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An Analysis of Market P/E using Auto Regression and Vector Auto Regression Models

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Abstract

Price Earnings (P/E) ratio is one of the most commonly used and one of the most useful techniques in valuation of companies which can be applied for companies as well as for market and can be used in different forms for analysis. Various macroeconomic factors affect stock market and the valuation of companies. Thus, it becomes very important to understand the behavior of P/E ratio with other relevant macro economic variables. This research is such an attempt where the market P/E is analyzed in comparison with payout ratios, money market rates, Forex rates and GDP using advanced statistical analysis such as Auto Regression and Vector Auto Regression Modeling. It was found that dividend payout and money market rates were the two important variables affecting market P/E.

Keywords: Auto Regression, Corporate Valuation, Econometrics, Financial Economics, Macroeconomics, P/E Ratio

1. Introduction

Price Earnings (P/E) ratio is one of the most commonly used and one of the most useful techniques in valuation of companies. According to Anderson and Brooks[1], P/E ratio is a widely used measure of the expected performance of companies. It is part of the family of ratios falling under 'Relatives valuation'. Other ratios include such as Price to Book Value (P/B) and Price to Sales ratio (P/S). The P/E ratio has many variants such as Normal P/E (uses normal earnings), Diluted P/E (uses diluted earnings), Intrinsic P/E (uses dividend discount model on intrinsic accounting information), Trailing P/E (using trailing earnings), Current P/E (uses latest reported earnings) and Forward P/E(uses future earnings). P/E ratios are calculated for a respective company and then multiplied by its earnings to find its equity value. Analysis of P/E ratios includes comparative analysis, historical analysis and using statistical techniques.

P/E ratio is an indicator of value of a company. The market P/E is the indicator of value of the stock market which represents the market movements and represents all the stocks. The market P/E can be studied in comparison with other macroeconomic variables to understand the inter-variable dynamics which can provide insights into equity valuation. This research is such an attempt where the market P/E is analyzed in comparison with payout ratios, money market rates, Forex rates and GDP using advanced statistical analysis such as Auto Regression and Vector Auto Regression Modeling. Payout ratios affect P/E ratio directly. Money market interest rates and Foreign exchange rates are two variables which affects the stock market by affecting the flow of funds, nationally and globally. Similarly it is expected that economic growth (GDP) affects the stock market positively. In discounted cash flow techniques of valuation, if discount rates increase, valuations will decrease if other factors are held constant. Discount rate such as cost of equity or cost of capital are depended on movements of interest rates and thus any change in interest rates will affect valuation of financial assets. Ehrmann and Fratzscher[7] and Bernanke and Kuttner[3] conclude that a 10 basis point surprise in the federal funds target rate would provoke a change in the US equity market in the range of approximately 40-60 basis points and this correlation was found to be negative. Hjalmarsson[8] and Kellard et al.[9] found that the interest rate and dividend yield are fairly robust predictors of stock returns. Charlotte and Tuypens[6] analyzed the long-run regression models using the trailing earnings over price ratio to predict future returns suggested by Campbell

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and Shiller[5]. They used a moving average of the log of 1 plus the EP ratio when forecasting long-run returns and found superiority of their approach to the existing ones. Campbell and Shiller[5] also investigated the value of multi-year earnings averages. They examined earnings over the stock index as a whole rather than at the level of individual companies with reference to the P/E effect (The current research also used market P/E). Bonga-Bonga [4] assessed the dynamic responses of stock prices on inflation, economic activity and monetary policy using a structural vector error-correction model and concluded that there is a positive relationship between equity prices and interest rates in South Africa. Some similar conclusions were also drawn by Muroyiwa[10] based on an SVAR where shocks were identified using a combination of both short-run and long-run restrictions. Basistha and Kurov[2] looked at United States equity market reactions to the surprise component from Federal Open Market Committee (FOMC) announcements and found that the US equity market reactions are more pronounced when the US economy is in a recession thus highlighting the importance of stage of economy.

