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Application Of Simple And Dimson Market Models: The Case Of The Karachi Stock Exchange

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ABSTRACT

Karachi Stock Exchange is one of the emerging stock markets of Asia. Unlike the developed equity markets, the emerging markets have thin trading, market overreaction, highly market volatility and lead or lag structure, which are the main reasons of the several forms of model misspecification. The current study investigates whether or not Dimson market model explains better stock behavior rather than the simple market model from the investor's point of view. Both the models are employed on the monthly data of all the sectors which are listed in KSE by using OLS and GARCH-M estimation methods for analysis. The paper concludes that simple market model is more acceptable model in many sectors of KSE than Dimson market model. The limitation of the study is that how large data is used and either all sectors or some specific sectors be taken into consideration for estimation. The future research should consider the KSE-30 and KSE-100 listed firms for estimation along with the increase in the time period.
KEYWORDS: Simple market model, Dimson market model, GARCH-M, KSE

INTRODUCTION

The beta coefficient explains the sensitivity of a security against the market movements. The market portfolio is said to be efficient if the expected returns have a linear function to the market beta coefficient, where it provides the sufficient information of the expected return [1][2][3]. The total risk existing in security has two components: the systematic risk and the non-systematic one. The non-systematic risk can be removed by diversification technique. But, the systematic risk is inherent in security and cannot be removedthrough diversification. It means, the beta coefficients explain the relative amount of systematic risk of a particular security on average asset risk [4].

The Efficient Market Hypothesis (EMH) states that at any given time, security prices fully reflect all available information. There are three forms of the efficient market hypothesis:firstly, the efficient market in its weak form does not hold enough information from investors can predict the future fluctuations in stock prices and their returns. Secondly, the semi strong form of efficient market states that the information which publically published and available in the form of firm's products, operations and balance sheets, makes predictions about the stock prices and future earnings. Lastly, the stock prices that reveal all the information to investors can depict the future stock prices and their respective returns; this is strong form of efficient market [5]. This type of information is usually with the insiders only and, hence, security and exchange commission (SEC) prohibits the insiders to invest in this very company. The strong form of market efficiency exists after the weak and semi strong forms.

There are many other factors that affect the expected return of securities which are not properly addressed in the existing market models, like: Sharpe-Linter-Black model (SLB). One of the main factors is the size, which better explains the average return along with market betas [6]. The other factor is leverage that has a positive relationship with the average return.This factor is associated with risk and the risk explains the return of security [7]. The other factor includes the book value to the market value of stocks which has also a positive relationship between the average return on stocks [8][9]. The earning price ratio includes both the size of the market and market beta, explains better cross section average return [10].

In the past, the different aspects of the traditional market model have been studied in case of both developed and new emerging stock markets. But the areas that are still needed to be addressed are: the validity of the traditional market model in specific areas of interest; and the exceptional market conditions. Unlike the developed markets, the emerging markets has thin trading, market over-reaction, highly market volatility and lead or lag structure, which are the main reasons of the several forms of model misspecification [11].

The simple market model explains the security return by taking into account the market beta. But the Dimson market model [12] states that the return of security not only depends on the lag but also on the lead period of the market return. These periods is more effective in emerging markets where thin trading, market over

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reaction and excess market volatility exist. The Dimson market model is used in case of thinly traded stocks which provides the reliable estimates of the market model parameters.

The certain serious issues that exist in the beta of simple market model, such asheteroskedasticity, auto correlation, non-normality and wrong functional form, make beta biased and need to be corrected. [12] resolved these issues by incorporating the lead and lag periods in market model. In bullish market, the upward market trends influenced by heteroskedasticity occur due to volatility and the presence of non-normality caused by unbiased betas. Infrequent trading causes the downward biased estimates of beta, while the frequent one causes the upward biased estimates. Therefore, the econometric techniques have been developed in order to reduce such biasness in the market returns.

The literature reveals the mixed findings on market efficiency in the Pakistan equity market. According to [13] [14][15][16][17][18][19][20], KSE is not efficient in its weak form. Hence, the future prices can be predicted from the past prices and analysts can forecast the market and earn the profits. But, [21] provided evidence that equity market of Pakistan is efficient in its weak form too. A few studies [22][23] tried to investigate the semi-strong form of market efficiency in the Pakistani equity market, rejected the semi-strong form of market efficiency of the KSE. Therefore, the public information did not play a significant role for determining of the stock returns which are more sensitive to private information.

