Analysis of Relationship between Risk and Return among Index Companies

Author: VENKATA LAKSHMI VALLURU
Assistant Professor, Employee code SETR0125
Malla Reddy University powered by Sunstone Eduniversity, Hyderabad, Telangana, India

Abstract:

The current research was carried out with the goals of analyzing the risk return connection as well as the volatility patterns in the return. For the purposes of this research, three well-established information technology businesses, namely TCS Ltd., Wipro Ltd., and Infosys Ltd., as well as the IT Index, of which each of these companies is a component, were analyzed. After converting the closing prices of the chosen firms and the IT Index to log returns, a price series analysis was performed on the closing prices of the IT Index and the selected companies. In order to investigate the degree of volatility present in the return series, both the standard deviation and the GARCH model have been used. The information gathered from the most recent four calendar years, 2019 through 2022, has been analyzed. Information was obtained from the Bombay Stock market, which claims the title of being the oldest stock market in all of Asia. The "More Risk, More Reward" adage does not seem to be followed by the return series during the course of the time under review. Even though the stocks of these firms and the index that was researched performed well throughout the time that was being studied, the return series that was analyzed did not reveal any specific volatility pattern.

Keywords: Return, Risk, Volatility, GARCH

Introduction:

Risk and return are deciding factors for investors to invest in any asset. Investors like more return but less risk.A rational investor will assume more risk only if it is accompanied by extra return. More risk more reward is an old axiom. This study aims at analysing whether this is still applicable in the Indian Stock market. Standard deviation is considered as the historical measure of risk/volatility, but it is still used by many as proxy to volatility. With the advent of Autoregressive Conditional Heteroscedastic (ARCH) model and its generalised version as GARCH (Generalised ARCH) model, volatility is being analysed by applying these models. Present study analyses volatility by applying standard deviation as well as GARCH model. Two major stock exchanges in India are Bombay Stock Exchange and National Stock Exchange. Bombay Stock Exchange is the oldest stock exchange of Asia.

Most of the studies in India have been taken by analysing the SENSEX or NIFTY50 as market index whereas sectoral indices are ignored. Infosys and Tata Consultancy Services (TCS), reported financial results that were worse than analysts had anticipated. These results highlight the problems that the sector is facing as a consequence of the protracted downturn in the developed nations. TCS receives around 95 percent of its income from the Americas, Europe, and the rest of the world (ROW), while Infosys receives more than 97 percent of its revenue from these regions combined. ROW refers to all other regions outside of North America and Europe. The weakness is also reflected in their stock values, which, over the course of the last year, have done poorly in comparison to the performance of the benchmark equity indexes.

As Per **Dr.Naveen Prasadula (2023)** In the last year, up to April 18, 2023, the value of a share in Infosys or TCS has decreased by 22.2 percent or 11.30 percent, respectively. On the other side, over the same time period, the BSE Sensex had a gain of 4.5 percent. Since April of last year, the share prices of other large-cap IT companies like as Wipro, HCL Technologies, and Tech Mahindra have also fallen by 32%, 4%, and 24%, respectively. examined the cross-sectional relation between conditional betas and expected stock returns for a sample period of July 1963 to December 2004. The study used all the NYSE, Amex, and Nasdaq financial and nonfinancial firms and data was obtained from the Center for Research in Security Prices (CRSP) for the periodfrom July 1963 through December 2004. Researchers used daily stock returns to generate the conditional beta measures. Compustat dataset was also used to obtain the book values for individual stocks. The result indicated a positive, significant relation between conditional betas and the cross-section of expected returns. The average return difference between high and low-beta portfolios ranges between 0.89% and 1.01% per month, depending on the time varying specification of conditional beta. After controlling for size, book-to-market, liquidity, and momentum, the positive relation between market beta and expected returns remained economically and statistically significant.**Menggen Chen, (2021),** through his study throws light on four research questions. First, he explored the changes of the risk-return relationship over time in the Chinese stock markets. Then, difference in risk-return relationship between Shanghai and Shenzhen stock markets were analysed. The study then compared the similarities and dissimilarities of the risk-return tradeoff for different frequency data. At last, an attempt was made by researcher to compare the explanation power of different GARCH-M type that are commonly used in exploring the risk-return tradeoff.The researcher used the stock price indices of the Shanghai Composite Price Index and Shenzhen Component Price Index from April 3, 1991 to July 29,

