The Information Content of Accounting Numbers as Earnings Predictors One Year Ahead: The Case of Hong Kong

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Abstract

The study measures the power of non-earnings accounting information released by firms in Hong Kong to predict unexpected changes in earnings and stock returns, thus replicating an experiment carried out by Ou (1990) using US data. Our study shows that Ou's (1990) methodology is robust, predicting future earnings changes even where substantial decline in economic conditions have taken place.

Introduction

Conventional wisdom in finance around the late 1980s held that stock markets in many countries are semi-strong form efficient: stock prices impound publicly available information promptly and without bias. Ou and Penman (1989) and Ou's (1990) finding that publicly available financial statement numbers can predict future abnormal stock returns was therefore striking.[1] This study replicates, using Hong Kong data, the Ou (1990) study on the predictability of stock returns, showing that non-earnings accounting numbers may convey information about changes in future earnings which are not reflected in current earnings and may be used to predict future returns.

Amongst models used to explain the time series behaviour of earnings, two types have been considered: the mean reverting type where expectations are constant over time and the stochastic type where expectations are not stable, changing with the previous outcome, i.e., the value of a random variable X in period $t+1$ is related to its value in period t as:

$$X_{t+1} = \varnothing X_t + \delta + e_t$$

Stochastic models are similar to submartingales where $\varnothing = 1$ and $\delta \geq 0$. X exhibits a trend whenever δ is greater than 0. A martingale model, on the other hand, will be described by the same as above with $\varnothing = 1$ and $\delta = 0$. If additionally the (e_t, $_{t+1}$ ...., $_{t+n}$) series is independently and identically distributed, the stochastic model is a random walk.

Over the last thirty years, research has been carried out in order to ascertain which model best describes the behaviour of earnings. Little (1962), an early study, examined the correlation between successive growth rates in the earnings of UK firms, concluding that "the work done on correlating past and future growth... strongly suggested that the true relationship was rather random". The later study of Little and Rayner (1966), again, reached the same conclusion. Lintner and Glauber (1967) also investigated the relationship between growth rates in successive periods finding only small cross-sectional correlation between the growth rates of successive periods. Brealey (1967; 1969) investigated changes in income instead of its growth rates concluding that income followed a martingale. Ball and Watts (1972) examined the US Compustat firms over the 1947-1966 period using different tests, the same inference arising from each test, that the net income and earnings per share series follow a martingale type of process.[2]

Later research, performing tests at the individual firm level leads to ambiguous evidence. Watts & Leftwich (1977) reported that, for over half the firms in their sample, they could "reject the null

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[1] More recent studies such as Chan, Hamao and Lakonishok (1991), Fama and French (1993), Grieg (1992), Stober (1992), Ou and Penman (1993) and Ball (1992) have corroborated the above results, providing compelling evidence on the relevance of fundamental accounting variables for equity valuation.

[2] In the study of Ball and Watts (1972), the actual net income data give a similar ranking to both a martingale and a submartingale with a trend.

hypothesis that the estimated process is no different from a random walk at the 0.05 level". Albrecht, Lookabill & McKeown (1977) reported a similar result. Departures from random walk are reported only when researchers adopt sample stratification analysis. Brooks and Buckmaster (1976; 1980) examined a sample of US Compustat firms, stratifying their sample by the magnitude of the previous year's earnings change. They concluded that "a large relative increase in income is generally followed by two or more periods when the firm underperforms the average or most likely outcome. Likewise, a firm with a large relative decrease in income generally outperforms the average or most likely outcome for two or more periods following the large increase". This result has been reported in other studies, for example, Beaver, Lambert & Morse (1980) and Freeman, Ohlson & Penman (1982).

Instead of pursuing the path adopted by most researchers, Ou and Penman (1989) and Ou (1990) used non-earnings accounting numbers to predict earnings changes one year ahead. Their results provide evidence for both a "predictive information link" between some non-earnings annual report numbers and future earnings changes and a "valuation link" between predicted future earnings changes and stock returns during the annual report dissemination period.[3] The predictive information link stems from fitting binary one-year-ahead earnings prediction models to selected annual report data and comparing these models' prediction power with that of a random walk.

Ou's (1990) results also provide an additional explanation for a result reported in Ball and Brown (1968). These authors noticed that the information on reported earnings is anticipated by the market as early as 12 months prior to the preliminary earnings announcement. They speculate that other news events, such as dividend and interim earnings announcements, might explain why "unexpected earnings" are anticipated. The predictive information link documented in Ou's (1990) study suggests that the release of the previous year's complete annual report, an event included in Ball and Brown's (1968) abnormal return accumulation period, provides useful information for forming expectations about the current year's earnings.