In literature review, it can be seen that behavior of market can be understood by using more than one technique. The study of developed countries' equity market shows that their share prices forecast the future prices and even then their markets are efficient. But, Pakistan is an emerging equity market which reflects the state of national economy and its information may take several lags. The aim of study is to test which model explains better equity behavior in case of Pakistan equity market.

METHODOLOGY

This study tries to make comparison of Dimson market model with a simple market model taking of all the sectors of Karachi Stock Exchange (KSE). The simple market model was developed by [1][2] that determineda risk associated with security (*i*) return as:

$$R_{it} = \alpha + \beta_i R_{mt} + \varepsilon_{it}$$

Where, α andβ are the estimated parameters. R_{it} is the return on security *i* in period *t* and R_{mt} is the return on market portfolio in time *t*. The Dimson market model states the return of security is dependent on the lag and lead periods of the market return as given below:

$$R_{it} = \alpha_{it} + \sum_{j=-k}^{k} \beta_{ij} R_{m,t+k} + \varepsilon_{it}$$

Where, α_i and β_{ij} are the estimated parameters. R_{it} is the return on security *i* in period *t*, R_{mt} is the return on market portfolio in time *t* and ε_{it} is the residual term. The symbol *-k* means the time lags and *+k* means the time leads. The return on security *i* in time *t* (R_{it}) is a function of return on market portfolio *m* in time *t* (R_{mt}), the return on the market portfolio m in up to time lags (*t-k*) and return on the market portfolio *m* in up to *k* time leads (*t+k*). So, the return of security *i* estimated by Dimson market model is:

$$\beta_i = \sum_{j=-k}^{k} \beta_{ij}$$

The estimated positive value of the return of security *i* indicates that if the return on market portfolio *m* was increasing in the past (*t-k*), and today (*t*), will increase in future (*t+k*) as well, then the return on security *i*has increasing trend.

The time series includes monthly data from January 2010 to September 2012 of 32 sectors of Karachi Stock Exchange All Index (KSE) collected from State Bank Monthly Bulletin (2013). The KSE index (P_m) and the share price index of the entire sectors (P_i) are converted into stock returns (R_i) by applying the below mentioned formula:

$$R_{it} = Log\left({P_{it}}/{P_{i,t-1}}\right)$$

Where, P_i is the share price index of security *i*. The variables that have been included in the current study are shown in Table 1 below:

Table 1 Identification of Variables by Sector Wise

Sr. #	Return	Sector
1	R_{s01}	share price index of oil & gas
2	R_{s02}	share price index of chemicals
3	R_{s03}	share price index of forestry & papers
4	R_{s04}	share price index of industrial metals & mining
5	R_{s05}	share price index of construction & materials

6	R_{s06}	share price index of general industrials
7	R_{s07}	share price index of electronic & electrical equipment
8	R_{s08}	share price index of industrial engineering
9	R_{s09}	share price index of industrial transportation
10	R_{s10}	share price index of support services
11	R_{s11}	share price index of automobile and parts
12	R_{s12}	share price index of beverages
13	R_{s13}	share price index of food producers
14	R_{s14}	share price index of household goods
15	R_{s15}	share price index of leisure goods
16	R_{s16}	share price index of personnel goods
17	R_{s17}	share price index of tobacco
18	R_{s18}	share price index of health care equipment & services
19	R_{s19}	share price index of pharmaceutical & bio tech
20	R_{s20}	share price index of media
21	R_{s21}	share price index of travel and leisure
22	R_{s22}	share price index of fixed line communication
23	R_{s23}	share price index of electricity
24	R_{s24}	share price index of gas, water and multi utilities
25	R_{s25}	share price index of banks
26	R_{s26}	share price index of non-life insurance
27	R_{s27}	share price index of life insurance
28	R_{s28}	share price index of real estate investment & services
29	R_{s29}	share price index of financial services
30	R_{s30}	share price index of equity investment & instrument
31	R_{s31}	share price index of software & computer services
32	R_{s32}	share price index of technology hardware and equipment

Selection of Lag and Lead Periods

The selection of lag and lead periods for Dimson market model is very necessary. But in the literature, there is no rule of thumb for incorporating the number of lead and lag variables in the model, except for low trading activity warrant [24]. According to [25], the excessive lag and lead periods can produce distortions during estimation.[26]recommends that there are no such reasons for using a large number of variable lags and leads periods.

