The Determinants of Stock Prices in the Kuwait Stock Exchange: An Extreme Bound Analysis

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Abstract

This paper uses traditional and relaxed extreme bound analysis to test the robustness of the determinants of stock prices for companies listed on the Kuwait Stock Exchange. Based on 1320 regressions, only three out of eleven potentially important variables passed the test. These are previous earnings per share, previous cash flow per share and the price to book value ratio. The final model that included these variables in addition to the earnings per share and the book value per share as the free variables produced a very strong explanatory power. The relaxed extreme bound analysis provided misleading results.

JEL Classification: G12-Asset Valuation.

Key words: Extreme Bound Analysis (EBA), Stock Price Determinants, Emerging Markets.

Introduction

The corporate finance literature tells us that value maximization is the main goal of business organizations. It entails that major corporate decisions should eventually lead to this goal. The two main types of decisions recognized by the literature that affect valuation are financing decisions and investment decisions. Theoretical and empirical research has examined the effect of these decisions on the price of company's stock. As a result, we now have controversial investment theories related to asset pricing and controversial financing theories related to the capital structure and the dividend policy. It is not the intention of this paper to discuss these theories in detail but rather to highlight the value-relevant variables each theory is concerned about.

Asset pricing theory recognizes two classes of valuation models: asset-based valuation models and discounted cash flow (DCF) models (for a detailed discussion, see White, Sondhi and Fried (2003)). Assets-based valuation models assign a value to the company based on the current market value of its assets. The following is a typical asset-based valuation model:

$$value = Assets - Liabilities \, .$$

It is clear that the resulting value of the above equation represents the book value of the firm. This implies that investors interested in buying the stock of this company are willing to pay the resulting value as a price of the purchase. Bao and Bao (1998) found that book value is a significant explanatory variable of firm value (see also Ohlson (1995) and Burgstahler and Dichev (1997)). It is therefore logical to assume that the stock price of the company should reflect this value.

All DCF valuation models are derived from the following equation:

$$Value = \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t} \, .$$

These models use three alternative cash flow (CF) measures: dividends, accounting earnings and free cash flows. The r is the required rate of return used as the discount rate. Predictions of future *CF* require the incorporation of a growth rate (g) which can be arrived at by

$$g = (1\text{-Dividend payout}) \times ROE.$$

For the no-growth case, when the valuation objective is the company's equity, earnings are defined as the net income. The value of the stock is calculated as:

$$P = \frac{EPS}{r},$$

where *EPS* is the earnings per share and r is the required rate of return, estimated using the Capital Asset Pricing Model (CAPM)

$$r_i = r_f + (r_m - r_f)\beta_i,$$

where r_f is the risk-free rate of return, r_m is the market rate of return and β_i is the beta coefficient that measures the risk of the stock in relation to the market.

Despite the controversial argument of Modigliani and Miller (1958) with regard to the irrelevance of capital structure to the firm's value, modern capital structure literature tells us that an optimal capital structure (the one with the right level of debt) leads to cost minimization and value maximization (for a detailed discussion, see Brigham and Daves (2004)).

With regard to dividend policy and its relation to the firm's value, and despite Miller and Modigliani's (1961) "irrelevance" argument, other studies provided evidence that high payouts lead to stock price increase Lintner (1962), Gordon (1963) and Fama and French (2001). In fact the literature recognizes the residual dividend model for setting the level of payout. That is when earnings are realized, priority should be given to capital investments and the residual should be paid out to shareholders. This implies that if dividend policy is relevant to value then the level of earnings, retention ratio, the level of capital investment and the financing policy of capital investment are all relevant to value.

Except for Durham (2002) who focused on the asset-pricing model violation, most of the empirical studies that attempted the examination of the above theories are based on the Pearson rank correlation coefficient and regression analysis, which invariably involves data mining. As argued by Moosa and Smith (2004, p. 289) "the problem with these studies is that they employ procedures that lead to uncertainty concerning the confidence assigned to their findings". This argument is in line with the Cooley and LeRoy's (1981, p. 825) statement that economic theory "ordinarily does not generate a complete specification of which variables are to be held constant when statistical tests are performed on the relation between the dependent variable and the independent variable of prime interest". To address confidence uncertainty, this paper uses the technique of extreme bound analysis (EBA) originally suggested by Leamer (1983, 1985) and extended by Granger and Uhlig (1990) and Sala-i-Martin (1997). It attempts to examine the robustness of 11 variables as determinants of stock price variation for companies listed on the Kuwait Stock Exchange (KSE). The possible variables of interest are derived from the asset pricing model, the capital structure theory and the dividend policy theory. This is the first attempt to examine the combined effects of variables derived from the three theories.