Ou (1990) used a dichotomous variable to predict the sign of the change in one-year-ahead earnings, i.e., an earnings increase or an earnings decrease. A change in firm *i*'s earnings in year *t+1*, denoted ΔEPS_{it+1} is calculated as:

$$\Delta EPS_{it+1} = (EPS_{it+1} - EPS_{it}) - drift_{it}$$

where EPS_{it+1} and EPS_{it} are firm *i*'s "as reported" earnings per share before extraordinary items for years *t+1* and *t*, respectively. The drift term for year *t* is defined as the mean earnings per share change over the four years prior to year *t* and is required for eliminating any apparent trend in earnings. ΔEPS_{it+1} is thus an unexpected change. After fitting univariate logit models for 61 financial ratios potentially useful as predictor candidates, only 8 such descriptors, with an estimated coefficient significant at the 10% level, were retained. Then multivariate logit models were used for these descriptors to find appropriate models. These descriptors are:

(1) %ΔINVTA: percentage change in the "inventory to total assets" ratio;

(2) %ΔSALTA: percentage growth in the "net sales to total assets" ratio;

(3) %ΔDPS: change in "dividends per share", relative to that of the previous year;

(4) %ΔDEP: percentage growth in "depreciation expense";

(5) %ΔCPXTA1: percentage growth in the "capital expenditure to total assets" ratio;

(6) %ΔCPXTA2: %ΔCPXTA1, with a one-year lag;

[3] In this framework, the observed contemporaneous association between accounting data and stock prices is the result of an "information link" between accounting data and future streams of benefits from equity investments and a "valuation link" between future benefits and stock prices. Information disclosure triggers revisions of investors' expectation of the future benefits. These revisions are then reflected in current stock prices. This framework is formally presented in Ohlson (1979) and Garman and Ohlson (1980), and empirically tested by Easton (1985).

(7) ROE: rate of return on equity (income before extraordinary items" divided by total owners' equity as of the beginning of the year);

(8) ΔROE: change in ROE, relative to the previous year's ROE.

Using the above eight ratios, Ou (1990) then constructed three multivariate prediction models: Model 1, based on all eight accounting predictors; Model 2, based on six accounting predictors excluding ROE & %ΔROE; and Model 3, based on ROE only.

The predictive performance for each of the above models during the period 1978-1983 was then examined. The output of the model is an estimated probability of an earnings increase in the subsequent year. To translate each probabilistic prediction into a binary prediction of an earnings increase or decrease, Ou (1990) used two pre-set probability cut-off schemes: (0.5, 0.5) and (0.6, 0.4). Under the (0.5, 0.5) scheme, the prediction is an earnings increase when the probability is greater than 0.5 and a decrease otherwise. Alternatively, under the (0.6, 0.4) scheme, the prediction is an earnings increase when the probability is greater than or equal to 0.6 and a decrease when the probability is less than or equal to 0.4; observations with probability between 0.6 and 0.4 are discarded. Each of the three logit models had a prediction accuracy higher than 50% (i.e., 61%, 58% and 58% for Models 1, 2 and 3 respectively under the (0.5, 0.5) scheme). The performance substantially improved when the (0.6, 0.4) cutoff scheme was used.

Data and Methodology

Similar to Ou's (1990), this study approximates "unexpected earnings" in the specification of earnings changes under a submartingale process. That is, the earnings change is defined as the difference in two consecutive years' earnings per share, net of estimated drift. Accounting information used in our study is extracted from an annual Pacific-Basin Capital Markets (PACAP) Database for the period 1985-1993[4]. Only firms not involved in banking, finance and insurance, with financial statement figures stated in HKD and USD have been chosen. The number of firms included in samples varies from year to year, increasing from about 215 in 1985 to 361 in 1993. Most of the Hong Kong firms do not disclose information on Cost of Goods Sold (and consequently Gross Margin) as they consider such information confidential and subject to usage by competitors. Therefore, computation of ratios related to such items cannot possibly be made even though Ou and Penman (1989) has used Gross Margin as the component predictor in their earnings prediction model. Three other ratios also impossible to compute in our case are Percentage Change in Depreciation (%ΔDEP), Percentage Change in Capital Expenditure to Total Assets (%ΔCPXTA1) and Percentage Change in Capital Expenditure to Total Assets with a one-year lag (%ΔCPXTA2) due to the fact that Depreciation and Capital Expenditure are not available in the PACAP database. These three ratios are also predictors in Ou's (1990) models. Another problem encountered in our study is the fact that a significant number of Hong Kong firms have zero inventory figures. This is typical of firms such as shipping, property development and other services. Accordingly, ratios related to Inventory were excluded from the analysis. One other ratio removed from the model due to the large amount of missing cases is Percentage Change in Dividend Per Share (%ΔDPS).

