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Determinants of P/E ratio of an index- an empirical study

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Abstract
In this study, an attempt is made to analyze and quantify the relationship between Price-Earnings multiple of the Indian stock market (represented by Nifty 50 index) and the fundamental and economic indicators. Ten variables highlighting dividends, earnings and returns of the market, and GDP growth, inflation, interest rates and money supply in the economy, were studied. The indicators were studied over a period of 76 quarters (July 2001 – April 2020), with a 1-quarter lag against dependent variable. Descriptive Statistics, Correlation and Linear Regression were used for analysis. When, Price-Earnings, or Earnings-Price multiple was used as dependent variable, several models were found to be significant. The final model had four significant variables namely, Dividend Yield of Nifty, Dividend Payout Ratio, Repo Rate and Standard Deviation of past 36-months returns, and explained 77 percent of P/E variation.

Keywords: nifty, price-earnings, stock market, economic indicators

1. Introduction
Financial market investors use a number of metrics to evaluate individual stocks and indices. This is done with the objective to gain insights that are used to develop trading and investing strategies, to generate higher than average returns. One such metric is the Price to Earnings multiple, or simply the P/E Ratio of the company. This highlights the price paid by an average investor for 1 unit of earnings per share generated by the company. Therefore, a higher (lower) P/E ratio means that the average investor is ready to pay more (less) in return of a unit of earnings per share.
Similarly, an index P/E ratio may be used to analyze the price being paid for a unit of earnings generated by the large portfolio of stocks in the index. It is calculated as follows:
Index P/E ratio= Index market capitalization / Gross earnings
This metric can be useful to study the broader stock market and develop relevant investment strategies. For example, an investor may decide to not enter the market at a time when the market index P/E ratio is too high, as it implies that he has to, in general, pay too high a price for the companies' earnings.
To pursue such strategies, the investor shall be interested to understand two aspects about the market index- a probable future value of P/E (to create such strategies in advance), and to understand the justified value of the index P/E ratio, based on the stock market environment.
Because the index P/E ratio is less affected by individual company biases, it may be assumed that the index P/E highlights the investors' stance (bullish/moderate/bearish) on the economy. Conversely, the economic indicators may also influence the index P/E.
Therefore, both stock market indicators and economic indicators can be used to justify or predict the index P/E ratio. This study aims to develop a regression model to explain the index P/E multiple (India's NSE Nifty 50) through 10 such indicators. It also evaluates if economic indicators reflect on the stock market.

2. Objectives
The objective of this study is to determine the indicators which justify the Price-earnings multiple of the Indian Stock Market (proxied by Nifty 50) at any given time and to develop a regression model to evaluate future P/E. The study aims to establish the view that the major economic indicators explain the variation in the price/earnings multiple and can also be used to provide grounds to explain the variation in the multiple in the future, besides fundamental market indicators. The rationale behind this is that the stock market generally reflects the economic conditions of an economy.

3. Literature Review
The P/E ratio has been used by the investors over the years. There exists significant evidence to highlight that investors can earn more than the average market returns over long periods by following a P/E based investment strategy. According to Chhaya and Nigam (2015) [1], value strategies based on low price relative to earnings outperformed the corresponding growth strategies and the market.
A number of researches explore the possible determinants of Price to Earnings multiple in the economic indices. Raymond (2002) [2] highlights that the dividend yield has an inverse relationship on P/E multiples of real estate companies in Hong Kong.
Krishnan and Chen (2020) [3] find a positive association between the Dividend Payout Ratio and the P/E multiple of the following quarter for S&P 1500 companies over an 88-quarter period.
The relationship between GDP growth rate and its effect on pieces of stock indices is established in Rey (2016) [4]. They test the relationship through an empirical study on multiple companies of ten equity indices for the period 1995-2004 and 2005-2014.
Chung and Ariff (2016) [5] find evidence to the theory that money supply increases lead to liquidity surges, which leads to credit expansion. They show that changes in liquidity have a significant positive effect on stock prices.

Good (1991) [7] investigated on the relationship between stock return and P/E multiple for period 1955-90 and found predictability in for P/E when the P/E was either too high or too low.

Another potential determinant of P/E multiple is the treasury bond rates, which are known to impact stock prices. A unidirectional causality is found between interest rates, among other variables, to stock prices in India is found by Naik and Padhi (2012) [8].

4. Research Methodology

This study employs a descriptive approach. For this study, quarterly time series data was used for each of the variables from July 2001 quarter to April 2020 quarter, for India. This period also saw the Financial Crisis of 2008 which adversely affected the financial market.

The dependent variables used are the P/E and E/P ratios of Nifty and the independent variables are

1. Dividend Yield of Nifty (DivYield),
2. Repo Rate (Repo),
3. 10-year Government Securities Yield (TBill),
4. Year on Year Change in Money Supply-M2 (M2Change),
5. Year on Year Earnings Growth of Nifty (ErnGrow),
6. Dividend Payout Ratio (DPR),
7. GDP Growth Year on Year (GDPGrowth),
8. Quarterly Change in Consumer Price Index-Industrial Worker (Inflation),
9. Standard Deviation of Returns of Nifty of past 36 months (StdDev), and
10. Quarterly percentage total return [dividends plus capital gains/losses] (TotReturn).