2. Research Methodology

With an objective of understanding the relationship of stock market (market P/E) with four other macroeconomic variables, Auto Regression(AR) and Vector Auto Regression (VAR)[11] are used in the research. Apart from market P/E, the other four variables used are payout ratios, money market rates, Forex rates and GDP. The time period of data has been taken from 1998-2004 for all five variables as this was the common time period of data available for all the five variables. Annual data of all the variables have been used. Current P/E has been used in this research. The PE data is the 'proxy' market representation by average P/E of nifty stocks extracted from 'Prowess' database. Money market rates, GDP rates and Forex rates data has been derived from RBI database. The payout ratio is annual average for all nifty stocks, data extracted from 'Prowess' data base. The money market rates are the 'Call/Notice money rates' as percentage per annum. The foreign exchange rate (USD/INR) is used. Absolute value of GDP (Rs. Billion) at factor cost has been used. Payout ratio is calculated as the annual average of 'equity dividend as a percentage of PAT' for all Nifty companies. The Mean Squared Error (MSE) and Mean Absolute Error (MAE) have also been used to interpret the errors in models.

3. Analysis

The summary statistics of the variables is indicated in Table 1. It can be observed that the coefficient of variation is highest for GDP and P/E (35%) and lowest for forex and payout (13%).

Table 1. Summary statistics of variables

Variable	Mean	Coefficient of Variation	Minimum	Maximum
PE	24.76	0.35	13.21	51.19
MMrates	6.94	0.233	3.29	9.15
Forex	48.22	0.134	41.26	62.93
GDP	35423.6	0.357	19570.3	57417.9
Pay Out	28.1	0.133	22.21	36.02

The correlation coefficients of the P/E ratio in comparison with other variables is indicated in Table 2, where it can be observed that all the coefficients are positive, although very low for money market rates and GDP and highest with payout ratios.

Table 2. Correlation coefficients (1999 – 2014)

	MM rates	Forex	GDP	Pay Out
PE	0.0735	0.1053	0.0597	0.2301

Table 3 indicates the output data of AR models with respective lags and the values for R-squared, D-W statistic, p-value, Mean Squared Error (MSE) and Mean Absolute Error (MAE). The forecast period is from 2014-2016. It

Table 3. The auto regression model statistics

Sl. No	Lags	R-squared (%)	D-W statistic	p-value	MSE	MAE
1	1	2.1	0.98	0.786	12.58	3.2
2	1 & 2	31.2	2.1	0.53	13.93	3.71
3	1 & 2 & 3	49.53	2.03	0.0007	13.09	3.37
4	1 & 2 & 3 & 4	32.06	1.71	0.06	14.38	2.87

was observed that the third AR model was better of the lot because of its significant p-value, high R-squared and NO autocorrelation. The details of the model are given in Table 4.

Table 4. Auto Regressive (AR) model upto lag 3

	Coefficient	p-value
const	20.21	1.00
PE_1	0.64	1.00
PE_2	−0.197	1.00
PE_3	−0.271	1.00

It is observed in Table 4 that the coefficient was highest for first lag of P/E, although not statistically significant. The AR model is significant (Table 3 and Table 4) but individual components are not. The model in Table 4 was found to be NOT normal, No ARCH effect was found and NO collinearity was found. Subsequently a Vector Auto Regression (VAR) model based on Sims[11] was developed to understand the effect of other macroeconomic variables on market P/E.

3.1 VAR System

Lag order 1 was used in VAR system as the time series includes annual data. The VAR system generated five equation for five different variables as dependent variables respectively but since the focus of study is to understand P/E ratios, only first equation was used for subsequent analysis. Log of all five variables was used in the VAR system. The Table 5 indicates the coefficients of the regression equation with P/E as dependent variable. The R-squared was found to be 57.84% and D-W statistic was 2.31 with a p-value of 0.11. When the model was checked for autocorrelation using Ljung-Box Q test, the null hypothesis of 'No autocorreation' was accepted. Also the null hypothesis of 'No ARCH effect' was accepted. The VAR residual were observed to be stationary (Figure 1). Subsequently the response of P/E ratio to one unit of positive shock in other four variables was observed. With one positive shock for payout ratio, the P/E ratio increased sharply till second year and then it fell down sharply, becoming negative in third year (Figure 2). For a shock of MM rates, P/E ratio came down initially and then it went up, holding and then reducing again from fourth year onwards (Figure 3). Positive shock in Forex rates indicates that rupee becomes weak and if rupee becomes weak, the P/E ratio increased till second year and then reversed till sixth year indicating that the positive effect of depreciating rupee will sustain till two years (time period only), as per Figure 4. According to Figure 5, the positive shock of GDP affects the P/E positively and for long period indicating that the effect of growing economy will be in long term and will be sustainable on stock prices in the country. The forecast ability of the VAR model is check by calculating forecast values for 2015 and 2016 as indicated in Table 6. The Mean Squared Error (MSE) was 0.029 and the Mean Absolute Error (MAE) was 0.17.