2011. This paper analysed the risk-return tradeoff by using daily, weekly and monthly return data simultaneously. The empirical results showed that the dynamic risk-return relationship was quite different between Shanghai and Shenzhen stock markets. A positive and statistically significant risk-return relationship was found for the daily returns in Shenzhen Stock Exchange, while the conditional mean of the stockreturns was negatively related to the conditional variance in Shanghai Stock Exchange. The study also found that the risk-return relationship usually became much weaker for the lower frequency returns in both markets. **Kuangnan Fang, Ji Wu &Cuong Nguyen (2015)** analysed the risk-return trade-off in a liberalized emerging stock market Vietnam during the period 2007–2014. The research data was extracted from DataStream website. Daily and monthly individual stock returns in the VSM from 2007 to 2014 were collected from the database as well as market capitalization and book to-market ratio (BM). The interbank offered rate was used as the risk-free rate. The study excluded stocks with either daily returns of less than −100 percent or monthly returns greater than 200 percent, as well as stocks with anegative book-to-market (BM) ratio, in order to reduce the noise in computing variables for each stock. Stocks that did not continually have past-twenty-two-days return records in a particular month were also excluded from the sample. 684 stocks were considered for the study. 42,828 monthly return observations and approximately 1 million daily return observations were used by the researcher.The author found that neither the realized idiosyncratic volatility nor the conditional idiosyncratic volatility has been priced. It was also found that the Rational multifactor models could well explain the stock portfolio returns. Flat trend for equal-weighted idiosyncratic volatility (IVOL), but a downward trend for market volatility was noticed in the study. The results also showed that the idiosyncratic risk played an unimportant role in pricing stocks and that the systematic risks still dominate asset returns in emerging stock markets. Results implied that Vietnamese investors can get increased benefit from portfolio diversification.**Al Adwani, J. (2016)**used factor models with macro- finance predictors to test the intertemporal risk-return relation for 13 European stock markets from 1986 to 2012. Researcher used monthly country specific, euro area, and US macro- finance factors to determine the conditional volatility and conditional return. The results confirmed negative risk-return trade-off. The Markov switching model confirmed that time- variation in the above mentioned trade-off between risk and return was linked to the state of the economy, but not the business cycles. Quantile regressions exhibited that the risk-return trade-off was stronger at the lowest quantile of the conditional return. **Patel, R. (2021)** conducted the study to examine the risk-return tradeoff in the Indian stock market. The sample period of study was from January 4, 2000 to December 31, 2020. The empirical results showed existence of risk-return tradeoff in the BSE. A positive risk-return tradeoffwas found for monthly & annual return series. The market has

weak risk-return relationship in daily return series. The CGARCH (1,1) captured the asymmetric volatility effect for all the different frequency based returns. The study has implications for the investors. The risk return relationship was stronger and significant in longer duration of investment. The market gave higher return for undertaking high risk.**Leirvik, T. (2022)**analyzed the relationship between the volatility of market liquidity and realized returns of the five largest cryptocurrencies Bitcoin, Litecoin, Ripple, Ethereum and BCH. The sample used in the study analysis covers the period from January 1st, 2016, to December 31st, 2020. The researcher used short time period for the study in order to compare cross-sectionally. Data for the study was taken from Coinmarketcap.com website and was at daily frequency which contains open, high, low, close prices, volume, and market capitalization. In order to control for other variables which might impact cryptocurrency returns, the VIX-index and S&P500 index were included in study. In addition, a cryptocurrency index was constructed by using twelve different currencies. The currencies used, in addition to the five currencies analyzed in the paper, were EOS.IO (EOS), BinanceCoin (BNB), Cardano (ADA), Stellar (XLM), Monero (XMR), Chainlink (LINK), and Tron (TRX). Because Bitcoin was much larger in capitalization than all other currencies, the index was equally weighted so that any sensitivity towards the index was not confused with sensitivity towards Bitcoin. The results indicated a positive relationship between the volatility of liquidity and returns in general. This means that investors consider the time-variation of liquidity as a risk which should be compensated with higher returns. For Bitcoin, the largest cryptocurrency, this relationship varies over time, and it was found that the relationship between the volatility of liquidity and returns is the lowest, yet positive, among the currencies studied. This again indicates that investors in Bitcoin consider liquidity less a risk compared to the other currencies, which might be due to the popularity of the particular currency.

