An empirical application of the clean-surplus valuation model: The case of the London Stock Exchange

S. N. Spilioti
Athens University of Economics and Business, Department of Business Administration, Patission 76, 10434, Athens, Greece

G. A. Karathanassis
Athens University of Economics and Business, Department of Business Administration, Patission 76, 10434, Athens, Greece

Abstract

Recent studies on equity valuation suggest that security prices should be determined by book value and discounted future abnormal earnings [Ohlson (1995), Feltham and Ohlosn (1995)]. This paper examines the empirical validity of these theoretical models for the English equity market. More specifically, it uses a panel data methodology to study equity prices for important sectors of the economy. To anticipate the results, these models appear to be reliable price valuation models, for English equities.

Keywords: Equity valuation, book value, abnormal earnings, panel data.

JEL Classification: G1.

1. Introduction

Traditional equity valuation models discount expected future dividends in order to arrive at a theoretically correct intrinsic value, which will be then compared to the current market price. However, in their recent studies Ohlson (1995) and Feltham and Ohlson (1995) suggest that security prices should be determined by book value and discounted future abnormal earnings. The advantages of this specification are that special emphasis is given to (a) book value, thus avoiding any economic hypotheses about future cash flows, and (b) the treatment of investments. Previous empirical studies find that book value and discounted future abnormal earnings have an important role to play in the determination of equity prices (see for example, Bernard (1995), Penman and Sougiannis (1998), Lee and Swaminathan (1998)).

Most of the previous studies, however, document these relationships for major developed and/or large capitalization American markets specially for the period before 1998; there is, however, little research regarding European market equity prices specially for the last seven years that several crises have taken place. In this paper, we attempt to fill this gap and examine the behavior of Ohlson's theoretical model with equity prices from the London Stock Exchange for the period 1996 - 2002. Repeated tests with data from various countries are essential to determining the applicability of a model to actual data. Thus, it would be particularly important to examine the degree to which *changes* in book value and abnormal earnings explain *changes* in equity prices, in a developed European market. In addition, the panel data models employed in the paper overcome common methodological problems (such as autocorrelation, multicolinearity, heteroscadsticity) and allow the estimation of unbiased and efficient estimators.

To anticipate the results, the model performs very well for two sample sectors of the English economy. These results, in conjuction with the theoretical merits and advantages of the model, make Olhson's approach a reliable price valuation model, for British equities. The rest of this paper is organized as follows. Section 2 discusses the relevant literature, section 3 presents the data and methodology, and section 4 presents the results. Section 5 concludes the paper.

2. The valuation model

Fundamental analysts, in their attempt to identify under-priced securities, have employed different approaches. Traditional models of security valuation typically discount future dividends in order to estimate the theoretical or intrinsic value of a security (see for example Williams (1938), Gordon (1959)). According to this view the intrinsic value of a security is equal to the present value of dividends expected from the share. Modigliani and Miller (1961), assuming perfect capital markets, rational behavior, and perfect certainty, argued for the Investment Opportunities Approach, according to which the factors that affect the security price are the expected dividends, the growth rate in expected dividends, and factors that proxy for the risk of the security. Alternatively, one could use expected earnings and expected growth rate in earnings instead of dividends. The results of empirical studies (see for example, Friend and Puckett (1964), Gordon (1959), Fisher (1961), Durand (1955), Bower and Bower (1969)) Karathanassis and Tzoannos (1977), Karathanassis and

Philippas (1988) indicate that the main explanatory variables of equity prices are dividends, earnings, retained earnings, size, variability in earnings, and debt to equity ratio.

However, in their recent studies Ohlson (1990, 1991, 1995) and Feltham and Ohlson (1995) suggest that security prices should be determined by book value and discounted future abnormal earnings. Ohlosn made three assumptions while developing the model. Firstly, the price of a security is equal to:

$$P_t = \sum_{\tau=1}^{\infty} R_f^{-\tau} [d_{t+\tau}] \qquad (1)$$

where, P_t is the price of the security at time t, d_t is the dividend at time t, R_f is 1 plus the risk free.