Except in the case of those ratios close to normality, we applied symmetrical logarithm transformations to eliminate skewness, reduce the number of outliers and subdue heteroscedasticity. The multivariate statistical technique employed in our study to build the empirical models is discriminant analysis. We avoided using logit regression as such tool implicitly incorporate group proportions as present in samples in the estimation of the predicted probabilities. If, for example, firms exhibiting positive earnings changes are more frequent in the sample than those having negative changes, then the logistic model is biased towards more easily recognising positive changes. Discriminant analysis separates the calculation of conditional probabilities from the introduction of non-equal priors.

[4] The PACAP database is developed by the Sandra Ann Morsilli Pacific-Basin Capital Markets Research Centre, in the College of Business Administration at the University of Rhode Island (USA) and is updated annually. We extend this history back to 1981 because of the requirement to estimate an earnings drift parameter over four years. Note, however, that the earnings prediction model is estimated using data from 1985 onwards.

Furthermore, we consider that what Ou (1990) describes as different cut-off probability schemes (0.5, 0.5) and (0.6, 0.4) is tantamount to introducing in the outcome, besides the bias referred to above, yet another arbitrary set of a-priori probabilities. Ou's (1990) cut-off of 0.6 means that an explicit prior probability is added to the logistic output. This renders the model more sensitive to upwards earnings changes. Similarly, the cut-off of 0.4 means that a second prior judgement, contradictory with the first, is added to the logistic regression output. Sensitivity to downwards changes also increases. The extra power of the models may thus reflect the above prior judgements. In order to illustrate the potential for unbalancing models which the use of non-equal priors entails, our results are replicated using unbalanced sets of priors.. Thus, in our case, the output of the discriminant model, a Z-score, is translated into a binary prediction of an earnings increase or decrease, using two sets of prior probability schemes (0.5, 0.5) and (0.6, 0.4). Under the (0.5, 0.5) scheme, earnings decreases are a-priori considered as equally likely as earnings increases. Under the (0.6, 0.4) scheme, earnings increases are considered, a-priori, more likely, thus models are more sensitive to positive earnings changes.

Model's results must be validated by measuring its performance in a different data set. Ou (1990) divided her data set in two periods, 1965-77 and 1978-83, using the first period to build the earnings prediction model and testing its performance in the second period. However, Freeman et al. (1982) suggest that the economy, namely macro-economic variables, may have explanatory power in predicting earnings changes. The predictive power claimed by Ou (1990) might then stem from smoothed economic conditions, not just from genuine accounting information. In our study, the hypothesis that the economy may interfere with accounting information is made explicit by choosing the period 1985-88 to build models and the period 1989-93 to test them. The first of such periods presents economic conditions which are opposed to those in the second.

Results

Predictive Information Link: when we refer to the predictive performance of a particular year, it means that the non-earnings accounting variables of that year are used to predict the earnings changes for the subsequent year. Ratios with overall explanatory power are (Table 1):

Table 1.
Discriminant Two-Period Earnings Prediction Model (1985-1988)

Financial Ratios	Abbreviation	Standardised Coefficient
Dividend per Share	DPS	+0.63
Sales to Total Assets	SALTA	+0.52
% Change in Sales to Total Assets	%ΔSALTA	-0.34
Cash to Sales	CSHSAL	+0.27
Return on Total Assets	RTA	-0.18

The magnitude of the standardised coefficient shows the relative explanatory importance of each ratio. A highly significant Chi-Square of 45.5 was obtained when estimating the overall fitness of the model. Univariate F-ratios of each of the above predictors are significant, at least at the 0.05 level, except in the case of Cash to Sales (CSHSAL), which is non-significant. However, when removing this variable from the analysis, a significant break in the overall Chi-Square and performance is observed. The above illustrates just how elusive univariate screening techniques can be. The performance obtained in the test period is 58%, distributed as follows (

Table 2):

Table 2.
Predictive Performance of Two-Period Earnings Prediction Model Without Prior Probability

Actual Group	As Predicted		Total No. of Cases
	Downwards EPS Changes	Upwards EPS Changes	
Downwards EPS Changes	212 (58%)	157	369
Upwards EPS Changes	152	209 (58%)	361
Total No. of Cases	364	366	730

Numbers refer to cases falling inside each classification group

The model is balanced (the proportion of upwards earnings changes correctly classified is similar to the corresponding proportion of downwards changes).

