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Empirical Tests of the Clean Surplus Valuation Model:

Canadian Evidence

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A Thesis in the Faculty of Commerce & Administration

Presented in Partial Fulfillment of the Requirements

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ABSTRACT

Empirical Tests of the Clean Surplus Valuation Model: Canadian Evidence

Yue Liu

The main purpose of this research is to empirically test the validity of the clean surplus valuation model for Canadian public companies.

The empirical results of this research confirm the high explanation power of the clean surplus model in predicting stock prices for Canadian public companies and support the use of the clean surplus model as a proxy for intrinsic firm value. Profitable trading strategies are successfully constructed based on the intrinsic values suggested by the model. It is evident that under-priced portfolios identified by the model consistently yield higher returns than other portfolios for all different holding periods.

This research proves that the clean surplus valuation model provides a criteria that is both theoretical sound and empirically valid. By comparing the theoretical values with associated market prices, one can effectively construct profitable trading strategies by using fundamental variables and market values of mispriced stocks will eventually move toward their intrinsic values.

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I. Introduction

A fundamental research question in finance is to explain the relationship between the accounting measures of firm value and the associated market value. Numerous researches have been done with regard to this issue. Though previous research has extensively examined the valuation relevance of accounting measures, such as earnings, cash flow, book value, earnings-to-book ratio, earnings-to-price ratio, etc., there was no sound theory to back up the research until Edwards, Bell and Ohlson proposed the theoretical clean surplus valuation model. [Ohlson 1995, Feltham and Ohlson 1995] Recent research has proved the significant role of this model in explaining cross-sectional returns.

Given the above background, this research has two objectives. First, the paper empirically tests the valuation relevance of the clean surplus valuation model for Canadian companies. The reason for me to use Canadian data to test this model is that though there are a number of previous researches testing the clean surplus valuation model, few of them are based on Canadian public companies. Second, this paper examines whether we can construct profitable trading strategies based on the intrinsic values suggested by this model.

All 1049 Canadian firms listed in Compustat database are included in this research. Accounting information and market prices are retrieved from 1985 to 1998. Monthly T-bill rates are extracted from the TSE database.

The empirical results of this research confirm the high explanatory power of clean surplus model to predict stock price for Canadian public companies. The conclusion is true for both pooled analysis and cross-sectional analysis by year. In addition, the test

also confirms the conclusion of previous research that the model works well even for limited horizons. This may have important implications for the real business application of this model because the forecast for long horizons is difficult and inaccurate.

Based on the soundness of the clean surplus valuation model, trading strategies are constructed by comparing theoretical value of a firm V with its associated market price P . Over-priced and under-priced portfolios are formed based on the ranking of V/P ratio and different holding periods are tested. Consistent with the hypothesis, under-priced portfolios yield much higher returns than correct-priced and over-priced portfolios for all different holding periods from one to three years.

The finding of this paper supports the use of the intrinsic values based on the clean surplus model as a proxy for firm value in predicting stock prices. It implies that if future earnings of limited horizons are correctly predicted, clean surplus valuation model may have great potential in predicting stock prices and identifying arbitrage opportunities. It suggests that one can effectively construct profitable trading strategies by using fundamental variables based on the clean surplus valuation model.

The rest of this paper is organized as follows: In section II, I review some of previous researches on the clean surplus valuation model and its application. In section III, I describe the research variables used in this research. In section IV, I discuss model design and model comparison issues, and provide empirical test results of the clean surplus model for Canadian public companies. In section V, I present and compare the empirical results of profitable trading strategies constructed based on the model for different holding periods. Section VI concludes this research.

II. Previous Research

The concept of measuring a firm's value has become the focus of much attention by both researchers and practitioners. Edwards, Bell and Ohlson are among those who have addressed this issue. They propose a theoretical valuation model (clean surplus model, Edwards-Bell-Ohlson model or EBO model) [Ohlson 1995, Feltham and Ohlson 1995]. It shows that the intrinsic value of a firm can be expressed as original investment (original book value) plus the present value of infinite abnormal earnings beyond that investment. The theoretical value of a firm can be expressed by:

$$V_t = B_t + \sum_{i=1}^{\infty} [NI_{t+i} - (r_t * B_{t+i-1})] / (1 + r_t)^i$$

Where V_t = value of a firm for time t ;

B_t = book value for time t ;

NI_t = net income for time t ;

r_t = cost of capital for time t ;

The term in square bracket is abnormal earning, which is generally defined as after-tax profit minus a charge for invested capital. If return on equity (ROE) equals the cost of capital, then V equals B , which means no additional wealth is created. If the current period ROE is higher or lower than the cost of capital, then firm value will be higher or lower than the book value of previous period. The key original empirical implications of the EBO model stem from the information dynamics that link current information to future residual income.

The beauty of this relationship is that it holds whatever accounting principles are used, as long as they satisfy the clean-surplus relation, “that is, all changes in net book value other than dividends (net of capital contributions) are recorded in earnings” [Bernard 1993]. It precisely specifies the role of accounting information in valuation theory and intends to capture the intrinsic value of a firm. The model “is completely resilient to biases arising from conservatism and other forms of accounting manipulation. The resilience arises because any decrease (increase) in book value caused by conservative (aggressive) accounting is exactly offset by the increase (decrease) in future ROEs.” “If a firm is conservative, its book value will be ‘too low’ in an economic sense. However, as these intangible assets generate future earnings, future reported ROEs will be ‘too high’. Given clean surplus accounting, the two effects offset exactly, leaving the estimated firm value unaffected” [Frankel & Lee, 1995]. Similar comments can be found in Lundholm [1995] and Colin [1996].

There are a number of previous researches on the EBO model. Frankel and Lee [1995] report that when market value (V) is calculated according to fundamental equity value (EBO model), V is more highly correlated with stock price than book value (B). They find that V based on analyst forecasts of future earnings can explain two-thirds of cross-sectional price variations. By comparison, B/P explains one-third of the price variation. They also show that V/P has predictive power for future returns. They also report that for predicting future realized returns, V/P is superior to B/P for long term realized returns over three-year holding period. However, for one-year holding period, V/P does not dominate B/P and both have incremental power relative to each other.

Bernald [1995] shows that EBO model works well even for horizons as short as four years with explanatory power of 68 percent. It is relatively high compared with the explanatory power of dividend analysis of only 29 percent. In addition, he proposes that little can be gained by forecasting earnings and book value beyond four years.

Lee, Myers and Swaminathan [1996] report that when using a residual income valuation model to calculate intrinsic firm value, stock price and long-term convergent. They show that since 1978 a V/P ratio based on the residual income model not only tracks price closely, but also is a better predictor of subsequent returns.

O'Hanlon [1996] and Ryan [1996] empirically test the clean-surplus model by using UK companies as a sample. He suggests that accounting rate of return is value relevant. He also shows that when considering time series dependence, earning is the only one that exhibits consistent evidence of value relevance. In addition, the value relevance lies both in the mean and the current level of accounting rate of return, with the former being several times more important than the latter.

Tse and Yaansah [1997] use three models to test the EBO model. 1. the forecast model, which is based on Value Line earnings forecasts to predict the value of a firm; 2. the perfect-foresight model, which is based on realized earnings and other information, to "predict" the value of a firm; 3. the historical model, which is based on past earnings to predict the value of a firm. They show that when the forecast model performs better than both the perfect-foresight model and the historical model. All three models provide significant explanatory power for security prices. They further report that for the moderate earnings-to-price (E/P) sample, the explanatory power of the historical model is higher than that of the perfect foresight model, and is similar to, sometimes even higher than, that of the analyst forecast model. For extremely low and high E/P samples, the perfect-foresight model offers a higher explanatory power than the historical model. But the perfect-foresight model has a lower explanatory power than the analyst's forecast model for the above samples. The results suggest that though financial analysts' forecast is more accurate for extreme E/P firms, in general, both historical data and analysts' forecast are complementary information sources for security valuation.

Xiang and Zhang [1997] show that "if investment decisions follow the net present

value rule and if accounting is historical based and satisfies the clean surplus relation, we necessarily obtain conservative accounting (in the sense of Feltham and Ohlson 1995) – that is, the market value is greater than the book value on average, even in the absence of growth opportunity and inflation.”

Amir and Sougiannis [1997] apply the EBO model in valuation of deferred tax carryforwards. They find that analysts tend to be less precise and more optimistic in forecasting earnings for firms with deferred tax carryforwards. They also find a positive relation between tax carryforwards and share prices, indicating these carryforwards are valued as assets because the tax carryforwards may let firms pay less tax in the future. In addition, earnings and book values are valued less in firms with carryforwards than firms without carryforwards.

Dechow, Hutton and Sloan [1997] show that residual income is well described by the mean reverting process assumed in Ohlson [1995]. They find that the persistence of residual income is systematically associated with characteristics of firms. They compare the EBO model with pure earnings model and pure book value model. Their empirical results show that the EBO model is better at predicting and explaining future abnormal earnings, current stock prices, current stock returns and future stock returns. They further report that when using analysts’ forecast data, the EBO model is more accurate than using historical accounting data. The main reason for this is the analysts’ ability to access to a wider information set.