Objectives of the Study: Present study has been undertaken with following objectives

1. To find out relationship between risk and return among some of the Information Technology companies listed on Bombay Stock Exchange
2. To find out whether the relationship is same among companies and the Index of which these companies are constituents
3. To determine the volatility patterns of returns analysed
4. To determine which of the returns analysed is highly volatile

Data for the study: Bombay Stock Exchange is the oldest stock exchange in India and information technology is a booming sector, so three established IT companies listed in S&P BSE Information Technology Index along with this index have been selected for the present

study. For sake of simplicity S&P BSE Information Technology Index will be termed as IT Index in rest of the research paper. Closing prices for 4recent calendar years for all the three companies selected and the IT Index, from 1st January 2019 to 31st December 2022, collected from Bombay Stock Exchange, have been analysed.

Table 1 shows the turnover of the three Companies selected for the present study for the period under study

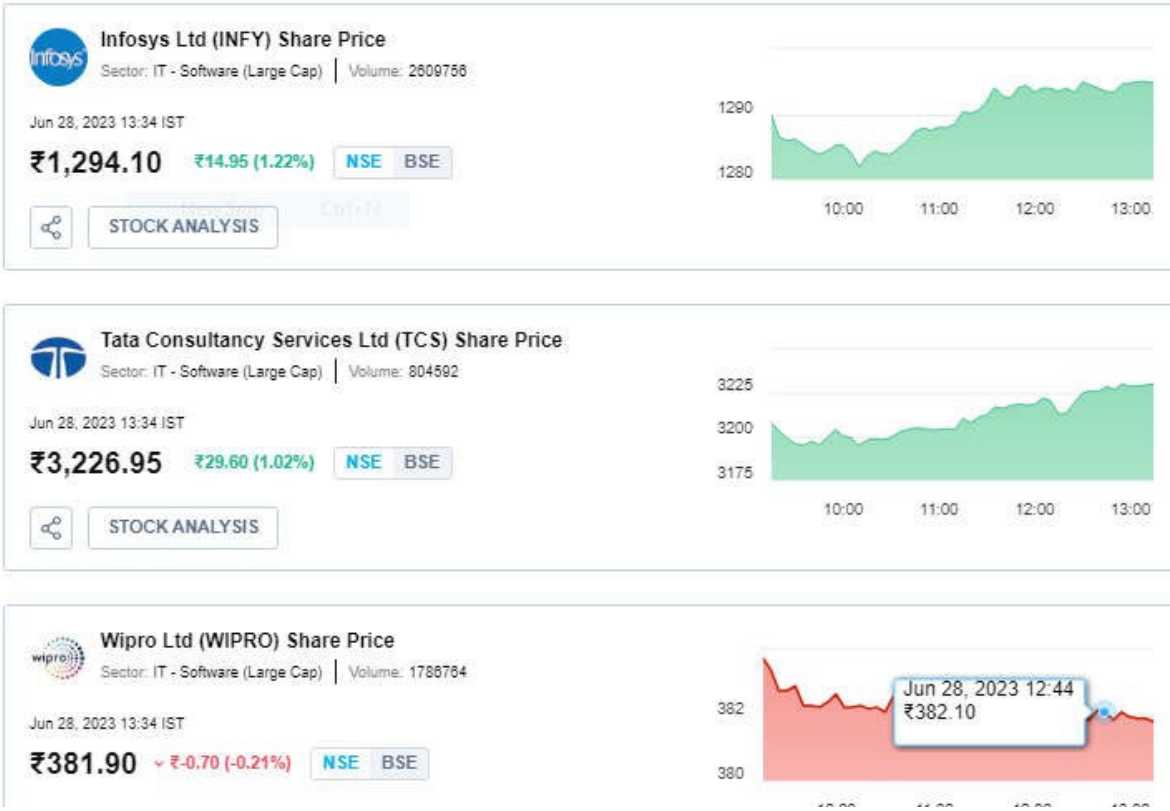


Table 1

Total Turnover (Rs.)			
Year	TCS Ltd.	Wipro Ltd.	Infosys Ltd.
2019	73289180385	44021992320	92428935722
2020	94141426396	33871164466	110058310162
2021	128682056993	78840995954	162078893681
2022	136383764860	66547000919	166450601296

It is clear from the above table that turnover for TCS Ltd. and Infosys Ltd. are on increasing trend for all the four years, whereas for Wipro Ltd. the trend is mixed.