When, in the same case, different prior probabilities are introduced to translate Z-Scores into classifications results, the balance referred to above is strongly affected. The overall performance is 55% and, in detail (Table 3):

Table 3.
Predictive Performance, Prior Probability 0.4 And 0.6

Actual Group	As Predicted		Total No. of Cases
	Downwards EPS Changes	Upwards EPS Changes	
Downwards EPS Changes	87 (24%)	282	369
Upwards EPS Changes	48	313 (87%)	361
Total No. of Cases	135	595	730

The above strong imbalance between upwards and downwards performance is obtained by introducing just a small amount of prior information: p=0.6 for upwards and p=0.4 for downwards. On a yearly basis, the prediction model performs as follows (Table 4):

Table 4.
Yearly Performance by year

Year	Total No. of Cases	Prior Probability			
		(0.5, 0.5)		(0.6, 0.4)	
		Correct Prediction		Correct Prediction	
		No. of Cases	%	No. of Cases	%
1989	160	93	58%	83	52%
1990	166	94	57%	87	52%
1991	196	110	56%	115	59%
1992	208	124	60%	115	55%
Overall	730	421	58%	400	55%

Under the (0.5, 0.5) scheme, the percentage of correct predictions ranges from 56% to 60%. When priors (0.6, 0.4) are used, prediction accuracy improves for year 1991 instead of for all years as in Ou's (1990) study. The results indicate that the superiority of the model over the random-guess strategy is consistent across individual years. Table 5 and 6 are further breakdowns of the correct prediction where subsequent earnings changes are a decrease or an increase.

Table 5.
Yearly Performance When Subsequent Earnings Changes are a Decrease

Year	Total No. of Cases	Prior Probability			
		(0.5, 0.5)		(0.6, 0.4)	
		Correct Prediction		Correct Prediction	
		No. of Cases	%	No. of Cases	%
1989	79	45	57%	17	22%
1990	85	49	58%	19	22%
1991	98	52	53%	25	26%
1992	107	66	62%	26	24%
Overall	369	212	58%	87	24%

Table 6.
Yearly Performance When Subsequent Earnings Changes are an Increase

Year	Total No. of Cases	Prior Probability			
		(0.5, 0.5)		(0.6, 0.4)	
		Correct Prediction		Correct Prediction	
		No. of Cases	%	No. of Cases	%
1989	81	48	59%	66	81%
1990	81	45	56%	68	84%
1991	98	58	59%	90	92%
1992	101	58	57%	89	88%
Overall	361	209	58%	313	87%

Under the (0.5, 0.5) scheme of the two-period model, the predictive power from year to year for downwards earnings changes shows more variability (between 53% and 62%) than for upwards earnings changes (between 56% and 59%). When prior probability (0.6, 0.4) is used, the correction prediction rate is only 22% to 26% for downwards earnings changes but 81% to 92% for upwards earnings changes.

Valuation Link: this study also investigates the link between predicted earnings changes and the behaviour of prices in the Hong Kong stock market. Following Ou (1990), the annual report of year *t* is viewed as containing two signals: First, signal E indicates the direction of changes in earnings in the current year (*t*). Second, signal F (forecast) corresponds to the possibility of investors forecasting next year's (*t+1*) earnings changes.

The above discriminant model is used to forecast the changes in earnings during the period 1988-92. Two sets of firms are obtained: F+ firms with a forecasted positive change in earnings and F- with a negative forecast. Then, four portfolios are formed: portfolio E+F+, containing firms having positive E and F signals; and similarly, portfolio E+F-, E-F+ and E-F-. Finally, the relative performance of each of these portfolios in the stock market is compared using the comulative abnormal return (CAR) measurement, calculated monthly from April of year *t* until March of year *t+1*.[5] The CAR of a portfolio held from month *m* to month *n* (both relative to month 0) has the form: $CAR_{mn} = 1/N \sum_t \sum_i \left(\prod_{m \text{ to } n} (1 + e_{ist}) - 1 \right)$ where e_{ist} is the market model residual of month *s* for firm *i* in year *t* and N is the total number of firm-year observations in each portfolio. Both monthly returns and the index used as the independent variable in market model regressions were extracted from the same PACAP database. Only 50 firms having fiscal year end on December were selected, yielding a total of 250 different cases. The obtained CAR for each month are displayed on Table 7 and in figure 1.

