An Empirical Examination of Traditional Equity Valuation Models:
The case of the Athens Stock Exchange

By

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Abstract

Early theoretical work on equity valuation suggests that equity prices are determined by variables such as dividends and growth in dividends. This paper employs panel data methodology and equity prices from Athens Stock Exchange to empirically investigate the performance of the traditional models of equity valuation.

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I.   Introduction

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)). Miller and Modilgiani (1961), assuming perfect capital markets, rational behavior, and perfect certainty argued that the main sources of intrinsic value are dividends and growth in dividends. Thus, the factors that affect the security price are the expected dividends, the growth rate in expected dividends, and a factor 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 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.

That is, the theoretical literature on traditional models of equity valuation indicates that the price of a security (*P*) is a function of a number of variables:

$$P = \mathrm{F}\,(D,\ G,\ V,\ L,\ S)$$

Where *D* is dividends, *G* is growth in dividends (or earnings), *V* is variability of earnings, *L* is leverage and *S* is size. Empirically, often earnings (*E*) or retained earnings (*RE*) are also used. For example, among others, Durand (1975) used regression analysis to examine the price of 117 banks and the results indicate that the explainability of the dividend coefficient was higher that the earnings and book value coefficient. Bower and Bower (1969) find, for a sample of 100 stocks, that the P/E ratio is positively correlated with *G*, with the dividend pay-out rate, the marketability of the stock and the variability in price. Other empirical studies find that book value and discounted future abnormal earnings have an important role to play in the determination of equity prices (Bernard (1995), Penman and Sougiannis (1998)). Francis, Ohlson and 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.

However, the above studies examine the validity of the valuation models for major developed and/or large capitalization markets; there are few studies on emerging and/or smaller equity markets. Thus, this paper empirically investigates the explainability traditional valuation models with data from the Athens Stock Exchange. In addition, the panel data models employed in the paper overcomes common methodological problems (such as autocorrelation, multicolinearity, heteroscadsticity) and allows the estimation of unbiased and efficient estimators.

II.   Data and Methodology

The aim of the paper is to empirically investigate the explainability of traditional equity valuation models, employing data from the Athens Stock Exchange. The data used in the study are obtained from the Athens Stock Exchange S.A. and cover the period between 1993-1998. Equity prices are calculated as the arithmetic average of

monthly average closing prices. More specifically, as a sample we use four very important sectors of the Greek economy, that is, the metallurgical sector, the commercial and industrial sector, the banking sector, and the food sector. 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 (Karathanassis and Fillipas, 1988).

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 (see Baltagi and Raj (1992)). More specifically, the algebraic model can be represented as follows:

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

$$i = 1,......,N$$

$$t = 1,........,T$$

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 Kth 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 (1) 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 Griffiths *et al.* (1993)). The empirical researcher is often faced with the problem of choosing among the two approaches, because it cannot be known on 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. 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

$$m = (\hat{\beta}_{FE} - \hat{\beta}_{GLS})(\hat{M}_1 - \hat{M}_0)^{-1}(\hat{\beta}_{FE} - \hat{\beta}_{GLS}) \tag{2}$$

This statistic has an asymptotic χ_k^2 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 (1) can be written as follows:

$$Y_{it} = \alpha + \sum_{K=1}^{K} \beta_K X_{Kit} + \varepsilon_{it} \tag{3}$$

$$i = 1,......,N$$

$$t = 1,........,T$$

where

$$\varepsilon_{it} = \mu_i + \lambda_t + w_{it} \tag{4}$$

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 as follows: dividend per share (D), earnings per share (E). Also, explanatory variables that proxy for growth are growth in assets per share (GRSIZE); and retained earnings per share (RE) calculated as retained earnings divided with the number of stocks in circulation. GRSIZE are calculated as the annual percentage change in assets per share and E, respectively. Other variables are total assets less the sum of riskless assets to own capital (RA), the debt to equity ratio (DE), size (SIZE), and variability in earnings (STD). Theoretically we should expect a positive relation between D, E, RE, GRSIZE, SIZE and equity prices, and a negative relation between RA, STD, and equity prices. There is no theoretical expectation as regards to DE since if it exceeds the market expected debt burden for a given firm it increases the possibility of default and should have a negative relation with equity prices, and visa versa.