Herzberg [1998] reports that for a 12-year backtest period, the model appears to have been very effective in uncovering firms whose stock is underpriced considering expectations for strong earnings and growth.

There are also critics for the EBO model. Verrecchia [1998] argues that the model fails to consider underlying cash flows and/or other noncash information that affects

valuation (e.g., credit sales and purchases).

In sum, most of previous research reports that the values based on the EBO model are highly correlated with market prices and have a high prediction power for subsequent stock returns.

Motivated by the potential application value of the EBO model and previous research, this paper will empirically test the validity of this model by using Canadian data. The main research question of this paper is whether a firm value based on the EBO model is highly related to the associated market value for Canadian companies and how to choose a proper method to test this valuation model. Once the validity of this model is approved, further research can be conducted with regard to the application of the model. In this paper, I test whether we can find profitable arbitrage opportunities based on the intrinsic values suggested by the EBO model.

III. Description of Data

The sample includes in all 1049 Canadian public firms listed in Compustat database for the 1985 – 1998 period.

Accounting information, including book value per share, earnings per share and market price, is extracted for this period from Compustat.

T-bill rates are extracted from TSE database for the same period. Annualized T-bill rates are used as discount rates to calculate the present values of future abnormal earnings.

The study period for regression approach and portfolio approach is from 1985 to 1994. Because the EBO model requires future abnormal returns, accounting information, including book value per share, earnings per share and market price, is extracted from 1985 to 1998.

Per share values of book values, earnings and prices are used in regression analysis to reduce heteroscedasticity problems. A similar practice can be found in Kothari and Zimmerman [1995].

Both pooled regressions and cross-sectional regressions by year from 1985 to 1994 are used to test the validity of the EBO model. Years 1985 to 1994 are used as base years and the book values and earnings of the following three years (model 1 and 3) or the following four years (model 2 and 4) beyond the base years are used to calculate abnormal earnings.

To survive in the sample, book values per share and earnings per share must be available for at least four (model 1 and 3) or five years (model 2 and 4) consecutive years and

prices per share must be available for the base year. Final sample sizes are reported in the tables of empirical results.

The study period for the test of trading strategies covers the same period of 1985 to 1994. I evaluate the performance of various portfolios by observing the closing prices of the last trading day one year, two years and three years after the portfolios are constructed. To survive in the portfolio, book values per share and earnings per share must be available for at least four consecutive years and prices per share must be available for the base year.

IV. Regression Approach

1. Research Method

1.1 Model Construction

In this research Canadian firms' realized financial statements information and relevant realized market prices are used to test the model instead of using analysts' forecast data. The reason for using this approach is to avoid forecasting of net incomes. Using analysts' forecast data as proxy for future earnings has been shown to have a positive bias since the forecast tends to be optimistic [Afeck-Grave, Davis and Mendenhall 1990]. Based on these considerations, historical data will be used to test the validity of the model.

Previous research uses each component of the EBO model, such as original book value and subsequent years' abnormal earnings, as independent variables [Bernald, 1995; Frankel and Lee, 1995; Tse and Yaansah, 1997]. There is a severe multi-collinearity problem for this method. Independent variables are highly correlated with each other. Though this may not be a big problem in testing the EBO model if we just look at the explanatory power of the model, it makes us less confident in explaining the economic meanings of the coefficients.

In this paper, empirical tests are conducted using both components and the final calculated theoretical value based on the EBO model. Using the components of EBO model in regression analysis is to test whether multi-collinearity problem exists. Using the final theoretical value calculated from the clean-surplus model in the regression is to test whether it can have a higher explanatory power for associated stock prices. If the

explanatory power is high, it may be the better way for the application of the EBO model because the multi-collinearity problem is solved. In addition, this is more consistent with the EBO model and the underlying clean surplus relation.

Recall that the EBO model requires calculating the present value of abnormal earnings over the infinite time period. In reality, it is impossible for us to do so because our ability to forecast future earnings is limited. The longer the forecast horizon, the less accurate the forecast. One way to solve the problem is to calculate discounted abnormal earnings for a definite horizon and omits discounted abnormal earnings beyond this horizon. Bernald [1995] shows that EBO model works well even for horizons as short as four years.

Based on the above analyses, four models will be tested in this research.

The first model consists of only one independent variable – the final theoretical value calculated according to EBO model to see whether it has a high explanatory power for the associated stock prices. For model one, three years' abnormal earnings are used to calculate the theoretical value.

Model 1:

$$P = \alpha + \beta_1 EBO_1$$

Where P is the market price of a firm;

EBO1 is the theoretical value of the same firm based on EBO model,

$$EBO_t = B_0 + \sum_{t=1}^3 X_t^a / (1+r)^t$$

B_0 = book value per share for year 0;

X_t^a = abnormal earning per share for year t;

Where

$$X_t^a = X_t - r_t B_{t-1}$$

r_t = cost of capital for year t;

B_t = book value per share for year t;

X_t = primary earnings per share before extraordinary items and discontinued operations for year t. It is calculated after the effect of conversion of convertible preferred, convertible debentures, and options and warrants which have been identified as common stock equivalents;

r = cost of capital for year t;

The second model is similar to model one. It consists of only one independent variable – the theoretical value calculated according to EBO model. The only difference is four years' abnormal earnings are used in calculation to see whether the longer study period can improve the model's explanatory power substantially comparing with model one.

Model 2:

$$P = \alpha + \beta_1 EBO_2$$

$$EBO_2 = B_0 + \sum_{t=1}^4 X_t^a / (1+r)^t$$

The definitions of variables in EBO_2 are the same as those in EBO_1 .

The third model using the components of EBO model as independent variables. This is the method used by most of previous research. Three years' abnormal earnings are used to calculate the theoretical value.

Model 3:

$$P = \alpha + \beta_1 B_0 + \beta_2 X_1^a + \beta_3 X_2^a + \beta_4 X_3^a$$

Where P is the market price of a firm;

B_0 = book value per share for year 0;

X_t^a = abnormal earning per share for year t;

Where

$$X_t^a = X_t - r_t B_{t-1}$$

r_t = cost of capital for year t;

B_t = book value per share for year t;

X_t = primary earnings per share before extraordinary items and discontinued operations for year t. It is calculated after the effect of conversion of convertible preferred, convertible debentures, and options and warrants which have been identified as common stock equivalents;

r = cost of capital for year t;

The fourth model is similar to model three using the components of EBO model as independent variables. The only difference is four years' abnormal earnings are used in calculation to see whether the longer study period can improve the model's explanatory power.

Model 4:

$$P = \alpha + \beta_1 B_0 + \beta_2 X_1^a + \beta_3 X_2^a + \beta_4 X_3^a + \beta_5 X_4^a$$

The definitions of variables in Model 4 are the same as those in Model 3.

The purpose of testing these models is to see whether the explanatory power of clean surplus model to predict stock price is high for Canadian public companies and the model works well for limited horizons.

The predictive powers will be tested and compared for these models. In addition, the multi-collinearity problem will be tested for model three and model four.

In all models, abnormal returns beyond certain year (year 3 or year 4) are omitted. The reason for the omission is that it is impossible for us to use infinite numbers of abnormal earnings as the model requires and with the increase of time the discounted values become smaller and smaller. Bernald [1995] uses this method and shows that EBO model works well even for horizons as short as four years. In reality, it is also impossible for us to make accurate earning predictions beyond a certain horizon.

For all of the four models in this research, the cost of capital r_t is assumed to be equal to the risk-free T-bill rate of year t .

1.2 Survival Bias Test

Survival bias test is conducted to identify possible sample selection problem by using the following model.

$$R_i - r_f = \alpha + \beta(R_m - r_f)$$

where

R_i = return of individual firms;

r_f = risk-free discount rate, using year-end Canadian T-bill rate;

R_m = market return (TSE 300 return).

Pooled regression for the ten-year study period is conducted for the above model to test whether α is significant. If it is positively (negatively) significant, the sample used may have positive (negative) selection bias, which means the average return of the selected sample is higher (lower) the return of market. If the sample selection bias problem exists, the returns from the sample should be adjusted accordingly.

The result of pooled regression shows that there is a selection bias problem in the sample of this research. The magnitude of α is 1.075%. It is highly significant at 0.0001 level and its sign is positive, indicating a positive selection bias of the sample. Therefore, the average return of the sample selected is about one percent higher than the unbiased sample. This factor should be taken into account when explaining the empirical results.

2. Regression Results

First pooled regressions are conducted to test whether the above models have high explanatory power for the ten-year study period as a whole. Pooled regressions can also be used to compare the above models and identify potential problems.

2.1 Pooled regression results

INSERT TABLE 1 HERE

From Table 1, we can see that the adjusted R-squares of all four models are quite satisfactory, ranging from 55.3% to 61.8%.