Methodology

The basic methodology consists of running cross-sectional regressions of the form

$$P = \alpha_0 + \sum_{t=1}^{n} \beta_i x_i + \varepsilon, \quad (1)$$

where P is the stock price and the x_i's are explanatory variables, which vary across researchers and across papers. Researchers typically and invariably report a sample of regressions. Variables like earnings per share, book value per share, the level of debt, the level of payout, and many others have been found to be significantly correlated with the stock price. The problem with equation (1) is that researchers may experiment with different combinations of explanatory variables and report the results they like best. This is an ethical issue described by Leamer (1985) as the "*con of econometrics*" and led to the introduction of EBA. The use of EBA technique can be summarized by the following steps:

1. By reviewing the literature, determine all explanatory variables that are suspected to have an effect on the dependent variable.
2. From this list, determine the explanatory variables (it could be only one) that always appear in the regression. These are called the free variables.
3. From the remaining variables, each variable must be selected one at a time as the variable of interest.
4. In addition to the variable of interest a set number of variables are included in the regression. These are the remaining potentially important variables.

The technique requires a model of the form

$$P = \alpha + \sum_{i=1}^{n} \delta_i X_i + \beta V + \sum_{i=1}^{m} \gamma_i Z_i + \varepsilon \,, \tag{2}$$

where, X_i is the free variable, V is the variable of interest whose robustness we want to test, and Z_i is the potentially important variable.

5. After running the required number of regressions, the variable of interest is considered robust if the highest and lowest values of its coefficient, β, remain statistically significant and of the same sign.

The total number of regressions for each variable of interest can be calculated by

$$\frac{k!}{(k-n)! \times n!}, \tag{3}$$

where k is the number of variables of interest, V, less 1 and n is k less the number of Z variables included in the each regression.

Multicollinearity may be a problem when more *Z* variables are included in the regression. This problem was addressed by Leamer (1978) and Levine and Renelt (1992) who suggested a remedy by limiting the pool of variables from which the Z variables are chosen and using only three *Z* variables to limit the number of explanatory variables in each regression.

Another problem is that EBA is considered a severe test of robustness. That is because the variable of interest is considered fragile if only one out of the large number of regressions results in a statistically insignificant coefficient or a change in the sign. Sala-i-Martin argues that "*… one is bound to find one regression for which the estimated coefficient changes signs if enough regressions are run. Thus, giving the label of nonrobust to all variables is all but guaranteed.*"

Therefore, a more relaxed approach to EBA was introduced by Granger and Uhlig (1990) suggesting the elimination of models with poor goodness of fit as measured by the R^2. They imposed a condition on the level of R^2 such that all models with a very low R^2 are excluded. The criteria is of the form

$$R_{\alpha}^2 \geq [(1-\alpha)R_{\max}^2 + R_{\min}^2], \tag{4}$$

where $0 < \alpha < 1$, such that if $\alpha = 0$, then the extreme bounds are represented by only one model, the highest R^2, whereas if $\alpha = 1$, then the extreme bounds are drawn from all models. If $0 < \alpha < 1$, then the extreme bounds are drawn from the models with an R^2 in the top $\alpha\%$ of the $(R_{\max}^2 - R_{\min}^2)$. This more relaxed robustness testing technique is oddly called the Restricted Extreme Bound Analysis (REBA). Preserving the same abbreviations, and because we are relaxing the selection criterion, the Relaxed Extreme Bound Analysis is a more appropriate name.

Data and Variables

The empirical results presented in this study are based on a sample of cross-sectional data of 61 companies listed on the Kuwait Stock Exchange for the period of 1999-2002.

The previous review of the asset valuation literature implies that there is no single model exists that completely specifies the determining variables of price variation. As a result, and based on the three theories discussed earlier, we have selected 2 *X* variables and 11 *V* variables. EPS and BV are the *X* variables that are always included in the regression model. EPS, which represents the main profitability measurement, is calculated as the net income available to shareholders divided by the number of shares outstanding. BV, which represents the book value of the company, is calculated as the total equity divided by the number of shares outstanding. The two variables have general acceptance in the literature of having theoretical and empirical effects on stock price variation. The dependent variable and the *V* variables are listed in Table 1.