Secondly, the change in book value between two periods is equal to the difference between earnings and dividends (The Clean-Surplus Relation). That is, if x_t is the earnings between period t-1 and t, and y_t is the book value at time t, then:

$$y_t = y_{t-1} + x_t - d_t \qquad (2)$$

If abnormal earnings are defined as:

$$x_t^a = x_t - (R_f - 1) y_{t-1} \qquad (3)$$

Equation (1) then becomes:

$$P_t = y_t + \sum_{\tau=1}^{\infty} R_f^{-\tau} E_t [x_{\tau+t}^a] \qquad (4)$$

Thirdly, Ohlson assumes linear information dynamics, that is, abnormal earnings can be estimated with linear regression analysis. Then, the abnormal earnings for period *t+1* are defined as:

$$x_{t+1}^{a} = \omega x_{t}^{a} + v_{t} + \varepsilon_{1t+1} \tag{5}$$

where the non-accounting information for period *t+1* is defined as:

$$v_{t+1} = \gamma v_{t} + \varepsilon_{2t+1} \tag{6}$$

If these assumptions hold the price of a security is defined as:

$$P_{t} = y_{t} + a_{1}x_{t}^{a} + a_{2}v_{t} \tag{7}$$

where

$$a_1 = [\omega/(R_f - \omega)] \geq 0 \text{, and } a_2 = [R_f/(R_f - \omega)(R_f - \gamma)] > 0$$

This specification has two advantages. Firstly, special emphasis is given to book value, thus avoiding any economic hypotheses about future cash flows. Secondly, the treatment of investments is such that investments are a balance sheet factor and not a factor that reduces cash flows (for a detailed discussion see Penman and Sougiannis (1998)).

Previous empirical studies find that book value and discounted future abnormal earnings have an important role to play in the determination of equity prices. For example, Bernard (1995) uses regression analysis to evaluate how well forecasted dividends and forecasted abnormal earnings explain the variation in security prices, and finds that dividends explain 29% of variation in equity returns vs. 68% for the combination of book value and abnormal earnings. Penman and Sougiannis (1998) examine valuation methods based on dividend, cash flow, and abnormal earnings estimates, for US equities. They find that abnormal earnings estimates have the smallest prediction errors than the other variables. The largest prediction errors are observed for the free cash flow variable. Lee and Swaminathan (1998) examined whether traditional indices (based on dividends, book to market, earnings) and an index based on Ohlson's model can predict US equity returns. They find that although the traditional indices have low return predictability, the index based on Ohlson's model is more successful. Francis, Ohlson, Oswald (2000) compare the reliability of value estimates from the dividend, earnings, and abnormal earnings models for the US equity market. They find that the abnormal earnings estimates are more accurate and explain more of the variability in equity prices that the other variables. Karathanassis and Spilioti (2003) find that the performance of the Ohlson model is quite similar to that of the traditional valuation models for the emerging Athens Stock Exchange.

To summarize, empirical results support the theoretical equity valuation model suggested by Ohlson. However, these studies examined the validity of the model for the developed and well-organized capital market of the USA. Thus, it will be very interesting to see whether the results will hold for a developed European equity market such as the London Stock Exchange specially in this problematic time period.

3. Data and Methodology

The aim of the paper is to evaluate whether changes in book values and abnormal earnings explain changes in security prices, for the English equity market. The data used in the study are obtained from the London Stock Exchange S.A. and cover the period between 1996-2002. More specifically, as a sample we use two very important sectors of the English economy, that is, the food sector and the pharmaceuticals sector (see Appendix for more details).

Previous research has typically used either time-series or cross-section methods for the empirical estimations. However, both methodologies have a number of drawbacks. For example, time-series analysis is subject to autocorrelation and multicolinearity problems, while cross-section methods are subject to heteroscedasticity problems and often fail to detect the dynamic factors that may affect the dependent variable.