For model 1 and model 2, the final theoretical values EBO1 and EBO2 based on EBO model are highly significant and the signs are positive, which means market prices increase with the increase of associated theoretical price. This is consistent with the EBO model implication that the increase in intrinsic value of a firm should result in the increase of stock price. Therefore, the coefficients of independent variables in model 1 and model 2 have obvious economic meaning.

Though model 2 includes one more abnormal return item, the adjusted R-square is only about one percent higher than that of model 1, indicating to include more future

abnormal returns may make very limited contribution to the total explanatory power of the model. In addition, to forecast future earnings for the fourth year may be difficult and inaccurate in practice. The empirical result implies that using three period abnormal earnings is a good choice for estimating stock prices.

Correlation analyses are conducted for model 3 and model 4 to examine possible multi-collinearity problem.

INSERT TABLE 2 AND TABLE 3 HERE

Based on the results of correlation analyses in Table 2 and Table 3, we can see that both model 3 and model 4 have severe multi-collinearity problems. All abnormal return components are highly correlated though almost all independent variables are highly significant except for AR4 (the abnormal earning of the fourth year) and the explanatory power of the model is high (Table 1). For both model 3 and model 4, the coefficients of abnormal earning beyond the second period are negative. This is not consistent with the EBO model that positive future abnormal earnings make positive contributions to firm value. Therefore they are of little economic meaning, indicating severe coefficient bias. If we can not explain the economic meanings of the coefficients, it will be less confident for us to interpret and apply the EBO model. Based on these considerations, model 3 and model 4 are not good models for the application of the EBO model.

From the above empirical results, it is evident that the final value calculated based on

EBO model is a good predictor of fair stock prices and using more abnormal earnings of future periods beyond period three provides very little improvement to the explanatory power. So model 1 will be used in the following regression test by year.

2.2 Cross-sectional regression results

Pooled regression approach in the previous section has approved the high explanatory power of the EBO model. One may be interested to see if the models works well for each year in the study period. So cross-sectional regressions are also conducted based on model 1 for each year of the ten-year period.

INSERT TABLE 4 HERE

From Table 4, the cross-sectional regression results by year for model 1 are very convincing. The adjusted R-squares range from 38.7% to 69.6%. Eight out of ten R-squares are over 50%, with five of them over 60% or very close to 60%. In addition, the coefficients for EBO1 are highly significant at 0.0001 and have the predicted sign.

In sum, based on the empirical results of this research, using individual components of EBO model as independent variables to forecast stock prices is not appropriate. It has severe multi-collinearity problem and the economic meanings of the coefficients cannot be explained. The final value calculated based on EBO model is a good predictor of fair

stock prices. Using three years' abnormal earnings can result in satisfactory explanatory power. This is confirmed by both pooled regression and cross-sectional regression results. In addition, using more abnormal earnings of future periods beyond period three provides very little improvement to the explanatory power. The comparison of the four models suggests model 1 is the best. It requires less forecasting periods and does not have multi-collinearity problems.

The explanatory powers obtained in this research are lower than those of previous research (Frankel and Lee, 1995 and Bernald, 1995). R-squares reported in their research are about 0.67. Lee, Myers and Swaminathan [1996] show that when firm value is calculated using historical earnings, the model's predictive power declines. Tse and Yaansah [1997] also report that forecast model (based on Value Line earnings forecasts) performs better than perfect-foresight model (based on realized future earnings). Another reason for the difference of explanatory powers between this research and previous research is that previous research uses the components of EBO model as independent variables. From Table 1 we can see that using the components of EBO model as independent variables can result in higher explanatory power for Canadian companies. Note that though the explanatory powers of the methods used by previous research are higher, I am reluctant to use the method because the economic meanings of the coefficients are hard to explain and severe multi-collinearity problem exists.

2.3 Market Factor Test

One may argue that the EBO model captures only company-specific factors. Market factors may also influence stock price and therefore are highly correlated with stock prices. It is common sense that when market index increases, the prices of most stocks increase, and vice versa. Many macro economy factors, such as the change of inflation rate and the change in gross national production, can be captured by market index. So it

is interesting to see when market index is included in the EBO model whether it can play an important role. In other words, whether market index is significant and whether it has a positive sign. Two indexes are tested – TSE total index (TSET) and TSE price index (TSEP). The two indexes are tested separately because they are highly correlated.

The two models tested are:

Model 5:

$$P = \alpha + \beta_1 EBO_1 + TSET$$

Model 6:

$$P = \alpha + \beta_1 EBO_1 + TSEP$$

Where

$$EBO_1 = B_0 + \sum_{t=1}^3 X_t^a / (1+r)^t$$

All variables have the same meaning as previous models.

If market index does play an important role in EBO model, we should hypothesize that TSET or TSEP is significant and their sign should be positive.

INSERT TABLE 5 HERE

Table 5 reports the empirical results of including TSE index in model 1. We can see that though adjusted R-squares are higher for both models compared with model 1, neither TSET nor TSEP is significant ($p=0.4608$ and $p=0.8757$ respectively). In addition, TSET has an unpredicted sign. The empirical results indicate that market index does not play an important role in the EBO model.

In sum, the results of regression approaches prove that using individual components of EBO model as independent variables to forecast stock prices is not appropriate and the final value based on EBO model can be used as a good predictor of fair stock prices. Both pooled regression results and cross-sectional regression results confirm this conclusion. In this way, the multi-collinearity problems and coefficient bias problems of previous researches are successfully controlled. Therefore model 1 and model 2 are preferred compared with model 3 and model 4.

In addition, the empirical results prove that using more abnormal earnings of future periods beyond period three provides very little improvement to the explanatory power. Furthermore predicting earnings of longer period tends to be difficult and unreliable. As a result, the model 1 is preferable to model 2. It requires less forecasting periods and does not have multi-collinearity problems. For these reasons, model 1 will be used in the following portfolio research.

V. Portfolio Approach

To further test the clean surplus valuation model and to evaluate whether profitable trading strategies can be constructed based on the model, I create portfolios based on the following rules.

First, portfolios are constructed by comparing intrinsic value (V) of a firm with its associated market price (P). The intrinsic values of the firms are calculated in the same way as the previous section of regression approach. Over-priced and under-priced portfolios are formed based on the ranking of V/P ratio.

Second, portfolios are formed on the first trading date in each sample year.

Third, stocks can only be sold on the last trading day of a given year to test whether under-priced portfolio(s) can yield higher returns than over-priced portfolio(s). Holding periods of one to three years are tested separately.

In the first part of my portfolio research, I use a simple two-portfolio approach to test whether under-priced portfolio can yield higher returns than over-priced portfolio. The under-priced portfolio consists of all companies with V/P ratios greater than one and the over-priced portfolio consists of all companies with V/P ratios less than one.

Then I test a more complicated five-portfolio approach. The portfolios are identified as most under-priced, less under-priced, correctly priced, over-priced and most over-priced portfolios based on the ranking of V/P ratios from high to low.

1. Two-portfolio approach

In the two-portfolio approach, stocks with V/P ratio greater than 1 are assigned to portfolio 1 and stocks with V/P ratio smaller than 1 are assigned to portfolio 2. Therefore portfolio 1 is under-priced portfolio and portfolio 2 is over-priced portfolio according to the EBO model. Base years for portfolio formation are from 1985 to 1994. Holding periods of one to three years are tested separately. Though this is a very simple portfolio approach, it is a beginning point to see whether the simplest strategy can produce some positive results.

1.1 Two-portfolio-one-holding-year trading strategy

INSERT TABLE 6 HERE

Table 6 reports the difference in returns between under-priced and over-priced portfolios for one year holding period. In each year of the study period, under-priced portfolio performs better than over-priced one. The biggest difference between the two portfolios is 64.8% in 1992 and the smallest difference is 6.6% in 1988. The average returns of under-priced and over-priced portfolios are 26.3% and 1.2% respectively. The average difference in returns between the two portfolios over the ten-year period is 25.1%.

The difference in returns between the two portfolios is shown in graph 1.

INSERT GRAPH 1 HERE

From the graph, it is quite obvious that the under-priced portfolio consistently yields higher returns than the over-priced portfolio.

In short, the simple two-portfolio-one-holding-year trading strategy is quite successful.

1.2 Two-portfolio-two-holding-year trading strategy

Using the same portfolio formation method as 1.1, two-year holding period is tested to test whether under-priced portfolio still yields higher returns.

INSERT TABLE 7 HERE

From Table 7, the difference in average annual returns between under-priced and over-priced portfolios is also obvious. In each year of the study period, under-priced portfolio performs better than over-priced one. The biggest difference of 67.7% occurs in 1991 and the smallest difference of 10.6% occurs in 1987. The average returns of under-priced

and over-priced portfolios are 29.6% and -0.2% respectively. The difference in average annual returns between the two portfolios over the 10 year research period is 29.8%, which is 4.7% higher than one year holding period.

The difference in annual returns between the two portfolios is shown in graph 2.

INSERT GRAPH 2 HERE

From the graph, it is also quite obvious that the under-priced portfolio consistently yields higher returns than the over-priced portfolio.