Table 1

List of the variables

Variable	Type	Description
PRICE	Dependent variable	Stock price
EPS	Free variables	Earnings per share
BV		Book value per share
PEPS	Variables of interest	Previous earnings per share
CDIV		Cash dividends per share
PCDIV		Previous cash dividends per share
ROE		Return on equity
G		Growth rate
D/A		Debt to total assets ratio
RET		Retention ratio
P/B		Price to book value ratio
P/E		Price earnings ratio
CFPS		Cash flow per share
PCFPS		Previous cash flow per share

PRICE is the dependent variable representing the end-of-the-year closing stock price of the company. Each of the 11 variables is selected as the variable of interest in turn. For a given V variable, three Z variables are selected from the remaining ten. By applying the calculation method specified in (3), and to test for robustness, each variable of interest, V, requires 120 regressions. The total number of regressions required for the 11 variables of interest is 1320.

Empirical Results

To begin, it is probably useful to discuss the correlation matrix of the variables presented by Table 2.

It can be seen that the variables of interest, PEPS, CDIV, PCDIV, ROE, P/B, CFPS and PCFPS are all highly correlated with the dependent variable PRICE as well as they are correlated with each others. G, D/A, RET and P/E are not significantly correlated with PRICE. PEPS has the highest correlation and RET has the lowest correlation. The clear correlation between the independent variables highlights the problem of multicollinearity which will be dealt with using the variable deletion hypothesis test as applied to the final model resulting from the EBA.

Table 2

The correlation matrix

	PRICE	PEPS	CDIV	PCDIV	ROE	G	D/A	RET	P/B	P/E	CFPS	PCFPS
PRICE	1.00	0.86	0.77	0.78	0.58	0.15	0.07	0.06	0.63	-0.09	0.61	0.56
PEPS		1.00	0.70	0.89	0.42	-0.02	0.03	0.04	0.39	-0.08	0.54	0.65
CDIV			1.00	0.58	0.48	0.08	-0.03	0.02	0.29	-0.07	0.70	0.35
PCDIV				1.00	0.38	-0.05	0.01	0.03	0.40	-0.06	0.47	0.74
ROE					1.00	0.43	0.07	0.11	0.48	-0.17	0.43	0.28
G						1.00	0.04	0.09	0.27	-0.09	0.08	-0.05
D/A							1.00	0.01	0.16	-0.03	0.25	0.22
RET								1.00	0.09	-0.54	0.04	0.04
P/B									1.00	-0.03	0.32	0.32
P/E										1.00	-0.08	-.06
CFPS											1.00	0.65
PCFPS												1.00

The basic regression of the dependent variable with the two free variables results in the following (*t* statistics is in parentheses):

$$PRICE = -0.002 + 4.11\,EPS + 1.07\,BV$$
$$(-0.07) \quad (8.54) \qquad (7.52) \qquad R^2 = 0.819$$

The high goodness of fit and the significance of the *t* statistics provide additional evidence of the importance of the joint effect of the earnings per share and the book value per share variables on the stock price variation. They also imply the importance of their selection as free variables. It may be useful to observe the effect of the *V* variables when added to the free variables one at a time. The results of this procedure are presented in Table 3.

Table 3

Results of regressing PRICE on the free variables and another V variable

Variable of Interest		Constant	EPS	BV	V	R^2
1	PEPS	0.08 (3.56)**	3.77 (9.07)**	0.34 (2.28)**	3.72 (9.08)**	0.867
2	CDIV	-0.01 (-0.23)	4.27 (7.73)**	1.09 (7.40)**	-0.28 (-0.58)	0.820
3	PCDIV	0.04 (1.88)	3.69 (8.70)**	0.68 (5.14)**	2.42 (8.48)**	0.862
4	ROE	-0.01 (-0.15)	4.01 (4.48)**	1.09 (5.61)**	0.03 (0.13)	0.819
5	G	0.002 (0.06)	4.18 (7.86)**	1.05 (6.91)**	-0.01 (-0.33)	0.819
6	D/A	-0.02 (-0.80)	4.18 (8.68)**	1.05 (7.36)**	0.06 (1.69)	0.822
7	RET	-0.001 (-0.06)	4.10 (8.49)**	1.07 (7.51)**	0.0004 (0.31)	0.819
8	P/B	-0.32 (-18.07)**	1.48 (5.41)**	1.50 (19.54)**	0.20 (24.75)**	0.950
9	P/E	-0.003 (-0.13)	4.12 (8.54)**	1.07 (7.51)**	.00002 (0.50)	0.820
10	CFPS	-0.002 (-0.07)	3.90 (7.76)**	1.05 (7.34)**	0.14 (1.41)	0.821
11	PCFPS	0.01 (0.36)	4.11 (9.06)**	0.87 (6.22)**	0.47 (5.48)**	0.840