ANALYSIS

At the first step, the beta coefficient of each security, by simple market model, is estimated on market returns with the help of ordinary least square (OLS) technique. The OLS assumptions such as autocorrelation, heteroskedasticity, normality in residuals and autoregressive conditional heteroskedasticity (ARCH), are also check for each security. The violations of these assumptions are also checked through different tests, like: Durbin Watson (DW-stat) test used for autocorrelation; Lagrange multiplier (LM-stat) statistic for first order autocorrelation; white statistic (W-stat) for testing heteroskedasticity; Jarque-Bera statistic (JB-stat) for testing normality; and ARCH test for test testing the ARCH effect. The results of the test are shown in Table 2:

Table 2 Estimated Equations with OLS of the Simple Market Model

Sec.	B	t-ratio (sig)	Adj R^2	DW	LM	W	JB	ARCH
R_{s01}	0.85	7.82 (0.00)	0.66	1.76	0.89	0.05*	0.40	0.66
R_{s02}	1.05	0.70 (0.48)	-0.01	1.44	0.97	0.71	0.00*	0.79
R_{s03}	0.90	3.72(0.00)	0.29	2.54	0.22	0.82	0.73	0.34
R_{s04}	0.61	2.21(0.03)	0.11	2.07	0.76	0.35	0.74	0.73
R_{s05}	1.36	6.48 (0.00)	0.57	1.07	0.13	0.50	0.90	0.22
R_{s06}	0.81	4.16 (0.00)	0.34	2.45	0.13	0.96	0.94	0.31
R_{s07}	0.75	2.73 (0.01)	0.17	1.90	0.25	0.50	0.85	0.42
R_{s08}	0.77	3.82 (0.00)	0.31	1.41	0.24	0.71	0.28	0.98
R_{s09}	1.19	3.48 (0.00)	0.44	1.93	0.44	0.39	0.96	0.63
R_{s10}	2.99	3.24 (0.00)	0.24	1.55	0.75	0.18	0.75	0.24
R_{s11}	0.76	3.39 (0.00)	0.25	2.39	0.13	0.50	0.83	0.39
R_{s12}	0.68	1.95 (0.06)	0.08	1.68	0.75	0.51	0.60	0.54
R_{s13}	0.82	2.85(0.00)	0.19	2.46	0.40	0.34	0.01*	0.42
R_{s14}	0.99	1.87 (0.08)	0.27	2.32	0.78	0.22	0.93	0.85
R_{s15}	0.93	2.24(0.03)	0.15	2.22	0.35	0.57	0.88	0.22
R_{s16}	1.00	7.40(0.00)	0.64	1.87	0.68	0.66	0.22	0.40
R_{s17}	0.57	2.26(0.03)	0.12	1.73	0.51	0.56	0.38	0.98
R_{s18}	1.83	4.83(0.00)	0.43	1.80	0.74	0.20	0.48	0.47
R_{s19}	0.74	3.07(0.00)	0.38	2.16	0.40	0.91	0.44	0.88