Table 5. Regression of P/E as dependent variables

	Coefficient	p-value
const	−4.37	0.15
l_PE_1	0.04	0.85
l_PayOut_1	0.77	0.26
l_MMrates_1	−0.23	0.47
l_Forex_1	0.93	0.40
l_GDP_1	0.16	0.51

Table 6. Forecast for 2015 and 2016

Year	l_PE	Prediction
2015	3.34	3.51
2016	------	3.67

Table 7. Forecast variance decompositions

Period	l_PE	l_PayOut	l_MM rates	l_Forex	l_GDP
1	100	0.0	0.0	0.0	0.0
2	77.5424	18.4470	1.3900	2.6194	0.0012
3	69.7511	19.8197	1.5361	8.8899	0.0032
4	63.5514	18.0693	6.9573	11.4131	0.0089
5	59.3677	16.9935	12.0925	11.5265	0.0197
6	57.9836	16.6262	13.9639	11.3906	0.0357
7	57.8167	16.5718	14.1926	11.3633	0.0555
8	57.7799	16.5866	14.2006	11.3554	0.0775
9	57.5730	16.5706	14.4282	11.3280	0.1002
10	57.1829	16.5030	14.9039	11.2872	0.1229

The Decomposition of Forecasted Variance (FEVD) values are indicated in Table 7 where it can be observed that the forecasted variance for market P/E is largely explained by payout ratio and less by forex rates and almost zero by GDP and this trend sustains till 10 time periods (years) ahead. Thus, it can be concluded that payout ratios and MM rates are two important variables affecting and explaining 30% of variance in P/E. The important observation is that this explained variance sustains from sixth year onwards, indicating that the uncertain effect of the input variables is till fifth year and then it becomes certain.

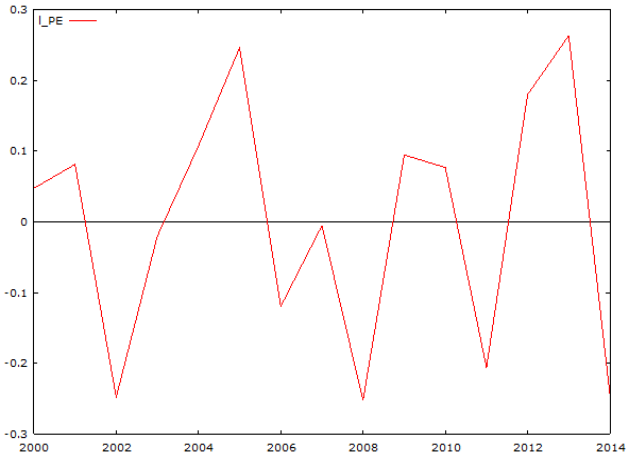

Figure 1. VAR residual for equation 1 with P/E as dependent variable.

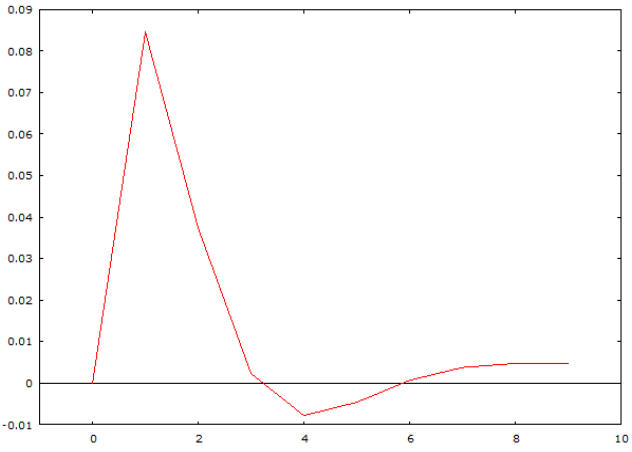

Figure 2. Response of P/E to shock in payout.