** Significant at 0.01 level
* Significant at 0.05 level

The results indicate that

1. The regression equation results in the highest explanatory power when P/B is added to the free variables.
2. In addition to P/B, the other *V* variables that produced significant coefficients are PEPS, PCDIV and PCFPS. Interestingly, these variables are the previous year's earnings per share, cash dividends and cash flows.
3. The coefficients of the two free are significant in all regressions.
4. The significance of the free variables' coefficients is not affected by the inclusion of the other *V* variables.

From these initial results, we expect that P/B, PEPS, PCDIV and PCFPS will be the only *V* variables qualified to pass the severe EBA robustness test. Actually, we believe the ones that produced higher explanatory power are more likely to pass.

The results of the traditional (more severe) EBA are presented in Table 4.

Table 4

Results of the traditional EBA

Variable of Interest		β_{max}	t	β_{min}	t	Significant $\beta's(\%)$
1	PEPS	3.84	9.25**	1.18	3.37**	100
2	CDIV	0.78	2.76**	-1.79	-0.42	3
3	PCDIV	2.63	5.92**	0.57	2.38**	100
4	ROE	0.08	0.35	-0.66	-5.41**	30
5	G	0.04	1.77	-0.23	-1.86	28
6	D/A	0.06	2.00*	-0.05	-2.57**	23
7	RET	0.001	0.68	-0.0007	-1.01	0
8	P/B	0.21	27.26**	0.18	23.88**	100
9	P/E	0.0003	0.62	-0.00002	-0.67	0
10	CFPS	0.21	1.45	-0.31	-2.33**	10
11	PCFPS	0.62	5.53**	-0.11	-0.70	48

** Significant at 0.01 level
* Significant at 0.05 level

It can be seen from the table that only three out of the eleven *V* variables passed the robustness test. These are PEPS, PCDIV and P/B variables. The maximum and minimum coefficients of these variables turned out to be statistically significant in all of the 120 regressions for each variable with the expected positive sign. The other eight variables are considered by the traditional EBA as fragile. However analyzing the results in Table 4, we find that there are other variables that appeared to have an effect in a considerable number of regressions. For example, PCFPS, ROE, G and D/A coefficients were found to be significant in 48%, 30%, 28% and 23% of the regressions respectively with a change in the sign. By applying the relaxed EBA considering the regression results of the top 20% of R^2's as shown in Table 5, only ROE passes the robustness test. However, the problem with this result is that the coefficient has the wrong expected sign. ROE is a measurement of the profit relative to the value of owners' equity and an increase in this profit is expected to lead to an increase in the company's value.

Table 5

Results of the relaxed EBA

		Considering only to 20% R^2's			
Variable of Interest		β_{max}	t	β_{min}	t
1	PEPS	1.87	8.49**	1.18	3.37**
2	CDIV	0.78	2.76**	-0.62	-2.35**
3	PCDIV	1.20	7.82**	0.57	2.38**
4	ROE	-0.47	-4.02**	-0.65	-5.93**
5	G	-0.02	-1.44	-0.05	-3.45**
6	D/A	-0.01	-0.43	-0.04	-2.52**
7	RET	-0.0003	-0.4	-0.0007	-1.01
8	P/B	0.18	25.81**	0.18	23.59**
9	P/E	0.00002	0.72	-0.00002	-0.67
10	CFPS	0.001	0.01	-0.26	-3.84**
11	PCFPS	0.31	5.99**	-0.03	-0.56

** Significant at 0.01 level
* Significant at 0.05 level

This problem can be explained by (i) the fact that ROE was found to be highly correlated with most of the other *V* variables, and (ii) Relaxation of the EBA is an arbitrary procedure which violates the rule of fairness by excluding a considerable number of regressions (in this case 80% of the regressions).