In short, the simple two-portfolio-two-holding-year trading strategy is quite successful and average annual return is higher than the return of one-year holding period.

1.3 Two-portfolio-three-holding-year trading strategy

Motivated by the higher return of two-year holding period, three-year holding period is tested to see whether higher return can be achieved.

INSERT TABLE 8 HERE

Table 8 reports the difference in average annual returns between under-priced and over-priced portfolios for three years holding period. In each year of the study period, under-priced portfolio performs better than over-priced one. The biggest difference between the two portfolios is 73.6% in 1990 and the smallest difference is 10.2% in 1987. The average returns of under-priced and over-priced portfolios are 30.6% and 0.2% respectively. The difference in average annual returns between the two portfolios over the ten-year period is 30.4%. It is slightly higher than the difference of returns of two-year holding period.

The difference in annual returns between the two portfolios is shown in graph 3.

INSERT GRAPH 3 HERE

Again, it is obvious that the under-priced portfolio consistently yields higher returns than the over-priced portfolio.

From the comparison of the three different holding periods, it seems that the longer the holding period, the higher the average annual return for under-priced portfolio. The

average annual returns for the under-priced portfolio are 26.3%, 29.6% and 30.6% for one-year, two-year and three-year holding periods respectively.

Based on mean returns of the portfolios constructed for the given one to three-year holding period, under-priced portfolios consistently outperform over-priced portfolios. Though using a simple portfolio approach, the difference between the two portfolios is quite obvious, indicating the great potential of the clean surplus valuation model in forming profitable trading strategies. The results are based on the assumption that trading occurs at closing prices and ignore transaction costs. Note that for the longer holding periods, the transaction costs would not be very significant, especially when the transactions are not frequent and the difference in returns between portfolios is apparent. In this research, there are at most two transactions each year (one buy and one sell).

In sum, for the ten-year period of the back test, the EBO model appears to have been very effective in uncovering under-priced firms by using the simple two-portfolio approach. It is also notable that all of the return differences demonstrate similar patterns for the one to three years holding periods.

2. Five-portfolio approach

Inspired by the successfulness of the two-portfolio approach, to further examine the validity of the clean surplus valuation model and its application value in constructing profitable trading strategy, I form five portfolios on the basis of ranked value of V/P ratios according to the following criteria. Stocks with V/P ratio smaller than 0.7 are assigned to portfolio 5; stocks with V/P ratio between 0.7 and 0.9 are assigned to portfolio 4; stocks with V/P ratio between 0.9 and 1.1 are assigned to portfolio 3; stocks with V/P between 1.1 and 1.3 are assigned to portfolio 2; and finally stocks with V/P ratio greater than 1.3 are assigned to portfolio 1. As a result, portfolio 1 is the most under-priced portfolio and portfolio 5 is the most over-priced portfolio based on the EBO model. Portfolio 3 tends to be correctly priced and could be a bench mark for evaluating portfolio 1, 2, 4 and 5.

2.1 Five-portfolio-one-holding-year trading strategy

Similar to two-portfolio approach, first I test the returns for one year holding period.

INSERT TABLE 9 HERE

Table 9 reports the returns of the five portfolios for one year holding period. For each year of the study period, it is evident that the returns of the most under-priced portfolio

1 far exceed the returns of the correctly priced portfolio 3, which is correctly-priced, while the returns of portfolio 3 far exceed the returns of most over-priced portfolio 5.

On average, the most under-priced portfolio produces an annual return of 33.7% over the ten-year study period. The difference in average annual returns between the portfolio 1 and 3 over the ten-year period is 28.3% while the difference in average annual returns between the portfolio 1 and 5 over the ten-year period is 35%.

The difference in annual returns between the five portfolios is shown in graph 4.

INSERT GRAPH 4 HERE

From the graph, it is obvious that the ranking of annual returns from highest to lowest is almost exactly the same as the ranking of portfolios beginning from the most under-priced to the most over-priced. The conclusion is true for almost each year of the ten-year study period, especially for the most under-priced portfolios and the most over-priced portfolios.

In short, the five-portfolio-one-holding-year trading strategy is quite successful, indicating the usefulness of the EBO model in constructing trading strategies.

2.2 Five-portfolio-two-holding-year trading strategy

Using the same portfolio formation method as 2.1, two-year holding period is tested to test whether under-priced portfolio still yields higher returns.

INSERT TABLE 10 HERE

The most under-priced portfolio produces an average annual return of 38.5% over the ten-year study period.

From Table 10 it is obvious that for each year of the study period, the returns of the most under-priced portfolio 1 far exceed the returns of the correctly priced portfolio 3, while the returns of portfolio 3 far exceed the returns of most over-priced portfolio 5.

The difference in average annual returns between the portfolio 1 and 3 over the ten-year period is 33.4% while the difference in average annual returns between the portfolio 1 and 5 over the ten-year period is 43.3%.

The difference in annual returns between the five portfolios is shown in graph 5.

INSERT GRAPH 5 HERE

Similar to graph 4, it is obvious that the ranking of annual returns from highest to lowest is almost exactly the same as the ranking of portfolios beginning from the most under-priced to the most over-priced. And the conclusion is true for almost each year of the ten-year study period, especially for the most under-priced portfolios and the most over-priced portfolios. So the five-portfolio-two-holding-year trading strategy is quite successful.

2.3 Five-portfolio-three-holding-year trading strategy

Motivated by the results of 2.1 and 2.2, three-year holding period is tested to see whether higher return can be achieved.

INSERT TABLE 11 HERE

From Table 11 we can see that on average the most under-priced portfolio P1 produces an annual return of 39.2% over the ten-year study period while correctly-priced portfolio P3 yields an annual return of 7% and the most over-priced P5 yields -4.5%. Again, the results are quite consistent with my expectation.

The difference in average annual returns between the portfolio 1 and 3 over the ten-year period is 32.3% while the difference in average annual returns between the portfolio 1 and 5 over the ten-year period is 43.7%.

The difference in annual returns between the five portfolios is shown in graph 6.

INSERT GRAPH 6 HERE

Similar to graph 4 and 5, it is evident that the ranking of annual return is almost exactly the same as the ranking of portfolios beginning from the most under-priced to the most over-priced. And the conclusion is true for almost each year of the ten-year study period, especially for the most under-priced portfolios and the most over-priced portfolios.

The results I present are based on average returns for all portfolios constructed for the given holding period. Performance is measured for one-year, two-year and three year-holding period. It is also notable that all of the return differences demonstrate similar patterns for the one to three years holding periods.

Note that the average annual returns of the five-portfolio approach for the ten-year research period are from 33.7% to 39.2% for one to three years holding periods. The results are quite exciting even when reasonable transaction costs and possible sample selection bias are considered. The transaction costs are very limited in this research since there are at most two transactions each year (one buy and one sell). At the same time, the sample selection bias of one percent in this research has very limited impact on the return of over thirty percent each year. Therefore, it is confident for us to say that the portfolio formation based on the intrinsic value of the EBO model is very successful.

From the comparison of the three different holding periods we can find that the longer the holding period, the higher the average annual return for the most under-priced portfolio. The average annual returns for the most under-priced portfolio are 33.7%, 38.5% and 39.2% for one-year, two-year and three-year holding periods respectively. This trend is also true for the under-priced portfolio in the simple two-portfolio approach.

The difference in returns of the two portfolio approaches suggests that forming more portfolios based on the EBO model tends to result in more desired results, namely, higher portfolio returns for the most under-priced portfolios. This is true regardless of the length of different holding period.

In addition to proving the potential application value of the EBO model, the empirical results also prove that market values of mispriced stocks will eventually move toward their intrinsic values, regardless of over-priced or under-priced stocks.

3. Comparison of the two-portfolio approach and the five-portfolio approach

We have seen that for the ten-year period of the back test, the EBO model has been very effective in uncovering firms whose stocks are mispriced for both two-portfolio approach and five-portfolio approach. But we are still interested in discovering whether forming more portfolios can produce higher returns.

As one would expect, Table 12 shows that there is significant increase in the average annual returns of the most under-priced portfolio in five-portfolio approach compared with the average annual returns of the under-priced portfolio in two-portfolio approach. The increases in average annual returns are 7.4%, 8.9% and 8.6% for one-year, two-year and three-year holding period respectively.

INSERT TABLE 12 HERE

The difference in returns suggests that forming more portfolios based on the EBO model tends to result in higher returns for the most under-priced portfolios. This is true regardless of the length of different holding period. Therefore, to apply the EBO model in real business world, to form more portfolios based on the ranking of V/P ratio and select the most under-priced one to buy, and short the most over-priced one at the same time seems to be the best strategy.

VI. Conclusions and Implications

This research reviews previous research on the clean surplus valuation model. It reports potential problems of previous research on using the model and empirically tests the validity of this model by using a different approach.

