigma_m^2}{\sigma_{E,m}^2} - 1\right].$$

The latter three terms in the numerator of (8) are assumed to be strictly proportional to the first term. Taken strictly, the martingale assumption implies that only the first term in the brackets in (9) is non-zero, which means that the last term in the numerator of (8) is exactly proportional to the first term.

In reality it is quite conceivable that the earnings of some firms may react faster to an unexpected upturn in the economy, e.g. firms in the consumer goods industry, than those of the average firm. Earnings that lag the average change in earnings, on the other hand, will probably be found among firms that produce capital goods. For firms in either of these two groups an important component in the beta coefficient as expressed in (8) may come from one of the two middle terms in the numerator.

In general, purely random fluctuations are likely to affect the first term more than those terms which contain changes in expectations. Consequently, the most significant part of the ß-coefficient is likely to be the last term in the numerator, i.e. the change in expected future earnings for the individual firm in response to a change in expected future earnings for the market as whole. The results by Beaver, Lambert and Ryan (1987), Collins, Kothari, and Rayburn (1987), and Freeman (1987) verify that the market will anticipate changes in future earnings, in advance of changes in reported earnings, especially for large firms. These forecast revisions will show up in the last term in expression (8).

The fact that the covariance between realized earnings for the firm versus the market is a relatively unreliable part of the beta coefficient explains why the accounting beta has not generally turned out be very successful in forecasting the market risk of the firm, as evidenced e.g. in Beaver, Kettler and Scholes (1970). In fact, earnings variability may even be a better predictor for the last term in the numerator of (8) in the sense that a firm which has been subject to large fluctuations in earnings may be more vulnerable to a deteriorating general business outlook than a firm with more stable earnings. The reason is found in the lack of synchronization in earnings changes between different firms. If we compute the covariance between earnings exclusively over the same period, given a low degree of synchronization in earnings changes, we will obtain a small number for all those firms whose earnings lead or lag changes in average earnings. However, among the firms with large fluctuations in earnings we are likely to find those firms whose earnings will fall the most in response to a deterioration of the general business out-look, be it a lagging or a leading response compared to the average[13].

Furthermore, the apparent success of other accounting variables to predict the market risk of stocks[14] can also be explained using (8). Fundamental variables like the sensitivity of the sales figures of the firm to the level of macroeconomic activity, the financial leverage, and the operating leverage of the firm are more efficient in measuring the long-run sensitivity of expectations for the individual firm´s earnings to changes in market conditions than is the correlation in contemporaneous earnings. These fundamental variables indicate how much the earnings forecasts for the individual firm should be adjusted in response to an adjustment in the general economic outlook and consequently to an adjustment in the aggregate earnings forecast.

5. Conclusions

In this paper we have shown that the relationship between accounting earnings and stock market returns, under plausible assumptions, are expected to be more complicated than a simple adjustment for a difference in scale. The covariance between earnings for the same period explains only a part of the beta coefficient. The rest of the beta coefficient derives from expected non-synchronous changes in earnings. It is important to note that in contrast to returns on traded assets there is nothing to force a synchronization in earnings. In fact, plausible examples in which nonsynchronized changes are expected, are easy to construct. Thus, in the capital goods industry we would expect earnings changes to lag the average earnings changes in the economy.

The fact that earnings changes may be nonsynchronized, and that a change in the earnings for one period may be a relatively unreliable estimate for changes in future

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[13] The earnings variability as well as the ß-coefficient will be positively related to the operating leverage of the firm. A considerable operating leverage on the other hand may imply a lagged response to an upturn since considerable fixed costs usually imply that the industry may be plagued by excess capacity in the beginning of the upturn.

[14] See Beaver, Kettler and Scholes (1970).

expected earnings explains why the success in applying so-called accounting betas in predicting market risk has met with limited success. Furthermore, the relatively more successful attempts to explain market risk with the financial, and the operating leverage of the firm are easily understood in the present context. These variables are simply better indicators for how future earnings forecasts for the individual firm will react to changes in general business conditions.

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ELINKEINOELÄMÄN TUTKIMUSLAITOS (ETLA)
THE RESEARCH INSTITUTE OF THE FINNISH ECONOMY
LÖNNROTINKATU 4 B, SF-00120 HELSINKI

Puh./Tel. (90) 601 322 Telefax (90) 601 753
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