To examine the joint effect of the *V* variables resulting from the traditional EBA in addition to the free variables, we estimate the following model

$$\underset{(-14.03)}{PRICE = -0.25} \quad \underset{(6.48)}{+ 1.55\ EPS} + \underset{(13.10)}{1.11\ BV} + \underset{(3.53)}{1.24\ PEPS} + \underset{(2.57)}{0.61\ PCDIV} + \underset{(23.86)}{0.18\ P/B} \qquad R^2 = 0.963$$

It can be seen, from the very high R^2, that the estimated model has a very strong explanatory power. Figure 1 shows a plot of the actual versus the fitted values of the above model which indicates the close relationship between the two curves implying a very small error term.

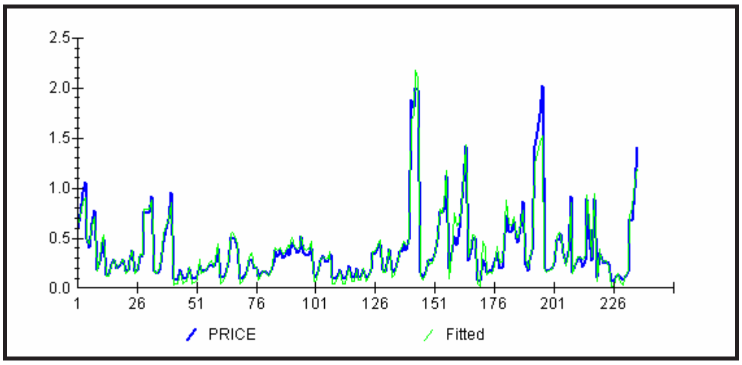

Fig. 1. Actual versus fitted values

The significance of the constant's negative coefficient typically means that if the explanatory variables have zero values then the price of the stock starts with the value of the constant. This means the starting value of the price is caused by variables other than those included in the model. The best explanation of the negative value of the constant is that the Kuwait Stock Exchange, during the period of 1999-2002, was affected by accelerating instability state of the Gulf region or by the bad performance of other international stock markets. By analyzing the performances of important indices of international stock markets during the same period, we find that most of them witnessed negative growth rates. For example, the growth rates for S&P500, NASDAQ, FTSE, DAX and NIKKEI for that period were -8.48%, -6.89%, -11.96%, -4.28% and -16.24% respectively.

Although it is true that BV and P/B are reflections of the earnings per share and that PCDIV is a reflection of the level of the previous earnings per share, it is important to test whether each of these variables is important in their own right. This can be achieved by conducting the variable deletion tests. The results of these tests are shown in Table 6.

Table 6

Results of the variable deletion tTests

Variable Deleted	Joint test of zero restriction on the coefficient of the deleted variable		
	LM χ^2 (1)	LR χ^2 (1)	F F(1,230)
BV	100.81**	131.49**	171.52**
P/B	168.11**	294.04**	569.52**
PCDIV	6.60*	6.69**	6.61*

** Significant at 0.01 level
* Significant at 0.05 level

LM = Lagrange Multiplier Statistic based on χ^2 with *df*=1

LR = Likelihood Ratio Statistic based on χ^2 with *df*=1

F = F Statistics based on the F distribution with df_1=1 and df_2=230

The LM, LR and F test statistics are significantly below their critical values rejecting the hull hypothesis of 'no importance'. These results imply the importance of these variables in explaining price variation and that the exclusion of any of them may cause model misspecification.