The empirical results show the relation between a firm's stock price and accounting numbers does exist as the model suggests. This paper proves the significant role of the clean surplus valuation model in explaining cross-sectional returns for Canadian public companies. In addition, the test also confirms the conclusion of previous research that EBO model works well even for limited horizons. This may have important implications for the real business application of this model because the forecast for long horizons is very difficult and highly inaccurate.

For the ten-year period of the back test, the EBO model appears to have been very effective in uncovering firms whose stocks are under-priced and over-priced. The finding supports the use of theoretical value based on clean surplus model as a proxy for firm value in predicting stock prices. It shows that fundamental analysis can play an important role in stock valuation and implies that if future earnings are correctly predicted, clean surplus valuation model may have great potential in predicting stock prices and identifying mispriced stocks.

Based on the soundness of the clean surplus valuation model in explaining cross-sectional returns, trading strategies are constructed by comparing theoretical value of a firm V with its associated market price P . Over-priced and under-priced portfolios are formed based on the ranking of V/P ratio. Two-portfolio approach and five-portfolio approach are tested separately, as well as different holding periods. Consistent with

hypothesis, under-priced portfolios consistently yield significant higher returns than over-priced portfolios for the all holding period from one to three years. The conclusion is true for both approaches.

Though this research uses back test approach, practitioners can use analysts' forecast, such as the Value Line earnings forecasts when using the EBO model. This could result in a higher explanatory power than the one reported in this paper. This conclusion is reported by Lee, Myers, Swaminathan [1996], and Tse Yaansah [1997]. Dechow P., Hutton A. and Sloan R. [1997] also report that the EBO model is more accurate when using analysts' forecast data than using historical accounting data. They propose the main reason is the analysts' ability to access to a wider information set. So though this paper uses historical data to back test the EBO model, it does not mean we cannot use it in practice. On the contrary, the model could work better than I reported in this research when it is used in practice where analysts' forecasts of earning are used to estimate future abnormal earnings.

In sum, the finding of this paper supports the use of the value based on clean surplus model as a proxy for firm value in predicting stock prices. It implies that if future earnings of limited horizons are correctly predicted, clean surplus valuation model may have great potential in predicting stock prices and constructing profitable trading strategies effectively. The EBO model provides us a criteria that is both theoretically sound and empirically valid.

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Appendix 1: EBO model development

Traditional view of firm value: firm value is equal to the present value of expected dividends

$$V_t = \sum_{\tau=1}^{\infty} \frac{d_{t+\tau}}{(1+r_t)^\tau} \quad [1]$$

According to the clean surplus accounting relation

$$B_t = B_{t-1} + X_t - d_t \quad [2]$$

Where

V_t = value of a firm for time t ;

d_t = dividend for time t ;

r_t = cost of capital for time t ;

B_t = book value for time t ;

X_t = earnings for time t .

The clean surplus relation indicates that book value in period t equals book value in period $t-1$ plus the difference between earnings and dividends in period t .

Define abnormal earnings as

$$X_t^a = X_t - r_t B_{t-1} \quad [3]$$

From [2] and [3] we can get

$$d_t = X_t^a - B_t + (1+r_t)B_{t-1} \quad [4]$$

plug [4] into [1], and transform the equation, then we can get the EBO model

$$V_t = B_t + \sum_{\tau=1}^{\infty} \frac{X_{t+\tau}^a}{(1+r_t)^\tau} \quad [5]$$

This is the same as the one proposed earlier in this paper

$$V_t = B_t + \sum_{i=1}^{\infty} [NI_{t+i} - (r_t * B_{t+i-1})] / (1+r_t)^i$$

Appendix 2: Compustat Data Items

Item	Compustat Mnemonic	Item Number	Definition
Book Value per Share	BKVLPS	N / A	Total common equity / common shares outstanding
Earnings per Share	EPSPX	A58	Earnings per share before extraordinary items and discontinued operations
Price per Share	PRCC	A22	Close market price of a calendar year

Table 1 Model Comparison - Pooled Regression

Study Period: 1985-1994

Model	n	Adj. R^2	Intercept	beta1	beta2	beta3	beta4	beta5
model 1	3227	0.553	4.414 (0.0001**)	0.844 (0.0001**)				
model 2	3097	0.565	4.585 (0.0001**)	0.805 (0.0001**)				
model 3	3227	0.584	4.09 (0.0001**)	0.908 (0.0001**)	2.349 (0.0001**)	0.344 (0.0374)	-0.376 (0.0001)	
model 4	3097	0.618	3.813 (0.0001**)	0.935 (0.0001**)	1.848 (0.0001**)	0.748 (0.0001**)	-0.509 (0.0001**)	-0.005 (0.9608)

** significant at 0.0001

Table 2 Correlation Analysis for Model 3

	P	BV	AR1	AR2	AR3
P	1	0.639 0.0001**	0.289 0.0923	0.01098 0.5066	0.638 0.0001**
BV	0.639 0.0001**	1	-0.13 0.0001**	-0.119 0.0001**	-0.005 0.7816
AR1	0.289 0.0923	-0.13 0.0001**	1	0.625 0.0001**	0.156 0.0001**
AR2	0.01098 0.5066	-0.119 0.0001**	0.625 0.0001**	1	0.347 0.0001**
AR3	0.638 0.0001**	-0.005 0.7816	0.156 0.0001**	0.347 0.0001**	1

**** significant at 0.0001**

Table 3 Correlation Analysis for Model 4

	P	BV	AR1	AR2	AR3	AR4
P	1	0.639 0.0001**	0.289 0.0923	0.01098 0.5066	0.638 0.0001**	0.462 0.0001**
BV	0.639 0.0001**	1	-0.13 0.0001**	-0.119 0.0001**	-0.005 0.7816	0.035 0.0377
AR1	0.289 0.0923	-0.13 0.0001**	1	0.625 0.0001**	0.156 0.0001**	0.083 0.0001**
AR2	0.01098 0.5066	-0.119 0.0001**	0.625 0.0001**	1	0.347 0.0001**	0.171 0.0001**
AR3	0.638 0.0001**	-0.005 0.7816	0.156 0.0001**	0.347 0.0001**	1	0.578 0.0001**
AR4	0.462 0.0001**	0.035 0.0377	0.083 0.0001**	0.171 0.0001**	0.578 0.0001**	1

**** significant at 0.0001**

Table 4 Regression By Year

Year	N	R^2	Intercept	beta1
1985	210	0.696	3.037 (0.0001**)	1.055 (0.0001**)
1986	239	0.599	3.631 (0.0001**)	1.100 (0.0001**)
1987	264	0.575	4.726 (0.0001**)	0.871 (0.0001**)
1988	286	0.387	5.999 (0.0001**)	0.640 (0.0001**)
1989	296	0.649	4.082 (0.0001**)	1.070 (0.0001**)
1990	301	0.671	2.926 (0.0001**)	0.820 (0.0001**)
1991	320	0.529	3.530 (0.0001**)	0.891 (0.0001**)
1992	334	0.418	4.550 (0.0001**)	0.736 (0.0001**)
1993	426	0.576	5.275 (0.0001**)	0.887 (0.0001**)
1994	551	0.601	4.400 (0.0001**)	0.692 (0.0001**)

** significant at 0.0001

Table 5 Market Factor Analysis

Model	n	Adj. R^2	Intercept	beta1	TSET	TSEP
Model 5	3726	0.633	1.397 (0.2068)	1.522 (0.0001**)	-0.0001 (0.4608)	
Model 6	3726	0.633	0.337 (0.8448)	1.523 (0.0001**)		0.000007 (0.8757)

** significant at 0.0001

Table 6 Portfolio Return Analysis

Two portfolios 1 year holding period

$V > P \Rightarrow$ under-priced

$V < P \Rightarrow$ over-priced

Annual Return

Year	Under_Priced		Over_Priced		Difference
	N	Return	N	Return	
85	134	0.282	76	0.066	0.216
86	129	0.149	109	-0.088	0.237
87	160	0.059	104	-0.037	0.096
88	171	0.168	111	0.102	0.066
89	158	-0.119	134	-0.236	0.117
90	223	0.404	76	0.072	0.332
91	220	0.352	97	0.006	0.346
92	226	0.922	105	0.274	0.648
93	233	0.117	186	-0.141	0.258
94	378	0.293	164	0.104	0.189
Average		0.263		0.012	0.251

Table 7 Portfolio Return Analysis**Two portfolios 2 year holding period**

V > P => under-priced

V < P => over-priced

2-Year Total Return

Year	Under_Priced		Over_Priced		Difference
	N	Annual Return	N	Annual Return	
85	133	0.389	76	-0.039	0.428
86	129	0.159	109	-0.147	0.306
87	160	0.251	104	0.039	0.212
88	169	0.022	110	-0.203	0.225
89	160	0.246	132	-0.146	0.392
90	222	0.903	75	0.015	0.888
91	218	1.592	98	0.238	1.354
92	224	0.951	105	0.051	0.9
93	230	0.521	184	-0.069	0.59
94	378	0.877	162	0.215	0.662
Ave.		0.591		-0.005	0.596