This paper uses a combination of time-series and cross-section data (panel data analysis), a procedure that avoids the methodological problems of the previous methodologies and in addition has a number of advantages. For example, it not only provides efficient and unbiased estimators, but also provides a larger number of degrees of freedom available for the estimation. This allows the researcher to overcome the restrictive assumptions of the linear regression model (for a more detailed discussion see Baltagi and Raj (1992) and Maddala (1987), among others). More specifically, the algebraic model can be represented as follows:

$$Y_{it} = \alpha + \mu_i + \lambda_t + \sum_{K=1}^{K} \beta_K X_{Kit} + \varepsilon_{it} \qquad (8)$$

$i = 1, \ldots\ldots, N$
$t = 1, \ldots\ldots., T$

where Y_{it} is the value of the dependent variable for the cross section i at time t, X_{Kit} is the value of the K^{th} explanatory variable for the cross section i at time t, μ_i is an unobserved cross-section effect, λ_i is an unobserved time effect and ε_i is the unobserved overall remainder. Equation (8) can be estimated either under the assumption that μ_i and λ_i are fixed so that $\sum_{i=1}^{N}\mu_i = 0$ and $\sum_{i=1}^{T}\lambda_t = 0$, or under the assumption that μ_i and λ_i are random variables. The first case is the well known Dummy Variable Model or the Covariance Model, while the second case is the Error Components Model (see among others Kmenta (1971), Griffiths *et al*. (1993), Hsiao (1986)).

The empirical researcher is often faced with the problem of choosing among the two approaches, because it cannot be known beforehand whether the μ_i and λ_i are random or fixed. The Error Components Model will lead to unbiased, consistent, and asymptotically efficient estimators only if the orthogonality assumption holds (i.e. that the explanatory variables are uncorrelated with the cross-section and time-series effects). If that is not true, the Error Components Model estimators will be biased and inconsistent, while the Covariance Model estimators will still be consistent, since they are not affected by the orthogonality condition (see for details Madalla (1971) and Mundlack (1978)).

In order to examine whether the explanatory variables are uncorrelated with the cross-section and time-series effects one can apply the statistical criterion developed by Hausman (1978). The null hypothesis is that the Error Components Model is correctly specified, i.e. that μ_i and λ_i are uncorrelated with the explanatory variables, X_{Kit}. The test statistic, m, defined as

$$m = (\hat{\beta}_{FE} - \hat{\beta}_{GLS})(\hat{M}_1 - \hat{M}_0)^{-1}(\hat{\beta}_{FE} - \hat{\beta}_{GLS}) \qquad \textbf{(9)}$$

This statistic has an asymptotic χ^2_k distribution. Note that β_{GLS} is the generalized-least square Error Component Model estimator, β_{FE} is the ordinary least square Dummy Variable Model estimator, M_1 is the covariance matrix of β_{FE}, and M_0 is the covariance matrix of β_{GLS}. Accepting the null hypothesis, H_0, will suggest the use of the generalized least square estimator. Rejecting the null hypothesis indicates that we should accept the alternative, H_1, i.e. that we should employ the Covariance Model approach.

The approach employed in this study (as will be demonstrated in the next section) is the Error Components Model. In this case, equation (8) can be written as follows:

$$Y_{it} = \alpha + \sum_{K=1}^{K} \beta_K X_{Kit} + \varepsilon_{it} \qquad (10)$$

$$i = 1,......, N$$
$$t = 1,......., T$$

where

$$\varepsilon_{it} = \mu_i + \lambda_t + w_{it} \qquad (11)$$

The last equation indicates that the total random effect basically consists of three random effects (for details see Wallace and Hussein (1969)).