Concluding Remarks

Extreme bound analysis was used to test for the robustness of the potentially important variables to explain the stock price variation for companies listed on the Kuwait Stock Exchange during the period from 1999 to 2002. Based on rigorous evidence from the literature, earnings per share and book value per share were selected as the free variables that appear in all regressions. Eleven more explanatory variables were then considered as variables of interest one at a time. After running a total of 1320 regressions, the main findings are:

1. Only three variables passed the severe robustness test of the traditional EBA. These are the previous earnings per share, the previous cash dividend per share and the price to book value ratio.
2. By running the relaxed EBA, return to equity ratio was found to pass the robustness test but with the unexpected sign. It was argued that this may be caused by the fact that ROE was found to be highly correlated with most of the other explanatory variables and the fact that we actually violated the fairness rule of considering all possible regressions by relaxing EBA the way it was suggested by Granger and Uhlig (1990).
3. By not trusting the relaxed EBA results, the final regression model includes five explanatory variables. These are earnings per share, book value per share previous earnings per share, previous cash dividend per share and the price to book value ratio. These variables explain 96.3% of stock price variation as measured by the R^2 which implies a very strong explanatory power.
4. Despite the existing correlations among the explanatory variables of the final model, multicollinearity did not seem to be problematic as the variable deletion test revealed that the removal of any of these variables from the final model may cause misspecification.

These findings imply that because of strong predictive power of this model, investors interested in predicting stock prices for companies listed on the Kuwait Stock Exchange should look more closely at the variables included in the final model. Because of the misleading results of the relaxed EBA, an important theoretical implication is that the relaxed approach to EBA cannot be trusted. That is because relaxing the severity of the EBA robustness test as suggested by Granger and Uhlig (1990) contradicts with main goal of considering all regression. That is avoiding throwing away the ones that we do not like.

Despite the strong explanatory power of the final model, this paper does not rule out other explanatory variables suggested in different theories related to company valuation.

References

1. Bao, Ben-Hsien and Da-Hsien Bao (1998), Usefulness of Book Value in Equity Valuation: Evidence from the Taiwan Stock Exchange, Advances in International Accounting, Vol. 11, pp. 189-201.
2. Brigham, E. and P. Daves (2004) Intermediate Financial Management, 8th Ed., South-Wester.
3. Burgstahler, D.A. and I.D. Dichev (1997), Earnings, adaptation and equity value, The Accounting Review (April), pp. 187-215.
4. Cooley, T. and LeRoy, S. (1981), "Identification and Estimation of Money Demand", American Economic Review, Vol. 71, pp. 825-844.
5. Durham, J. (2002), The Extreme Bounds of the Cross-Section of Expected Stock Returns, The Federal Reserve Board, Finance and Economics Discussion Series, 34.
6. Fama, E. and K. French (2001), Disappearing Dividends: Changing Firm Characteristics or Lower Propensity to Pay? Journal of Applied Corporate Finance, Vol. 14, No. 1, Spring, pp. 67-79.
7. Gordon, M. (1963), Optimal Investment and Financing Policy, Journal of Finance, May, pp. 264-272.
8. Granger, C. and Uhlig, H., (1990), Reasonable Extreme Bound Analysis, Journal of Econometrics, Vol. 44, pp. 154-170.
9. Leamer, E. (1978), Specification Search: Ad Hoc Inference from Non-Experimental Data, New York: Wiley.
10. Leamer, E. (1983), Sensitivity Analysis Would Help, American Economic Review, Vol. 75, pp. 308-313.
11. Levine, R. and Renelt, D. (1992), A Sensitivity Analysis of Cross-Country Growth regressions, American Economic Review, 82, pp. 942-962.
12. ______ (1985), "Let's Take the Con Out of Econometrics, American Economic Review, Vol. 37, pp. 31-43.
13. Lintner, J. (1962), Dividends, Earnings, Leverage, Stock Prices, and the Supply of Capital to Corporations, Review of Economics and Statistics, August, pp. 243-269.
14. Miller, M. and F. Modigliani (1961), Dividend Policy, Growth and the Valuation of Shares, Journal of Business, October, pp. 411-433.
15. Modigliani, F. and M. Miller (1958), The Cost of Capital, Corporation Finance, and the Theory of Investment, American Economic Review, June, 48, pp. 261-297.
16. Moosa, I. and Smith L. (2004), Economic Development Indicators As Determinants of Medal Winning at The Sydney Olympics: An Extreme Bound Analysis, Australian Economic Papers, September, pp. 288-301.
17. Ohlson, J.A. (1995), Earnings, book value, and dividends in equity valuation, Contemporary Accounting Research (Spring), pp. 661-687.
18. Sala-i-Martin, X. (1997), I Just Ran Two Million Regressions, American Economic Review, Vol. 87, pp. 178-183.
19. White, G., Sondhi A., and Fried D (2003), The Analysis and Use of Financial Statements, 3rd ed., Wiley.