III.   Results

As a first stage in the analysis we regressed every variable separately on the equity prices of each sector and we proceeded with various combinations of the statistically significant variables. Tables 1-4 report the results. The Hausman (1978) criterion suggests the cross-section and time-series effects can be considered as random variables. For example, the m-statistic is lower than the critical value for all industries. Thus, we proceed with the estimation using the Error Components Model.

The results for the metallurgical sector (Table 1), indicate that the explainability of the first combination is significant since the three independent variables (SIZE, GRSIZE, E) are statistically significant, have the expected sign, and explain 80% of the variability of the dependent variable. The second combination is also significant since the two independent variables (GRSIZE, D) are statistically significant, have the expected sign, and also explain 80% of the variability of the dependent variable. The

third combination results to one independent variable (D), which is statistically significant, has the expected sign, and explains 78% of the variability of the dependent variable. The results for the commercial-industrial sector (Table 2) suggest that there are two independent variables (D, RE) that are statistically significant, have the expected sign, and also explain 87% of the variability of the dependent variable. The results for the food sector indicate (Table 3) that the expainability of the first model is lower than other sectors since the significant independent variables (SIZE, E) have the expected sign but explain only 66% of the variability of the dependent variable. The second combination (independent variable: D) also explains less of the variability of the dependent variable (63%). Lastly, the results for the banking sector (Table 4) are quite interesting: the expainability of the first model is quite low (28%), although both variables (SIZE, E) are statistically significant and have the expected sign. The second combination (Size, D) also explains a small portion of the variability of the dependent variable (35%), while the third model (D) explains 30%.

IV.   Conclusion

This paper empirically evaluates the explainability of traditional equity valuation models for Greek equities. The results indicate that for most sectors the valuation models have very high explainability, while there is only one sector (banks) for whom the explainability is very low. Note that in an earlier study Karathanassis and Philippas (1988) report very high explainability for the banking sector. The difference in the results could be due to the extensive re-structuring of the sector during the 1990s, that made it difficult for investors to correctly discount future earning prospects of the sector.

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Table 1: Metallurgical Sector

Independent Variables	Model 1	Model 2	Model 3
CONSTANT	399.64	1485.05	1646.14
	(0.98)	(3.68)[*]	(4.30)[*]
SIZE	0.61		
	(6.65)[*]		
GRSIZE	2.69	3.49	
	(1.97)[*]	(2.46)[*]	
E	6.60		
	(5.03)[*]		
D		8.82	8.97
		(8.73)[*]	(8.75)[*]
$\overline{R}^2$	0.80	0.80	0.78
m-statistic	4.29	7.56	0.07
p-value	0.23[**]	0.02[***]	0.97[**]
df	3	3	3

Notes to Table 1:SIZE : Assets per share, GRSIZE : Growth in assets per share, E : Earnings per share, D
: Dividends per share, t-statistics appear in parentheses,
* denotes significance at the 5%
** p-value at 95% confidence level
*** p-value at 99% confidence level
m-statistic: Hausman's (1978) test statistic

Table 2: Commercial & Industrial Sector

Independent Variables	Model 1
CONSTANT	-273.24 (-0.66)
D	21.14 (6.53)*
RE	14.91 (6.95)*
$\overline{R}^2$	0.87
m-statistic	0.01
p-value	0.99**
df	3

Notes to Table 2:
RE : Retained Earnings per share
See also Notes to Table 1.

Table 3: Food Sector

Independent Variables	Model 1	Model 2
Constant	678.86 (1.50)	1308.58 (3.63)
SIZE	0.58 $(3.38)^*$	
E	3.26 $(2.34)^*$	
D		14.80 $(4.03)^*$
$\overline{R}^2$	0.66	0.63
m-statistic	2.04	0.90
p-value	0.56^{**}	0.64^{**}
df	3	2

Notes to Table 3: See also Notes to Table 1.

Table 4: Banking Sector

Independent Variables	Model 1	Model 2	Model 3
CONSTANT	1119.58 (1.10)	623.16 (0.71)	2552.47 $(3.37)^*$
SIZE	0.04 $(2.88)^*$	0.04 $(2.87)^*$	
E	2.54 $(2.08)^*$		
D		8.26 $(3.96)^*$	8.87 $(3.67)^*$
$\overline{R}^2$	0.28	0.35	0.30
m-statistic	2.55	0.75	1.17
p-value	0.47^{**}	0.86^{**}	0.56^{**}
df	3	3	2

Notes to Table 4: See also Notes to Table 1.