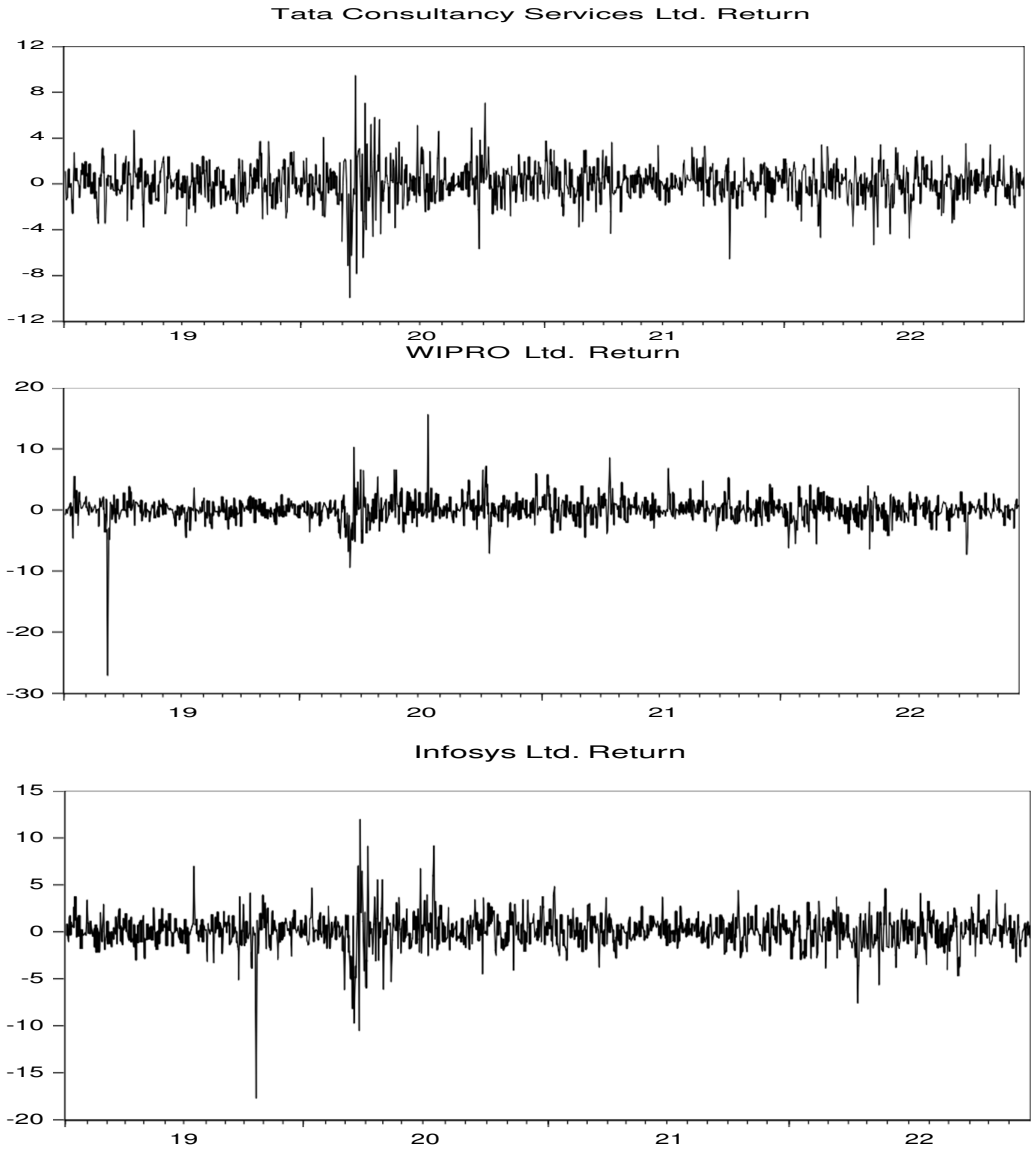
Return:

Closing prices of all the three companies as well as IT Index were converted to log return with the help of following formula

Return= $(Log \text{ of } closikg\ prices_t - Log \text{ of } closikg\ prices_{\ t-1}) * 100$

Where log is the natural log and t is the time period

All the return series are presented graphically.