R_{s20}	1.12	3.83(0.00)	0.31	2.02	0.76	0.83	0.33	0.70
R_{s21}	0.51	2.41(0.02)	0.13	1.85	0.17	0.94	0.00*	0.71
R_{s22}	0.90	3.18 (0.00)	0.23	1.96	0.98	0.63	0.00*	0.80
R_{s23}	0.53	4.58(0.00)	0.40	1.88	0.51	0.88	0.43	0.21
R_{s24}	0.90	3.72(0.00)	0.29	2.54	0.22	0.82	0.73	0.34
R_{s25}	1.14	8.27(0.00)	0.69	1.96	0.72	0.43	0.10	0.43
R_{s26}	1.07	5.42(0.00)	0.48	2.29	0.62	0.77	0.31	0.58
R_{s27}	1.12	3.83(0.00)	0.31	2.02	0.76	0.83	0.33	0.70
R_{s28}	1.00	7.40(0.00)	0.64	1.87	0.68	0.66	0.22	0.40
R_{s29}	2.15	4.55(0.00)	0.39	2.21	0.55	0.14	0.00*	0.23
R_{s30}	0.75	2.73(0.01)	0.17	1.90	0.25	0.50	0.85	0.42
R_{s31}	1.76	4.20(0.00)	0.35	1.55	0.52	0.67	0.02*	0.43
R_{s32}	1.37	1.70(0.09)	0.08	2.18	0.67	0.74	0.73	0.62

* indicates significance at the 0.10 level.

The beta coefficients of securities are significant. They indicate the high t-ratio, except securities, i.e. Rs_{02}, Rs_{12}, Rs_{14}, andRs_{32}. The adjusted R^2 (Adj. R^2) is almost high except securities, i.e. Rs_{02}, Rs_{12}, andRs_{32}. It is observed that there is no autocorrelation in each security estimated by DW-stats. In the securities, i.e. Rs_{02}, Rs_{13}, Rs_{21}, Rs_{22}, Rs_{29}, Rs_{31}, there is non-normality and in one security i.e. Rs_{01}, conditional heteroskedasticity is found.

At the second step, the securities that violate the assumptions of OLS while estimating the simple market model are now estimated through generalized autoregressive conditional heteroskedasticity (GARCH). The estimation of simple market model with GARCH*(p,q)* are shown in Table 3:

Table 3 Estimated Equations with GARCH-M(p.q) of Simple Market Model

Sec.	B	t-ratio (sig)	Θ	adj. R^2	DW	ARCH	ARCH (1)=γ1 (sig)	GARCH (1)=γ1 (sig)
R_{s01}	0.76	9.03(0.00)		0.70	1.61	0.62	-2.20(0.02)	1.99(0.04)
R_{s02}	1.39	5.97(0.00)		0.29	2.02	0.98	-1.76(0.07)	4.72(0.00)
R_{s13}	0.54	1.69(0.08)	0.01	0.12	2.65	0.18	2.69(0.00)	-4.44 (0.00)
R_{s21}	0.25	1.80(0.07)		0.02	1.91	0.60	-3.83 (0.00)	17.34(0.00)
R_{s22}	0.97	1.92(0.05)	18.33	0.12	2.02	0.40	-2.22(0.02)	2.90(0.00)
R_{s29}	1.57	9.27(0.00)	-0.01	0.13	1.56	0.23	1.88(0.06)	-1.65(0.09)
R_{s31}	1.63	3.89(0.00)	11.89	0.42	1.59	0.90	-16.10(0.00)	216.36(0.00)

* indicates significance at the 0.10 level.

It shows much better results through GARCH than the OLS estimation. GARCH gives the best evaluation of results about the return's volatility of group of stocks under large observation [27]. The OLS assumptions that are violated in simple market model through OLS, now are no longer violation of assumptions through GARCH technique.

The estimation of Dimson market model is taken in two steps: first step is to determine the dimensions of the model, means lags (-k) and leads (+k) length. There are two types of criterion used to determine these dimensions Akaike criterion (AIC), and Schwartz criterion (SC). The latter criterion is considered to be the best criterion to select the simple market model or Dimson market model [11]. With the help of these criterions, the minimum lag length determines the dimensions of Dimson market model.The SC statistics determine the dimensions of Dimson market model are estimated with OLS are shown in Table 4:

Table 4 AIC and SC statistics for estimating with OLS the dimensions of the Dimson market model