In order to study the predictive capabilities and eliminate computational interdependence of the above-mentioned factors, a lag of one quarter has been applied for all the variables except the Standard Deviation of returns (which is already historical in nature).

To analyze the data, Descriptive Analysis, Correlation and Linear Regression were used. All the variables used were ratio data meaning they had an absolute zero and mathematical operations could be performed on them.

5. Results and Interpretation

The mean, standard deviation, minimum and maximum values of each of the variables is computed. Nifty P/E multiple has ranged between 12.57 and 29.33 during the period of the study, with mean as 19.98.

Table 1: Descriptive statistics of variables used

Particulars	Minimum	Maximum	Mean	Std. Deviation
NiftyPE	12.57	29.33	19.98	4.26213
StdDev	.03500	.10159	.06293	.01952
DivYield	.60	2.98	1.4396	.41884
DPR	.08742	.39157	.27400	.04798
TotReturn	-.31692	.34394	.04949	.11684
GDPGrowth	.20000	13.30000	7.15000	2.47868
Repo	4.7500	9.0000	6.9184	1.0791
TBill	5.11	10.08	7.5485	.94857
Inflation	-.17	.19	.0103	.07079
M2Change	-.12410	.37750	.1336895	.06288
ErnGrow	-.21375	.54588	.11158	.13533

The initial regression model employs all the independent variables with the dependent variable as Nifty P/E multiple.

Table 2: Correlation Table

	Repo	GDPGrowth	TotReturn	TBill	Inflation	M2Change	StdDev	ErnGrow	DivYield	DPR
Nifty P/E Pearson Correlation	-.395	.199	.166	.012	-.021	-.004	-.480	-.330	-.620	.145
Sig.(1-tailed)	.000	.043	.078	.458	.429	.485	.000	.002	.000	.106

In the correlation table, it is observed that there is a significant negative correlation between Nifty P/E multiple and Repo Rate, Standard Deviation of Returns of last 36 months, Quarterly Earnings Growth and Dividend Yield and a significant positive correlation between Nifty P/E multiple and Quarterly GDP Growth.

Table 3: Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.895[a]	.801	.770	2.05401	.801	25.762	10	64	.000	1.787
a. Predictors: (Constant), DPR, M2Change, TotReturn, Inflation, ErnGrow, GDPGrowth, Repo, Standard Deviation, TBill, DivYield										
b. Dependent Variable: Nifty P/E Ratio										

Table 4: Anova test

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1086.868	10	108.687	25.762	.000[b]
	Residual	270.013	64	4.219		
	Total	1356.882	74			

- The model is a good fit and explains the variation in the dependent variable
- Adjuted R^2 is 77%.
- DB Statistic is 1.787 showing near absence of auto-correlation.

Table 5: Coefficients Table

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
(Constant)	36.997	5.55		6.666	0	25.91	48.084		
Repo	-1.203	0.344	-0.305	-3.495	0.001	-1.89	-0.515	0.409	2.446
GDPGrowth	0.138	0.123	0.079	1.119	0.267	-0.108	0.384	0.617	1.622
TotReturn	1.311	2.402	0.036	0.546	0.587	-3.488	6.111	0.73	1.37
TBill	-0.202	0.443	-0.045	-0.457	0.649	-1.086	0.682	0.319	3.131

Inflation	5.332	3.769	0.089	1.415	0.162	-2.197	12.862	0.794	1.26
M2Change	-1.258	4.283	-0.018	-0.294	0.77	-9.815	7.298	0.816	1.226
StdDev	-66.597	19.686	-0.305	-3.383	0.001	-105.924	-27.269	0.382	2.621
ErnGrow	-3.036	2.33	-0.096	-1.303	0.197	-7.69	1.617	0.571	1.751
DivYield	-7.25	1.178	-0.713	-6.155	0	-9.603	-4.897	0.232	4.317
DPR	25.185	11.037	0.284	2.282	0.026	3.136	47.234	0.201	4.978

- Four variables namely Repo Rate, Dividend Yield, Dividend Pay-out Ratio and Standard Deviation are statistically significant variables in the regression model.
- Multicollinearity does not exist

Some studies, like White (2000) have demonstrated that the E/P multiple shows better results than the P/E multiple because of linearity with economic variables. Hence, it is used as the dependent variable in an attempt to improve the model.