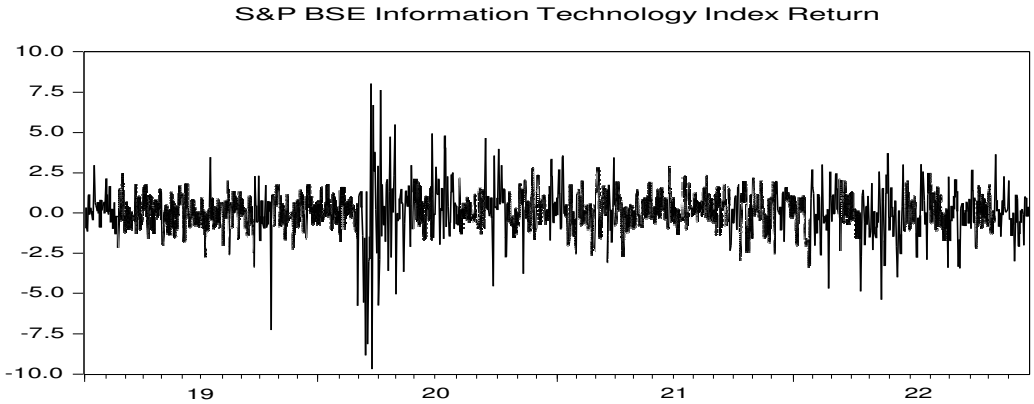


Table 2

Descriptive Statistics of Return

Statistic	Tata Consultancy Ltd.	Wipro after adjusting for outlier	Infosys after adjusting for Outlier	S&P BSE Information Technology Index
Mean	0.054275	0.042344	0.100955	0.071241
Median	0.055945	0.056084	0.123131	0.107359
Maximum	9.435958	15.56413	11.94903	8.029748
Minimum	-9.92652	-9.39433	-10.4895	-9.68986
Std. Dev.	1.655707	1.876742	1.810902	1.517803
Skewness	-0.26074	0.667892	0.074208	-0.56622
Kurtosis	7.405526	10.71179	9.137117	9.441243
Jarque-Bera	813.465	2531.918	1557.698	1767.91
Probability	0	0	0	0
Observations	992	992	992	992

TCS VS INFOSYS

REVENUE GROWTH FOR FIVE YEARS

Fiscal year	TCS (in $ million)	Growth rate	INFOSYS (in $ million)	Growth rate
FY22	25,707	15.9%	16,311	20.3%
FY21	22,174	0.7%	13,561	6.1%
FY20	22,030	5.3%	12,780	8.3%
FY19	20,913	9.6%	11,799	7.8%
FY18	19,089	8.6%	10,939	7.2%

Above graphs as well as the Descriptive statistics show that there are some common patterns in the return series of all the three companies and the Index returns. All the return series are negatively skewed and highly kurtotic i.e. all are not normally distributed. While analysing time series data we are less concerned with normality and more concerned with autocorrelation. Some outlier is visible in graph of Wipro Ltd. return and Infosys Ltd. return. The return series for these two companies were modified by replacing the outliers with the average value of previous and next period return and the descriptive statistics for the series was calculated again. Further analysis was carried on the modified series of returns of Wipro Ltd. and Infosys Ltd. If we compare the return and standard deviation of the series, we find that Infosys Ltd. has highest return but not the highest standard deviation whereas Wipro Ltd. has lowest return but not the lowest standard deviation, i.e. more risk more reward axiom is not followed by these series if we consider standard deviation as a measure of risk. S&P BSE Information Technology Index has lowest standard deviation confirming that risk may be minimised with diversification.

