

Exploring Long-Term Dynamics: ARDL Analysis of Share Price Relationships between Consumer Product Giants and NIFTY 50 in the Indian Stock Market

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ABSTRACT

The Autoregressive Distributed Lag (ARDL) test is a statistical method for detecting long-term relationships between variables in a time series environment. The ARDL technique integrates short-run dynamics and long-run interactions in a single model. The current study looks on the long-term relationship between the share prices of Tata Consumer Products Limited, Britannia Industries Limited, and Nestle India Limited and the NIFTY 50. The analysis is based on secondary data collected weekly from January 1, 2018 to January 5, 2024, with the data source being Yahoo Finance. To summarise, Tata Consumer Products Limited, Britannia Industries Limited, Nestle India Limited, and Hindustan Unilever Limited have no long-term co-integration with the NIFTY 50. This implies that the absence of co-integration indicates that these variables do not move together in a stable manner over the long term.

Key words: Autoregressive Distributed Lag, Long-Term Relationship, Short-Run Dynamics, Co-Integration.

I. INTRODUCTION

The Autoregressive Distributed Lag (ARDL) test is a statistical approach for determining the presence of a long-term link between variables in a time series setting. When dealing with mixed-order integrated time series data, ARDL modelling is widely used, where certain variables are integrated at order one (I(1)) and others at order zero (I(0)). The ARDL technique combines short-run dynamics with long-run interactions in a single model. It is especially useful when the variables in the analysis have varying order of integration. The basic framework of an ARDL model contains lagged levels and variables' initial differences. The current study

investigates the long-term link between the share prices of Tata Consumer Products Limited, Britannia Industries Limited, and Nestle India Limited and the NIFTY 50.

Tata Consumer items Limited engages in several business categories, including tea, coffee, water, and ready-to-eat items. Its diverse product portfolio strengthens its ability to withstand changing market conditions. Brands: It owns and manages popular brands such as Tata Tea, Tata Coffee, Tetley, and Tata Salt. Britannia Industries Limited is one of India's oldest and best-known food enterprises, having a history reaching back to 1892. The trademark is linked with biscuits and bread products throughout the country. Britannia provides a variety of food goods, including biscuits, bread, cakes, and dairy products. Nestle India Limited is a multinational food and beverage company that operates in the country through its subsidiary Nestle India. The brand is recognised for its dedication to quality and nutrition. Nestle's product portfolio comprises a variety of commodities such as infant formula, dairy products, coffee, and confectionary. The NIFTY 50 is India's benchmark stock market index, reflecting the performance of the 50 largest and most liquid businesses listed on the National Stock Exchange (NSE).

II. NEED AND SIGNIFICANCE OF THE STUDY

The use of the ARDL (Autoregressive Distributed Lag) technique in this study is motivated by its ability to seamlessly integrate short-run dynamics and long-run interactions within a single model, which is especially useful when dealing with variables with varying integration orders. This methodological choice is motivated by the need to fully comprehend the

intricate relationships between the share prices of key players in the consumer products industry, specifically Tata Consumer Products Limited, Britannia Industries Limited, and Nestle India Limited, and the broader market dynamics reflected by the NIFTY 50 index. The study's goal is to uncover both short-term swings and long-term patterns in these companies' stock prices in relation to the overall market performance by combining lagged levels and starting differences of these factors. The significance of this investigation stems from its potential to provide insights into how these consumer product behemoths respond to and influence market movements over time, allowing investors, policymakers, and industry analysts to make informed decisions and understand the dynamics of the stock market in the context of the broader economic environment.

III. OBJECTIVE OF THE STUDY

To examine the long-term relationship between the share prices of Tata Consumer

Products Limited, Britannia Industries Limited, Nestle India Limited, and the NIFTY 50 index using the ARDL (Autoregressive Distributed Lag) technique.

4. Hypothesis of the study

There is statistically no significant dynamic long-term relationship between the share prices of Tata Consumer Products Limited, Britannia Industries Limited, Nestle India Limited, and the NIFTY 50 index using the ARDL (Autoregressive Distributed Lag) technique.