The explanatory variables employed in the study are the variables suggested by Ohlson (1995) and discussed in section 2. More specifically, we used two explanatory variables: book values (BV) and abnormal earnings (AE). BV is the owners' equity over the number of stocks in circulation, and AE is the difference between current earnings and the opportunity cost of capital. The opportunity cost is defined as the previous period's BV times the cost of capital (that is, the risk-free rate). Ohlson suggests that for the model to be correctly specified we should expect a positive relationship between AE and prices. We should also, theoretically, expect a positive relationship between BV and prices. Note that equity prices are calculated as the arithmetic average of monthly average closing prices.

4. Presentation and Interpretation of Results

As a first stage in the analysis we examine which approach to use in the estimation of equation (8). To this end we apply the Hausman (1978) criterion discussed above. The results are presented in Table 1, and seem to suggest that (for two industries) the cross-section and time-series effects can be considered as random variables. In other words, μ_i and λ_i are uncorrelated with the explanatory variables, X_{Kit}, or the Error Component Model is correctly specified. For example, as can be seen from Table 1, the M-statistic is lower than the critical value for two industries. Thus, we proceed with the estimation using the Error Components Model (equation 10).

[INSERT TABLE 1 HERE]

According to the theoretical relationships predicted by the Ohlson valuation model we should expect both book value and abnormal earnings to be positively related with share prices. Our empirical findings are in accordance with the theoretical predictions. Thus, our ex-ante relationships are empirically validated since both variables expected a positive and significant influence on share prices.

The results of estimating equation (10) with the variables discussed in the previous section are presented in Table 2. We can see that the explanatory power of the model for the food sector is good enough ($\overline{R}^2 = 0.18$). The explanatory power of the model is also very high for the pharmaceuticals sector ($\overline{R}^2 = 0.89$). For two sectors the explanatory variables are highly singificant at the 5% level. Furthermore, for two sectors both the BV and AE coefficients have the expected positive sign.

[INSERT TABLE 2 HERE]

5. Conclusion and Implication for further Research

This paper examines whether changes in security prices are explained by book value and discounted future abnormal earnings, as suggested by Ohlson (1995) and Feltham and Ohlosn (1995). Previous studies document these relationships for major developed and/or large capitalization specially American markets. Here, we examine the behavior of equity prices in the London Stock Exchange for the problematic period 1996-2002 that several crises have take place.

The results indicate that the model has high explanatory power for the food as well as the pharmaceutical sector. Also, all the coefficients are highly singificant for two sectors.

Overall, the empirical results suggest that the model performs very well for two sample sectors of the English economy. These results, in conjuction with the theoretical merits and advantages of the model, make Olhson's approach an interesting price valuation model, for English equities.

Our results should be treated with caution. We should recall that in the past many researchers using the dividend valuation model reported equally good results (Karathanassis (1981), Keenan (1980)) .

Specifically, virtually all researchers reported good results for the coefficient of determination and the sign of the regression coefficients. It should be stressed, though that the values of the coefficients did not remain constant over time. This is a very serious disadvantage for the purpose of using these models for making financial decisions. Stability and precision of economic functions are also required in order to draw meaningful conclussions of the reliability of an economic relationship and of its relative superiority over other alternative relationships.

References

Baltagi, B. H., and Raj, B. (1992) “A survey of recent theoretical developments in the econometrics of panel data”, *Empirical Economics*, 17, 85-109.

Bower D. H. and Bower R. S. (1969), “Risk and the Valuation of Common Stock”, *Journal of Political Economy*, Vol. 77, 349-362

Durand D. (1955), “Bank Stock Prices and the Analysis of Covariance”, *Econometrica*, Vol.23, 30-45

Fisher G.R. (1961), “Some Factors Influencing Share Prices”, *Economic Journal*, Vol. LXXI, 121-141

Francis J. Olsson P. and Oswald D.(2000), “Comparing the Accuracy and Explainability of Dividend, Free Cash Flow, and Abnormal Earnings Equity Value Estimates”, *Journal of Accounting Research*, Vol. 38, 45-70

Friend I. and Puckett M. (1964), “Dividends and Stock Prices”, *American Economic Review*, Vol. LIV, 656-682

Gordon M. J. (1959), “Dividends, Earnings and Stock Prices”, *Review of Economics and Statistics*, Vol. XLI, 99-105

Griffiths, W.E., Hill, C., and Judge, G.G. (1993) *Learning and Practicing Econometrics*, John Willey and Sons, INC.