GARCH Model: Unlike Classical Linear Regression Model (CLRM), GARCH Models don't assume the variance of errors to be constant over time. (Brooks, 2018) Before applying

P

ARCH/GARCH model, ARCH effect in residuals is tested, if ARCH effect is present in residuals, appropriate GARCH model is applied. For applying GARCH model, two equations are to be specified, the mean equation and the variance equation, whereas in CLRM (Classical Linear Regression Model) only mean equation is specified, as variance of error terms is assumed to be constant. Variance equation for GARCH (1,1) model is:

$$\sigma^2_t = {}_0 + \alpha_1 u^2_{t-1} + \beta\, \sigma^2_{t-1}$$

Where $\sigma^2_t$is known as conditional variance for period t, $\alpha_1 u^2_{t-1}$ is the information for volatility during previous period and $\beta\ \sigma^2_{t-1}$is the previous period variance.

GARCH in Mean: To study the risk-return relationship, GARCH-in-Mean model has been applied in the present study and standard deviation has been introduced in the mean equation. So for the present study mean equation has been specified as:

$$Returk = c + \delta\sigma_{t-1} + u_t$$

Where δspecifies whether investors are rewarded for assuming more risk or not, if δis positive and significant, it indicates that more risk contributes to higher average return.

Empirical Results: Data for the present study has been analysed with the help of eviews9 software. After preliminary analysis of data through graphs and descriptive statistics,all the return series were regressed on c and the ARCH effect was studied in residuals. Null hypothesis of the test applied is "ARCH effect is not present in the residuals". Results of the test are presented in Table 2.

Table 3

Results of Heteroskedasticity Test: ARCH

	Infosys Ltd.	TCS Ltd.	Wipro Ltd.	IT Index		Infosys	TCS	Wipro Ltd.	IT Index
F-statistic	**123.39**	**29.90**	**4.23**	**91.99**	**Prob. F(1,989)**	**0.000**	**0.000**	**0.040**	**0.000**

On the basis of probability value of the test statistic (probability value of F-statistics less than 0.05), null hypothesis of "no ARCH effect present in residuals" may be rejected at 5% level of significance and GARCH model may be applied on the return series. As already discussed, GARCH-in-Mean model has been applied to study the risk return relationship and the results are presented in Tables 4 through7.

Table 4

Results of GARCH-in-Mean Model for TCSLtd. Return

Dependent Variable: RETURN				
Sample (adjusted): 1/02/2019 12/30/2022				
GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
Mean Equation				

@SQRT(GARCH)	0.12864	0.153526	0.837908	0.4021
C	-0.13059	0.229555	-0.56888	0.5694
Variance Equation				
C	0.206165	0.05481	3.761429	0.0002
RESID(-1)^2	0.105387	0.020335	5.182614	0
GARCH(-1)	0.81494	0.037173	21.92309	0

Table 5

Results of GARCH-in-Mean Model for Wipro Ltd. Return

Dependent Variable: RETURN				
Sample (adjusted): 1/02/2019 12/30/2022				
GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
Mean Equation				
@SQRT(GARCH)	0.239574	0.169449	1.413844	0.1574
C	-0.37131	0.295401	-1.25696	0.2088
Variance Equation				
C	0.694165	0.104375	6.65069	0
RESID(-1)^2	0.166607	0.025602	6.507624	0
GARCH(-1)	0.64455	0.047029	13.70536	0

Table 6

Results of GARCH-in-Mean Model for Infosys Ltd. Return

Dependent Variable: RETURN				
Sample (adjusted): 1/02/2019 12/30/2022				
Included observations: 992 after adjustments				
GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
Mean Equation				
@SQRT(GARCH)	-0.01117	0.164064	-0.06807	0.9457
C	0.151515	0.260125	0.582471	0.5602
Variance Equation				
C	0.204106	0.047787	4.271126	0
RESID(-1)^2	0.083831	0.013936	6.015404	0
GARCH(-1)	0.846186	0.027508	30.76165	0

Table 7

Results of GARCH-in-Mean Model for IT Index Return

Dependent Variable: RETURN
Sample (adjusted): 1/02/2019 12/30/2022
GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Mean Equation				
@SQRT(GARCH)	0.117244	0.155929	0.751908	0.4521
C	-0.05128	0.205205	-0.24989	0.8027
Variance Equation				
C	0.10802	0.026269	4.112018	0
RESID(-1)^2	0.075793	0.011688	6.484836	0
GARCH(-1)	0.871759	0.021235	41.05259	0