Table 7.
Comulative Abnormal Returns (CAR) for Portfolios and Overall

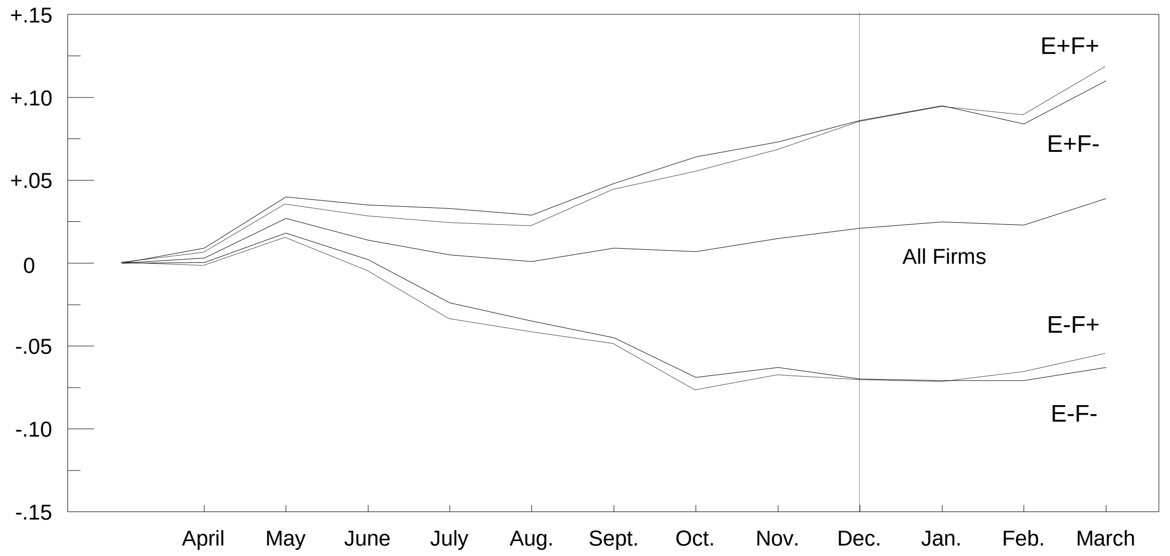
Month	All Firms	E-F-	E+F-	E-F+	E+F+
April	0.003	0.004	0.009	-0.002	0.003

[5] See, e.g., Ball & Brown (1968), Ou (1990), or other texts on the absorption of information by capital markets for more details. Notice that, in our case, CARs, not APIs (abnormal performance indices), were used.

May	0.022	0.024	0.040	0.015	0.030
June	0.014	0.002	0.035	-0.005	0.028
July	0.005	-0.024	0.033	-0.034	0.024
August	0.001	-0.035	0.029	-0.042	0.022
September	0.009	-0.045	0.048	-0.049	0.044
October	0.007	-0.069	0.064	-0.077	0.055
November	0.015	-0.063	0.073	-0.068	0.068
December	0.021	-0.070	0.086	-0.071	0.085
January	0.025	-0.071	0.095	-0.072	0.094
February	0.023	-0.071	0.084	-0.066	0.089
March	0.039	-0.063	0.100	-0.050	0.118

This result shows that, also in Hong Kong, investors use forecasts of changes in earnings, based on accounting information, to price quoted firms. Indeed, during the annual report dissemination period (January to March of year *t+1*), there is a change of behaviour in portfolios F+ and F- with regard to the performance based solely on the information available for the current year (E+ or E). The differences from Ou's (1990) results are that, in her case, such change takes place one month earlier and, in the case of bad news, there is no clear evidence of a post-annoncement period where investors take a significant amount of time to absorb such news.

Figure 1. Comulative Abnormal Returns



Conclusions

This study has replicated, in the Hong Kong context, a significant and well-known piece of research which digs straight into the problem of whether or not accounting numbers convey significant information to investors. Features of firms bearing significant predictive power were quite similar in Ou's (1990) and in our models. For example, the Percentage Change in Sales to Total Assets (%ΔSALTA) is exactly the same in both Ou's (1990) and our models; the Rate of Return on Equity (ROE) in Ou's (1990) models is similar to our Return on Assets (RTA).

Our study confirms Ou's basic intuition: the existence of a multivariate mechanism leading to the predictability of firm's earnings, small as it may be, means that investors, also in Hong Kong, can obtain marginal information about future earnings changes. One major result of our study is the fact that Ou's (1990) methodology seems to be basically robust in the presence of different economic patterns. In other words, accounting information may be used to predict, to a given extent, earnings changes one year ahead, irrespective of the economic mood. This result importantly suggests that, contrary to what happens in capital markets (where prices, in spite of reflecting investor's expectations, are very sensitive to pervasive economic forces and to specific or local events), accounting information is more sheltered from such disturbances.

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