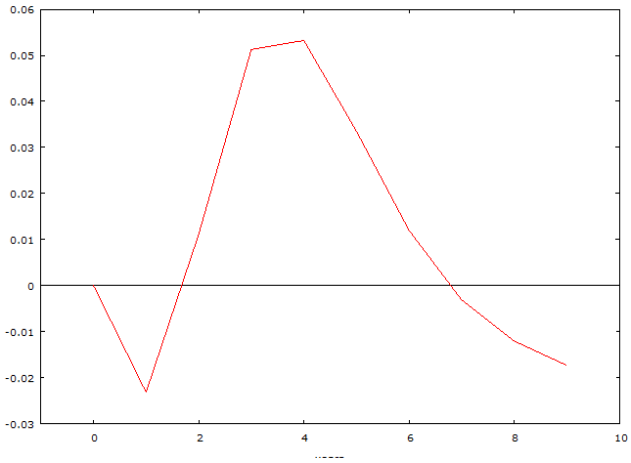

Figure 3. Response of P/E to shock in MM rates.

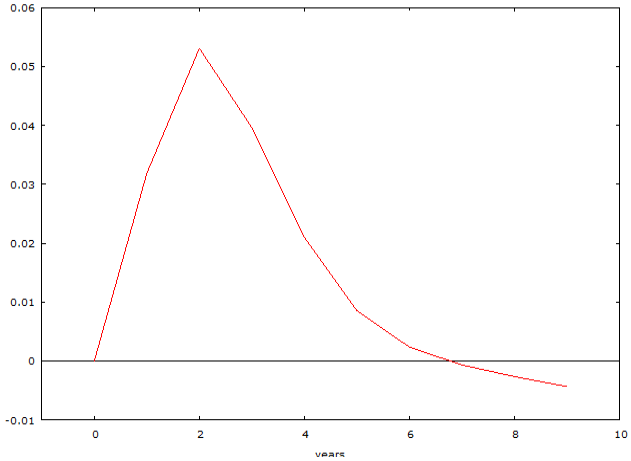

Figure 4. Response of P/E to shock in Forex.

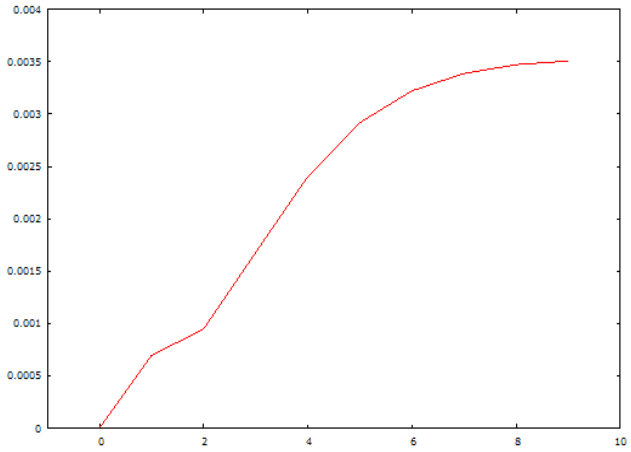

Figure 5. Response of P/E to shock in GDP.

4. Conclusion

The two important variables affecting P/E ratios out of the four studied are Dividend Payout and Money market rates. Managers and policy makers interested in investing in Indian stocks should consider the movements of these two variables before investing. The VAR system came out to be a better predictor of P/E ratio (R-squared of 57.84%) in comparison to simple Auto Regression model (R-squared of 49.53) and should be used to forecast market P/E. The findings of the research will help domestic and foreign investors in making investment while provide hints to policymakers on deciding money market rates.

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