Security	Criterion	0	(-1,+1)	(-2,+2)	(-3,+3)
R_{s01}	AIC	-4.65	-4.55	-4.90*	-4.51
	SC	-4.60	-4.41	-4.76*	-4.36
R_{s02}	AIC	-0.53	-1.33*	-1.11	-0.93
	SC	-0.49	-1.18*	-0.97	-0.78
R_{s03}	AIC	-3.80*	-3.62	-3.65	-3.50
	SC	-3.76*	-3.48	-3.50	-3.35
R_{s04}	AIC	-3.77*	-3.68	-3.67	-3.59
	SC	-3.73*	-3.54	-3.52	-3.45
R_{s05}	AIC	-3.59	-3.46	-3.52	-3.61*
	SC	-3.54*	-3.32	-3.38	-3.46
R_{s06}	AIC	-4.25*	-4.05	-4.06	-4.01
	SC	-4.21*	-3.91	-3.92	-3.86
R_{s07}	AIC	-3.70*	-3.66	-3.61	-3.69
	SC	-3.65*	-3.51	-3.47	-3.54
R_{s08}	AIC	-4.15*	-4.04	-3.98	-4.01
	SC	-4.10*	-3.90	-3.84	-3.86
R_{s09}	AIC	-3.38*	-3.30	-3.24	-3.19
	SC	-3.34*	-3.16	-3.10	-3.04

R_{s10}	AIC	-1.89*	-1.71	-1.84	-1.83
	SC	-1.84*	-1.57	-1.69	-1.68
R_{s11}	AIC	-4.02*	-3.95	-3.94	-3.87
	SC	-3.97*	-3.81	-3.80	-3.73
R_{s12}	AIC	-3.34*	-3.21	-3.28	-3.25
	SC	-3.29*	-3.07	-3.13	-3.11
R_{s13}	AIC	-3.60*	-3.45	-3.59	-3.50
	SC	-3.56*	-3.31	-3.44	-3.36
R_{s14}	AIC	-3.17*	-3.02	-2.95	-2.90
	SC	-3.12*	-2.88	-2.81	-2.75
R_{s15}	AIC	-2.98	-2.91	-3.27*	-3.24
	SC	-2.93	-2.77	-3.13*	-3.09
R_{s16}	AIC	-4.30	-4.11	-4.12	-4.38*
	SC	-4.26*	-3.97	-3.97	-4.24
R_{s17}	AIC	-3.96*	-3.77	-3.80	-3.76
	SC	-3.92*	-3.62	-3.65	-3.61
R_{s18}	AIC	-3.58	-3.45	-3.66*	-3.55
	SC	-3.53*	-3.31	-3.52	-3.41
R_{s19}	AIC	-3.94	-3.83	-3.87	-4.35*
	SC	-3.90	-3.69	-3.73	-4.21*
R_{s20}	AIC	-1.95*	-1.85	-1.79	-1.72
	SC	-1.91*	-1.71	-1.65	-1.57
R_{s21}	AIC	-4.26*	-4.20	-4.03	-4.17
	SC	-4.21*	-4.06	-3.88	-4.03
R_{s22}	AIC	-3.58	-3.46	-3.73*	-3.67
	SC	-3.53	-3.32	-3.59*	-3.52
R_{s23}	AIC	-5.12	-4.958	-5.14	-5.39*
	SC	-5.07	-4.81	-4.99	-5.25*
R_{s24}	AIC	-3.40	-3.56*	-3.49	-3.44
	SC	-3.35	-3.42*	-3.34	-3.29
R_{s25}	AIC	-4.10	-3.97	-4.19*	-4.16
	SC	-4.06*	-3.82	-4.04	-4.02
R_{s26}	AIC	-3.91	-3.79	-3.78	-3.97*
	SC	-3.86*	-3.65	-3.64	-3.82
R_{s27}	AIC	-3.41	-3.37	-3.52*	-3.46
	SC	-3.36	-3.23	-3.37*	-3.32
R_{s28}	AIC	-2.19	-2.00	-2.23*	-2.22
	SC	-2.14*	-1.86	-2.08	-2.07
R_{s29}	AIC	-2.32*	-2.15	-2.09	-2.19
	SC	-2.27*	-2.01	-1.95	-2.05
R_{s30}	AIC	-3.66*	-3.49	-3.42	-3.44
	SC	-3.61*	-3.35	-3.27	-3.30
R_{s31}	AIC	-2.63*	-2.60	-2.50	-2.61
	SC	-2.58*	-2.46	-2.36	-2.46
R_{s32}	AIC	-1.72*	-1.65	-1.64	-1.65
	SC	-1.67*	-1.51	-1.50	-1.51

* indicates minimum value in same row.