Avarage Annual Return

Year	Under_Priced		Over_Priced		Difference
	N	Annual Return	N	Annual Return	
85	133	0.195	76	-0.020	0.214
86	129	0.080	109	-0.074	0.153
87	160	0.126	104	0.020	0.106
88	169	0.011	110	-0.102	0.113
89	160	0.123	132	-0.073	0.196
90	222	0.452	75	0.008	0.444
91	218	0.796	98	0.119	0.677
92	224	0.476	105	0.026	0.450
93	230	0.261	184	-0.035	0.295
94	378	0.439	162	0.108	0.331
Average		0.296		-0.002	0.298

Table 8 Portfolio Return Analysis**Two portfolios 3 year holding period**

V > P => under-priced

V < P => over-priced

3-Year Total Return

Year	Under_Priced		Over_Priced		Difference
	N	Annual Return	N	Annual Return	
85	133	0.438	76	-0.103	0.541
86	128	0.359	109	-0.079	0.438
87	157	0.084	103	-0.222	0.306
88	169	0.275	109	-0.134	0.409
89	158	0.893	130	-0.164	1.057
90	219	2.422	77	0.213	2.209
91	215	1.344	98	0.078	1.266
92	221	1.137	102	0.142	0.995
93	229	0.975	181	0.106	0.869
94	374	1.252	160	0.232	1.02
Average		0.918		0.007	0.911

Avarage Annual Return

Year	Under_Priced		Over_Priced		Difference
	N	Annual Return	N	Annual Return	
85	133	0.146	76	-0.034	0.180
86	128	0.120	109	-0.026	0.146
87	157	0.028	103	-0.074	0.102
88	169	0.092	109	-0.045	0.136
89	158	0.298	130	-0.055	0.352
90	219	0.807	77	0.071	0.736
91	215	0.448	98	0.026	0.422
92	221	0.379	102	0.047	0.332
93	229	0.325	181	0.035	0.290
94	374	0.417	160	0.077	0.340
Average		0.306		0.002	0.304

Table 9 Portfolio Return Analysis**Five portfolios 1 year holding period**

P1 $V > 1.3 \cdot P \Rightarrow$ most under-priced
P2 V between $1.1 \cdot P$ and $1.3 \cdot P \Rightarrow$ under-priced
P3 V between $0.9 \cdot P$ and $1.1 \cdot P \Rightarrow$ correctly-priced
P4 V between $0.7 \cdot P$ and $0.9 \cdot P \Rightarrow$ over-priced
P5 $V < 0.7 \cdot P \Rightarrow$ most over-priced

Annual Return

Year	P1	P2	P3	P4	P5	P1-P5	P1-P3
85	0.352	0.167	0.166	0.091	0.158	0.194	0.186
86	0.203	0.048	-0.049	-0.019	-0.124	0.327	0.252
87	0.089	-0.003	0.069	0.004	-0.143	0.232	0.020
88	0.173	0.165	0.153	0.142	0.038	0.135	0.020
89	-0.083	-0.167	-0.195	-0.196	-0.299	0.216	0.112
90	0.498	0.153	0.099	0.027	0.060	0.438	0.399
91	0.499	0.026	-0.013	-0.108	0.069	0.430	0.512
92	1.097	0.556	0.311	0.225	0.304	0.793	0.786
93	0.195	-0.026	-0.080	-0.081	-0.214	0.409	0.275
94	0.350	0.195	0.078	0.160	0.022	0.328	0.272
Average	0.337	0.111	0.054	0.025	-0.013	0.3502	0.2834

Sample Size

Year	P1	P2	P3	P4	P5
85	81	35	33	27	34
86	83	32	41	36	47
87	104	42	36	39	43
88	118	32	39	51	46
89	109	29	48	50	60
90	169	35	40	32	25
91	157	44	44	33	42
92	164	38	55	34	43
93	161	52	51	78	84
94	291	55	77	63	65

Table 10 Portfolio Return Analysis**Five portfolios 2 year holding period**

- P1 $V > 1.3 \cdot P \Rightarrow$ most under-priced
P2 V between $1.1 \cdot P$ and $1.3 \cdot P \Rightarrow$ under-priced
P3 V between $0.9 \cdot P$ and $1.1 \cdot P \Rightarrow$ correctly-priced
P4 V between $0.7 \cdot P$ and $0.9 \cdot P \Rightarrow$ over-priced
P5 $V < 0.7 \cdot P \Rightarrow$ most over-priced

Average Annual Return

Year	P1	P2	P3	P4	P5	P1-P5	P1-P3
85	0.281	0.060	0.052	0.016	-0.068	0.348	0.229
86	0.112	0.026	-0.009	-0.041	-0.125	0.236	0.120
87	0.153	0.079	0.084	0.062	-0.060	0.213	0.070
88	0.015	0.012	-0.025	-0.085	-0.138	0.153	0.039
89	0.192	0.008	0.027	-0.063	-0.155	0.346	0.165
90	0.583	0.052	0.019	-0.009	0.026	0.558	0.564
91	1.054	0.206	0.152	0.079	0.112	0.943	0.903
92	0.597	0.191	0.113	0.004	-0.010	0.607	0.485
93	0.355	0.085	0.006	0.016	-0.085	0.440	0.349
94	0.514	0.276	0.098	0.196	0.031	0.484	0.416
Average	0.385	0.099	0.052	0.018	-0.047	0.433	0.334

Sample Size

Year	P1	P2	P3	P4	P5
85	80	35	33	27	34
86	82	32	41	36	47
87	104	42	36	39	43
88	114	32	38	50	45
89	108	29	47	50	58
90	168	34	40	30	25
91	154	44	44	33	41
92	161	38	54	33	43
93	154	51	50	78	81
94	285	55	77	61	62

Table 11 Portfolio Return Analysis**Five portfolios 3 year holding period**

- P1 $V > 1.3 \cdot P \Rightarrow$ most under-priced
P2 V between $1.1 \cdot P$ and $1.3 \cdot P \Rightarrow$ under-priced
P3 V between $0.9 \cdot P$ and $1.1 \cdot P \Rightarrow$ correctly-priced
P4 V between $0.7 \cdot P$ and $0.9 \cdot P \Rightarrow$ over-priced
P5 $V < 0.7 \cdot P \Rightarrow$ most over-priced

Average Annual Return

Year	P1	P2	P3	P4	P5	P1-P5	P1-P3
85	0.201	0.051	0.059	0.001	-0.089	0.290	0.142
86	0.166	0.043	0.026	0.004	-0.076	0.242	0.140
87	0.057	-0.037	0.010	-0.061	-0.130	0.187	0.048
88	0.107	0.077	0.030	-0.025	-0.091	0.199	0.077
89	0.434	0.015	0.025	-0.020	-0.118	0.552	0.409
90	1.015	0.209	0.084	0.057	0.101	0.914	0.931
91	0.603	0.080	0.074	0.024	-0.006	0.609	0.529
92	0.477	0.157	0.104	0.022	0.024	0.452	0.372
93	0.393	0.204	0.126	0.069	-0.018	0.411	0.267
94	0.468	0.317	0.157	0.163	-0.045	0.513	0.311
Average	0.392	0.111	0.070	0.023	-0.045	0.437	0.323

Sample Size

Year	P1	P2	P3	P4	P5
85	80	35	33	27	34
86	81	32	41	36	47
87	102	42	35	39	42
88	115	32	37	49	45
89	106	29	47	49	57
90	165	34	40	32	25
91	152	43	44	33	41
92	158	38	54	33	40
93	153	51	50	77	79
94	283	55	74	60	62

Table 12

Comparison of Average Annual Returns For Under-Priced Portfolios

Holding period	Two-portfolio	Five-portfolio	Difference
1-Year	26.3%	33.7%	-7.4%
2-Year	29.6%	38.5%	-8.9%
3-Year	30.6%	39.2%	-8.6%