Hausman, J. A. (1978) “Specification tests in econometrics”, *Econometrica*, 46, 1251-1272.

Hsiao, C. (1986) *Analysis of Panel Data*, Econometrics Society Monographs, No. 11.

Karathanassis G. and Tzoannos J. (1977) “ The Demand for Money by Business Firms: A Temporal and Cross-Sectional Analysis”, *Applied Economics*, Vol. 9, 63-76

Karathanassis G. (1981) “ Empirical Valuation Models: How Useful Have They Been?”, *Accounting and Business Research*

Karathanassis, G., and Philippas, N. (1988) “Estimation of bank stock price parameters and the variance components model”, *Applied Economics*, 20, 497-507.

Karathanassis, G., and Spilioti, S (2003) “En Empirical Investigation of the Traditional and the Clean Surplus Valuation Model”, *Managerial Finance,*

Keenan M. (1970) “Models of Equity Valuation: The Great Germ Bubble”, *Journal of Finance*, Vol. XXV, 243-273

Kmenta, J. (1971) *Elements of Econometrics,* Macmillan, New York.

Maddala, G.S. (1987) “Recent developments in the econometrics of panel data analysis”, *Transportation Research*, 21, 303-326.

Maddala, G.S. (1971) “The use of variance components models in pooling cross-section and time-series data”, *Econometrica*, 39, 341-358.

Miller M. and Modilgianni F. (1961) , “Dividend Policy, Growth and the Valuation of Shares”, *The Journal of Business* Vol. XXXIV, 411-433

Mundlak, Y. (1978) “On the pooling of time-series and cross-section data”, *Econometrica*, 46, 69-85.

Ohlson J. (1990), “A Synthesis of Security Valuation Theory and the Role of Dividends, Cash Flows, and Earnings”, *Contemporary Accounting Research* Vol. 6, 648-676

Ohlson J. (1991), “The Theory of Value and Earnings and an Introduction to the Ball-Brown Analysis”, *Contemporary Accounting Research*, Vol. 7, 1-19

Ohlson J. (1995), “Earnings Book Values and Dividends in Security Valuation”, *Contemporary Accounting Research*, Vol. 11, 661-687

Wallace, T. and Hussain, A. (1969) “The use of Error Components Model in combining cross-section with time-series data”, *Econometrica*, 37, 55-73.

Williams J. B. (1938), *The Theory of Investment Values*, Harvard University Press

Table 1
Are μ_i and λ_i uncorrelated with the explanatory variables?

$$m = (\hat{\beta}_{FE} - \hat{\beta}_{GLS})(\hat{M}_1 - \hat{M}_0)^{-1}(\hat{\beta}_{FE} - \hat{\beta}_{GLS})$$

	m-statistic	P-Value	DF
Pharmaceuticals			
Food			

Notes to Table 1:
Null hypothesis: the Error Components Model is correctly specified
m-statistic: Hausman's (1978) test statistic
DF: degrees of freedom
P-Value at 95% confidence level

Table 2
Do changes in BV and abnormal earnings explain the changes in security prices?

$$Y_{it} = \alpha + \sum_{K=1}^{K} \beta_K X_{Kit} + \varepsilon_{it}$$

	Food	**Pharmaceuticals**
Constant	1.09 (1.49)	2.59 (3.64)*
BV	0.01 (1.91)*	0.02 (8.30)*
AE	0.08 (3.07)*	0.04 (3.99)*
$\bar{R}^2$	0.18	0.89

Notes to Table 2:
BV: Book Value
AE: Abnormal Earnings
t-statistics appear in parentheses
* denotes significance at the 5%