As stated above the SC criterion is the best criterion for determining the Dimson market model dimensions, explains 75.24% of securities under investigation of simple market model. From the results of SC criterion, dimension of 8 securities are non-zero of Dimson market model while dimension for 24 securities are zero.

In the second step of estimation of Dimson market model, the OLS estimation of 8 securities are done, which are non-zero. The estimated equations with OLS of Dimson market model are shown in Table 5:

Table 5 Estimated equations with OLS of the Dimson market model

Security	B	t-stat (sig)	Adj. R^2	DW	LM(1)	W	JB	ARCH(1)
R_{s01}(-2,2)	0.59	13.36 (0.00)	0.70	1.62	0.69	0.62	0.91	0.34
R_{s02} (-1,1)	2.97	2.28 (0.10)	0.12	1.86	0.92	0.00*	0.00*	0.73
R_{s15} (-2,2)	0.93	2.24(0.03)	0.15	2.22	0.35	0.57	0.88	0.22
R_{s19} (-3,3)	0.72	3.28 (0.02)	0.39	2.14	0.41	0.56	0.65	0.01*
R_{s22} (-2,2)	2.51	3.89 (0.01)	0.35	2.45	0.50	0.41	0.58	0.83
R_{s23} (-2,2)	0.58	2.26(0.07)	0.27	1.96	0.63	0.32	0.51	0.33
R_{s24} (-1,1)	0.93	4.68 (0.00)	0.28	2.60	0.18	0.44	0.55	0.18
R_{s27} (-2,2)	0.44	5.05 (0.00)	0.43	2.64	0.11	0.42	0.72	0.73

* indicates significance at the 0.10 level.

Table 5 shows that the securities having high beta coefficients and significant F-statistics. The Adj. R^2 is almost fine, not high too much. There is no autocorrelation found in each security which is estimated by DW-stats. In these eight securities, there is no normality and no heteroskedasticity. But in case of the security Rs_{02} and

Rs_{19}, the violation of OLS assumptions exist, i.e. the non-normality and ARCH effect respectively. GARCH*(p,q)* test has been used to estimate the better coefficient, but now they are no longer violation of assumptions as shown in Table 6:

Table 6 Estimated equations with GARH-M*(p,q)* of the Dimson market model

Security	B	F-stat (sig)	Adj.R^2	DW	Significance		ARCH (1)=γ_1	GARCH (1)=δ_1
					ARCH(1)	JB		
R_{s02}(-1,1)	1.39	5.97(0.00)	0.29	2.02	0.98	0.41	-0.31(0.07)	1.16(0.00)
R_{s19} (-3,3)	0.88	4.56(0.00)	0.34	1.85	0.16	0.44	-0.24(0.09)	1.24(0.00)

* indicates significance at the 0.10 level.

CONCLUSION

KSE is one of the emerging stock markets of Asia. Unlike the developed markets, the emerging markets has thin trading, market over-reaction, highly market volatility and lead or lag structure, which are the main reasons of the several forms of model misspecification. Therefore, the current study investigates whether or not the Dimson market model explains better stock behavior rather than the simple market model for the investor's point of view in case of KSE. The econometrics estimation techniques, i.e. OLS and GARCH (p,q) are used on the monthly data from 2010 to 2012. The diagnostic tests have been used to determine the heteroskedasticity, auto serial correlation, functional misspecification form and non-normality in case of both estimation techniques; because the both Dimson market model and simple market model are more sensitive in violation of basic OLS assumptions.

The behavior of stocks is explained much better by simple market model rather than Dimson market model as supported by estimated results. The AIC criterion explains that the 56.25% behavior of stock is explained by simple market model. But by the SC criterion, 75.24%behaviour of stock is explained by simple market model. Hence, there is no hesitation to conclude that simple market model explains much better stocks behavior in most sectors of KSE than that of Dimson market model. The limitation of the study is that how large data is used and either all the sectors or some specific sectorsbe taken into account for estimation. The future research should consider the KSE-30 and KSE-100 listed firms for estimation along with the increase in time period.

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