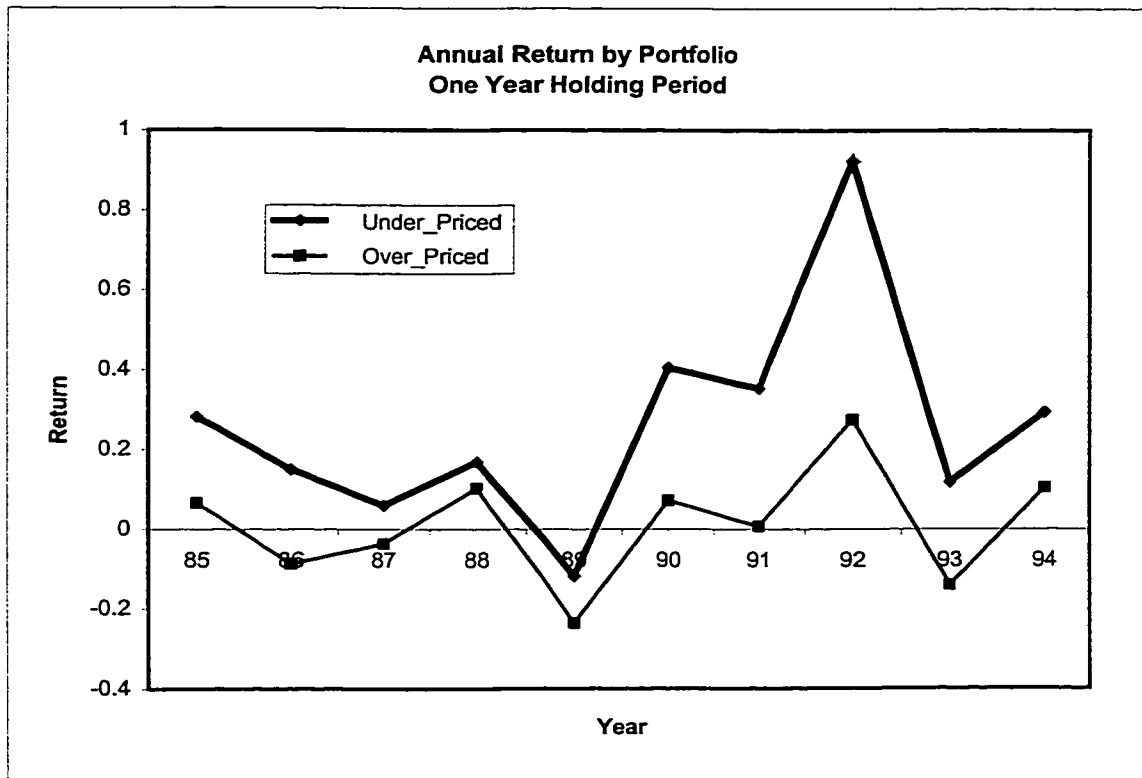
Graph 1 Portfolio Return Analysis

Two portfolios

1 year holding period

$V > P \Rightarrow$ under-priced

$V < P \Rightarrow$ over-priced



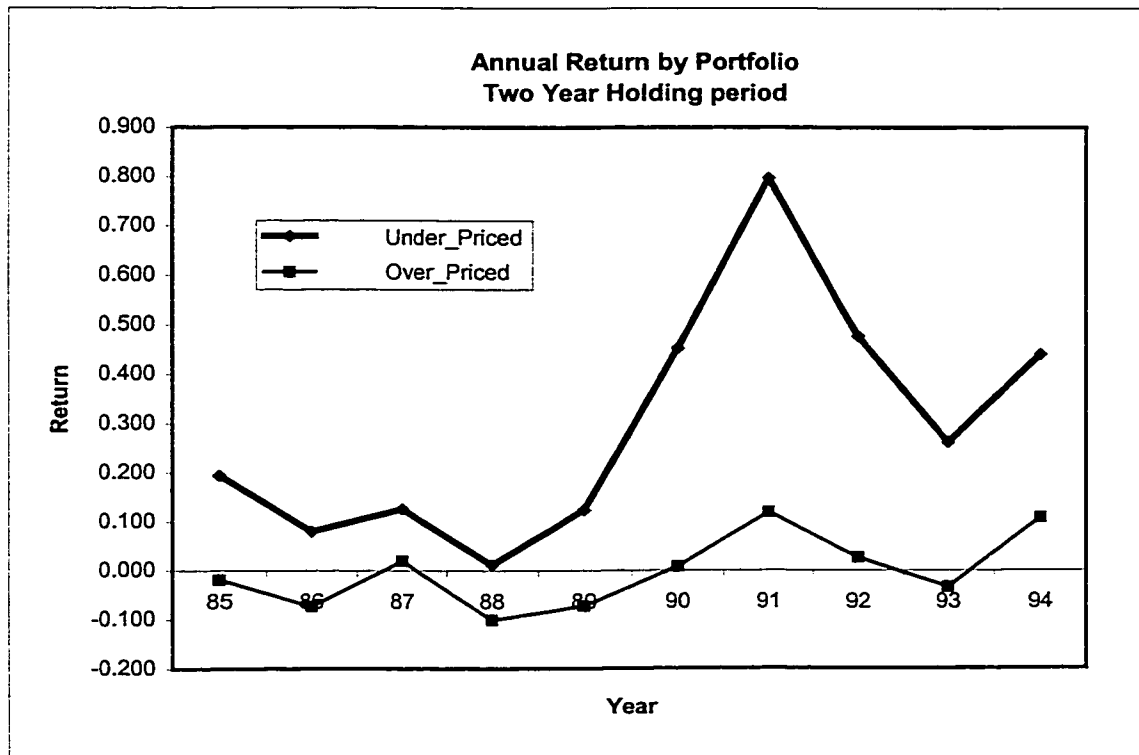
Graph 2 Portfolio Return Analysis

Two portfolios

2 year holding period

$V > P \Rightarrow$ under-priced

$V < P \Rightarrow$ over-priced



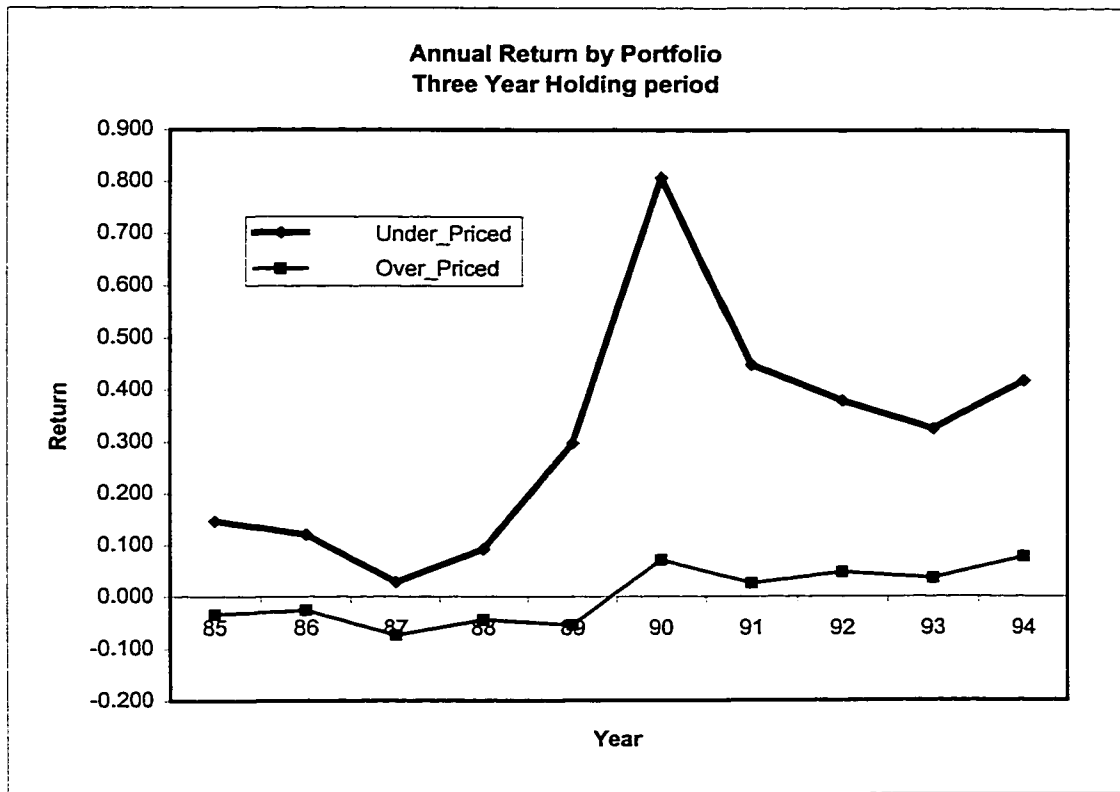
Graph 3 Portfolio Return Analysis

Two portfolios

3 year holding period

$V > P \Rightarrow$ under-priced

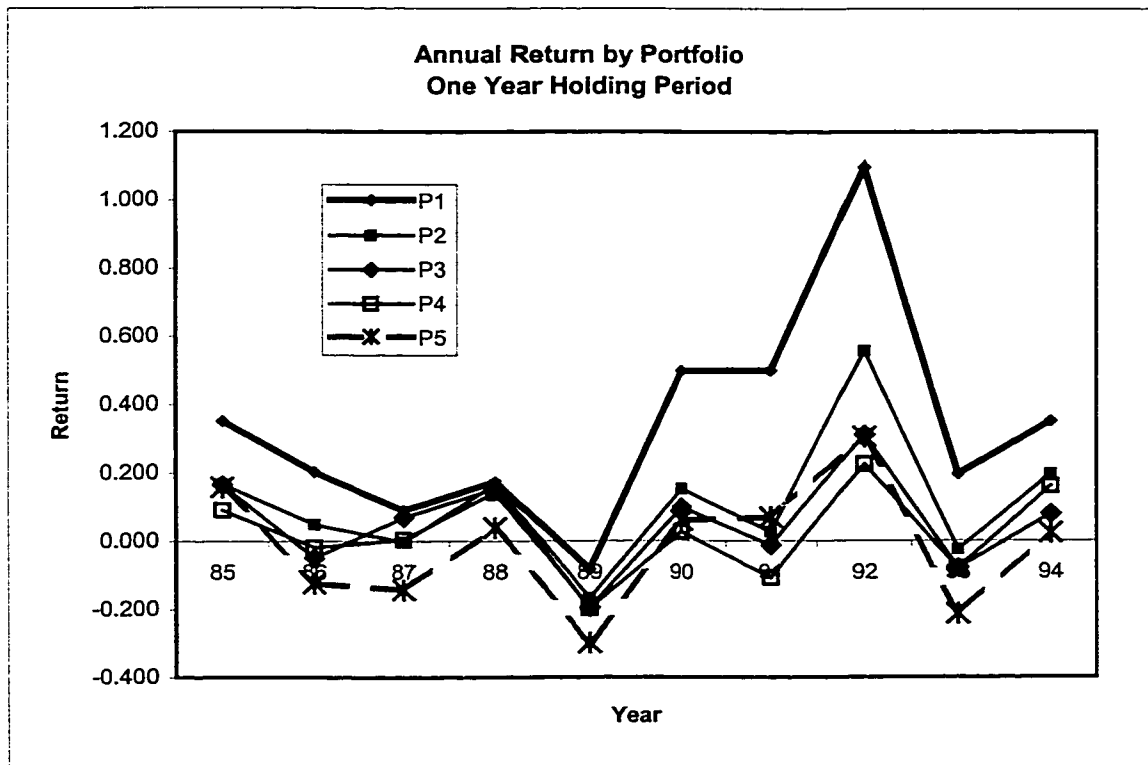
$V < P \Rightarrow$ over-priced



Graph 4 Portfolio Return Analysis

Five portfolios 1 year holding period

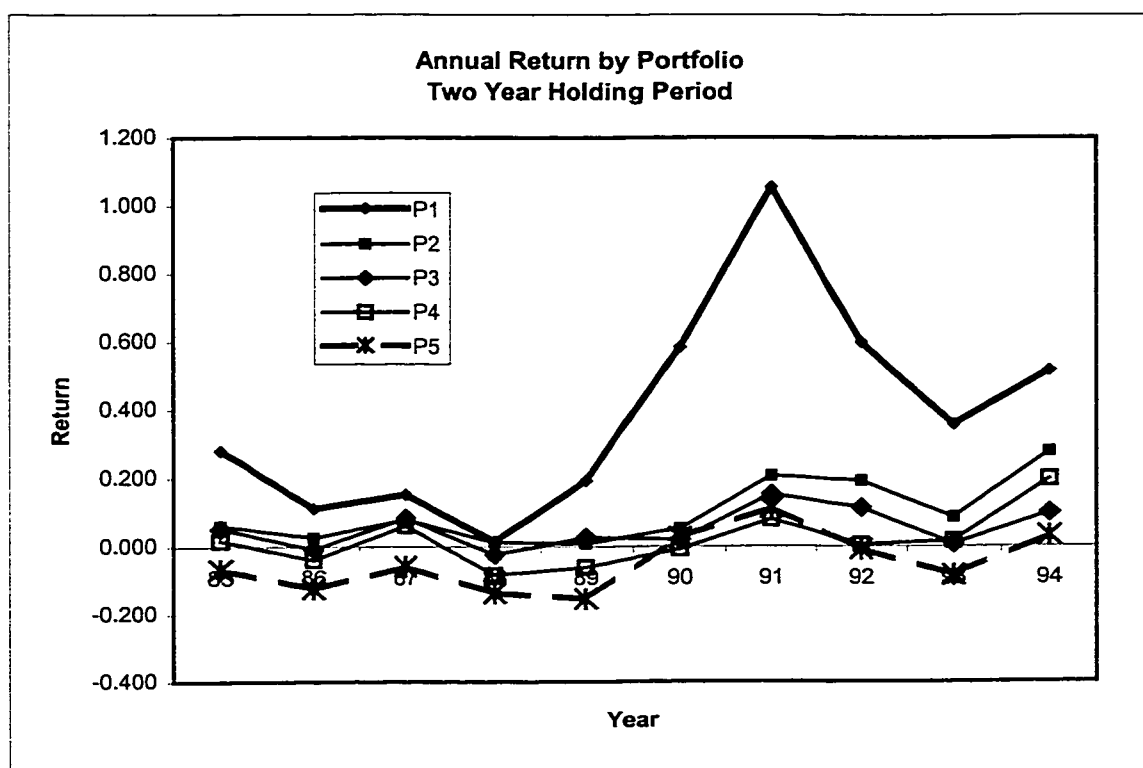
- P1 $V > 1.3 * P \Rightarrow$ most under-priced
- P2 V between $1.1 * P$ and $1.3 * P \Rightarrow$ under-priced
- P3 V between $0.9 * P$ and $1.1 * P \Rightarrow$ correctly-priced
- P4 V between $0.7 * P$ and $0.9 * P \Rightarrow$ over-priced