Table 6: Correlation Table

	Repo	GDPGrowth	TotReturn	TBill	Inflation	M2Change	StdDev	ErnGrow	DivYield	DPR
Nifty E/P Pearson Correlation	.356	-.241	-.222	-.063	.072	.041	.414	.328	.659	-.064
Sig. (1-tailed)	.001	.019	.028	.295	.269	.362	.000	.002	.000	.293

In the correlation table, it is observed that there is a significant positive correlation between Nifty E/P multiple and Repo Rate, Standard Deviation of Returns of last 36 months, Quarterly Earnings Growth and Dividend Yield and a significant negative correlation between Nifty E/P multiple and Quarterly GDP Growth, Nifty Quarterly Return.

Table 7: Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.876[a]	.767	.731	.006148258815125	.767	21.090	10	64	.000	1.942
a. Predictors: (Constant), DPR, M2Change, TotReturn, Inflation, ErnGrow, GDPGrowth, Repo, StdDev, TBill, DivYield										
b. Dependent Variable: NiftyEP										

Table 8: Anova Test

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.008	10	.001	21.090	.000[b]
	Residual	.002	64	.000		
	Total	.010	74			

- The model is a good fit and explains the variation in the dependent variable
- Adjuted R^2 is 73.1%, lesser than obtained using the P/E multiple.
- DB Statistic is 1.942 showing near absence of auto-correlation, an improvement from the previous model.

The same 4 independent variables, namely Repo Rate, Dividend Yield, Dividend Pay-out Ratio and Standard Deviation were found to be statistically different. The E/P multiple model is not an improvement over the P/E multiple model.

The final model is obtained by ignoring the insignificant variables. Only Repo Rate, Dividend Yield, Dividend Pay-out Ratio and Standard Deviation of monthly returns of Nifty of past 36 months are considered as independent variables for the dependable variable P/E ratio.

Table 9: Correlation Table

	Repo	StdDev	DivYield	DPR
Nifty P/E Pearson Correlation	-.395	-.480	-.615	.148
Sig.(1-tailed)	.000	.000	.000	.102
N	76	76	76	76

Repo Rate, Standard Deviation and Dividend Yield show significant negative correlation.

Table 10: Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.884[a]	.782	.769	2.04698	.782	63.538	4	71	.000	1.670
a. Predictors: (Constant), DPR, Repo, Standard Deviation, DivYield										
b. Dependent Variable: Nifty P/E Ratio										

Table 11: Anova Test

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1064.930	4	266.233	63.538	.000[b]
	Residual	297.498	71	4.190		
	Total	1362.428	75			

- The model is a good fit and explains the variation in the dependent variable
- Adjuted R^2 is 76.9%.
- DB Statistic is 1.670 showing near absence of auto-correlation

Table 12: Coefficients Table

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
(Constant)	32.571	3.859		8.441	0	24.877	40.265		
Repo	-1.066	0.262	-0.27	-4.069	0	-1.589	-0.544	0.699	1.431
Standard Deviation	-53.694	17.743	-0.246	-3.026	0.003	-89.073	-18.315	0.466	2.148
DivYield	-8.232	0.864	-0.809	-9.523	0	-9.955	-6.508	0.426	2.346
DPR	36.549	9.148	0.411	3.995	0	18.307	54.79	0.29	3.449
a. Dependent Variable: Nifty P/E Ratio									

- Adjusted R2 is 76.9%.
- DB Statistic is 1.670 showing near absence of auto-correlation.
- All variables are statistically significant

The final regression model obtained is as follows:

Table 13: Regression Equation

NIFTY P/E Multiple =	32.571
	(-)1.066*[Repo Rate of at the end of previous quarter]
	(-)53.694*[Monthly Standard Deviation of Nifty return of last 36 months]
	(-)8.232*[Dividend Yield at the end of previous quarter]
	(+)36.549*[Dividend Payout Ratio at the end of previous quarter]

6. Findings of the Study

The quarterly variations in the index P/E ratio can be significantly explained using past data of market and economic indicators. The study involves the use of 10 relevant variables (11 initially; 1-year bond rate was dropped due to multicollinearity) based on past studies on market returns and P/E ratio, to find an appropriate regression model for the P/E multiple of India's Nifty 50. An attempt to study the same variables for the E/P variable did not enhance the model.

The regression model obtained reveals 77% of the variation in the P/E multiple. Four out of the ten variables were found to be statistically significant to the model- Index Dividend Yield in the previous quarter (negative), Index Dividend Payout Ratio in the previous quarter (positive), Standard Deviation of monthly Nifty returns over the past 36 months (Negative), and the Repo Rate at the end of the previous quarter (Negative). Table 5 summarises the model obtained in the form of the regression equation.

7. Conclusion

The results clearly highlight existence of regression models to indicate how the markets will price the aggregate corporate earnings in a quarter, based on past data. This can be used by the investors to predict the price-earnings ratio for the future and to evaluate if the markets are priced too high or low at a given point of time. Companies' dividend decisions, market volatility and interest rates are good indicators for such a model, and therefore have a high impact on how the market perceives and values the corporate earnings. Also, macroeconomic indicators such as GDP growth, money supply and inflation do not affect market's pricing significantly. This is in-line with the view that the markets are not a good indicator of the state of the economy, and vice versa.

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