In the above four tables i.e. from Table 4 to Table 7,in the mean equation, @SQRT(GARCH) is an indicator of reward for more risk assumed by the investor, C is the average return. In variance equation, RESID(-1)^2 is the information for previous period volatility and GARCH(-1) is previous period variance estimated from the model applied in the present study. If we observe the coefficients of these, it can be said that coefficient of @SQRT(GARCH) is positive for TCS Ltd. return, Wipro Ltd. return and IT Index return but it is not significantat 5% level of significance (Probability value greater than 0.05) for any of these returns. For Infosys Ltd. return it is negative but again not significant at 5% level of significance(probability value greater than 0.05). This indicates that there is no "More risk more reward" relationship in the return series analysed for theperiod selected for the present study. Coefficient of C in mean return indicates the average return. If we observe this coefficient, it is not significant for any of the return series analysed, it indicates that return for all the series is not significantly different from zero and it can be said that the stocks and IT Index studied behaved efficiently during the period of study. Coefficient of RESID(-1)^2, i.e. information for volatility during previous period, indicates about the spikes in the series and in the present study, it is significant (P value around 0) for all the return series analysed. Highest spikes are observed in case ofWipro Ltd. followed by TCS Ltd. and Infosys Ltd. and least spikes are observed in case of IT Index. Coefficient of GARCH(-1) indicates about the persistence of volatility and in the present study, it is significant for all the return series analysed. It is highest for IT Index, followed by Infosys Ltd., TCS Ltd. and Wipro Ltd.

Q2FY23 NUMBERS AT A GLANCE

	TCS	Infosys	Wipro	HCLTech
Revenue	$6.87 billion	$4.5 billion	$2.8 billion	$3.08 billion
QoQ USD Revenue Growth	1.20%	3%	2.30%	1.90%
Operating Margins	24%	21.50%	15.10%	18%
Total Contract Value	$8.1 billion	$2.7 billion	$725 million	$2.38 billion
Net addition	9,840	10,032	605	8,359
Fresher addition	20,000	NA	4,000	10,339
Attrition rate (LTM)	21.50%	27.10%	23%	23.80%

Conclusion:

On the basis of data analysed, it can be concluded that though the stocks and Index analysed in the study behaved efficiently during the period of study, investors are not rewarded for assuming extra risk. Spikes in the series are also observed and the volatility is persistent. No particular pattern could be observed in the volatility of the return series analysed. The major four information technology businesses in India, Tata Consultancy Services (TCS), Infosys, Wipro, and HCLTech, all reported results that ranged from positive to mixed for the second quarter, which came to a close on September 30.In spite of concerns over an imminent recession, inflation, difficulties in obtaining US H-1B visas, a toughening climate in key markets such as north America, the United Kingdom, and Europe, and delays in employing freshers, the information technology industry shown resilience during this quarter as demand remained constant.Only a few localized areas have been seeing a slowdown, according to the commentary provided by corporate management, but overall, demand is still quite high. Executives from the corporation, on the other hand, have advised caution and stressed that they are continuing to monitor the situation closely.

References:

1. Bali, T. G., Cakici, N., & Tang, Y. (2009). The conditional beta and the cross-section of expected returns. *Financial Management*, *38*(1), 103-137.
2. Chen, M. (2015). Risk-return tradeoff in Chinese stock markets: some recent evidence. *International Journal of Emerging Markets*, Vol. 10 Iss 3 pp. 448 – 473.
3. Kuangnan Fang, Ji Wu &Cuong Nguyen (2015): The Risk-Return Trade-Off in a Liberalized Emerging Stock Market: Evidence from Vietnam, Emerging Markets Finance and Trade, DOI: 10.1080/1540496X.2015.1103129
4. Al Adwani, J. (2016). *Risk and return in domestic and foreign stock trading: the GCC perspective* (Doctoral dissertation, RMIT University).
5. Patel, R. (2021). Risk-return tradeoffs in Indian stock market: Evidence from GARCH model. *Towards Excellence*, *13*(1). https://doi.org/10.37867/TE130149.
6. Leirvik, T. (2022). Cryptocurrency returns and the volatility of liquidity. *Finance Research Letters*, *44*, 102031.
7. Brooks, C. (2014). *Introductory econometrics for finance: Chris Brooks* (3rd ed.). Cambridge University Press.
8. Gujarati, D. N. (2013). Basic econometrics, Fifth Edition, Tata McGraw-Hill Education.