- P5 $V < 0.7 * P \Rightarrow$ most over-priced



Graph 5 Portfolio Return Analysis

Five portfolios 2 year holding period

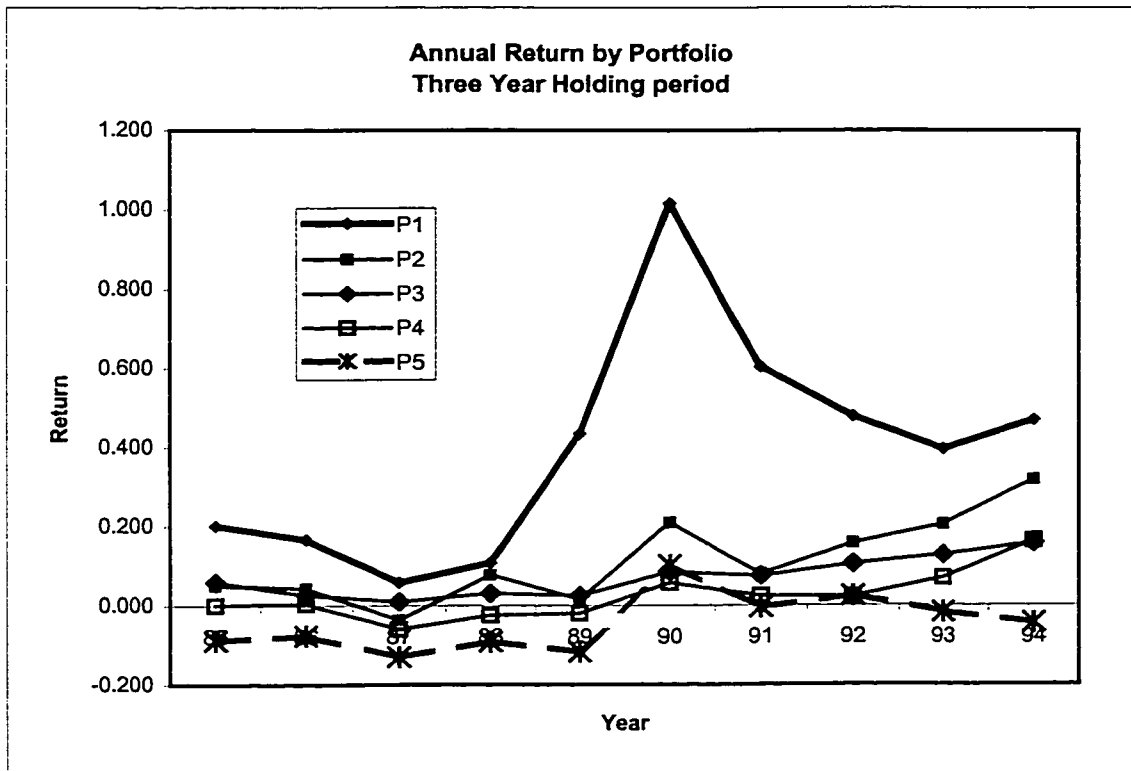
- P1 $V > 1.3 * P \Rightarrow$ most under-priced
- P2 V between $1.1 * P$ and $1.3 * P \Rightarrow$ under-priced
- P3 V between $0.9 * P$ and $1.1 * P \Rightarrow$ correctly-priced
- P4 V between $0.7 * P$ and $0.9 * P \Rightarrow$ over-priced
- P5 $V < 0.7 * P \Rightarrow$ most over-priced



Graph 6 Portfolio Return Analysis

Five portfolios 3 year holding period

- P1 $V > 1.3 * P \Rightarrow$ most under-priced
- P2 V between $1.1 * P$ and $1.3 * P \Rightarrow$ under-priced
- P3 V between $0.9 * P$ and $1.1 * P \Rightarrow$ correctly-priced
- P4 V between $0.7 * P$ and $0.9 * P \Rightarrow$ over-priced
- P5 $V < 0.7 * P \Rightarrow$ most over-priced



Graph 7

Comparison of Average Annual Returns For Under-Priced Portfolios