5. Methodology of the study

The study is based on secondary data pertaining to Tata Consumer Products Limited, Britannia Industries Limited, Nestle India Limited and NIFTY 50 on a weekly basis from 01-01-2018 to 05-01-2024 to consider the assumptions of the ARDL approach in interpreting the findings. The data source is Yahoo Finance.

IV. RESULTS AND DISCUSSIONS

Table 1.1

Augmented Dickey-Fuller test - Tata Consumer Products Limited, Britannia Industries Limited, Nestle India Limited and NIFTY 50

Null Hypothesis: Tata Consumer Products Limited has a unit root		
Exogenous: Constant, Linear Trend		
Lag Length: 0 (Automatic - based on SIC, maxlag=15)		
Augmented Dickey-Fuller test statistic	t-Statistic	Prob.*
	-2.058748	0.5663
Test critical values:	1% level	-3.987554
	5% level	-3.424201
	10% level	-3.135126
Not Significant		
Null Hypothesis: Britannia Industries Limited has a unit root		
Exogenous: Constant, Linear Trend		
Lag Length: 0 (Automatic - based on SIC, maxlag=15)		
Augmented Dickey-Fuller test statistic	t-Statistic	Prob.*
	-2.385397	0.3865
Test critical values:	1% level	-3.987554
	5% level	-3.424201
	10% level	-3.135126
Not Significant		
Null Hypothesis: Nestle India Limited has a unit root		
Exogenous: Constant, Linear Trend		
Lag Length: 0 (Automatic - based on SIC, maxlag=15)		
Augmented Dickey-Fuller test statistic	t-Statistic	Prob.*
	-2.569170	0.2949
Test critical values:	1% level	-3.987554
	5% level	-3.424201
	10% level	-3.135126
Not Significant		
Null Hypothesis: NIFTY 50 has a unit root		
Exogenous: Constant, Linear Trend		
Lag Length: 0 (Automatic - based on SIC, maxlag=15)		
Augmented Dickey-Fuller test statistic	t-Statistic	Prob.*

		-2.015890	0.5899
Test critical values:	1% level	-3.987554	Not Significant
	5% level	-3.424201	
	10% level	-3.135126	

Source: Yahoofinance (Author's own calculation)

Based on the results of the Augmented Dickey-Fuller (ADF) test conducted on Tata Consumer Products Limited, Britannia Industries Limited, Nestle India Limited and NIFTY 50, the null hypothesis that the security has a unit root cannot be rejected at conventional significance levels, as the p values for Tata Consumer Products Limited, Britannia Industries Limited, Nestle India Limited and NIFTY 50 are greater than 5%. This

suggests that there is insufficient evidence to conclude that the time series data for Tata Consumer Products Limited, Britannia Industries Limited, Nestle India Limited and NIFTY 50 statistic is stationary, and it may possess a unit root. The inclusion of exogenous variables such as a constant and linear trend did not substantially alter the results.

Table 1.2
 Augmented Dickey-Fuller test - Hindustan Unilever Limited

Null Hypothesis: Hindustan Unilever Limited has a unit root		
Exogenous: Constant, Linear Trend		
Lag Length: 0 (Automatic - based on SIC, maxlag=15)		
Augmented Dickey-Fuller test statistic	t-Statistic	Prob.*
	-3.795851	0.0179
Test critical values:	1% level	-3.987554
	5% level	-3.424201
	10% level	-3.135126

Source: Yahoofinance (Author's own calculation)

The results of the Augmented Dickey-Fuller (ADF) test on Hindustan Unilever Limited (HUL) indicate that the null hypothesis of the presence of a unit root in the time series data can be rejected at the 1% significance level. The test statistic, -3.795851, is less than the critical value at

the 1% level, demonstrating statistical significance. This indicates that HUL's time series data is most likely stationary, and the unit root hypothesis is not supported. The introduction of a constant and linear trend in the model had no significant effect on the outcome.

Figure 1.1

Line Graph- Tata Consumer Products Limited, Britannia Industries Limited, Nestle India Limited and NIFTY 50

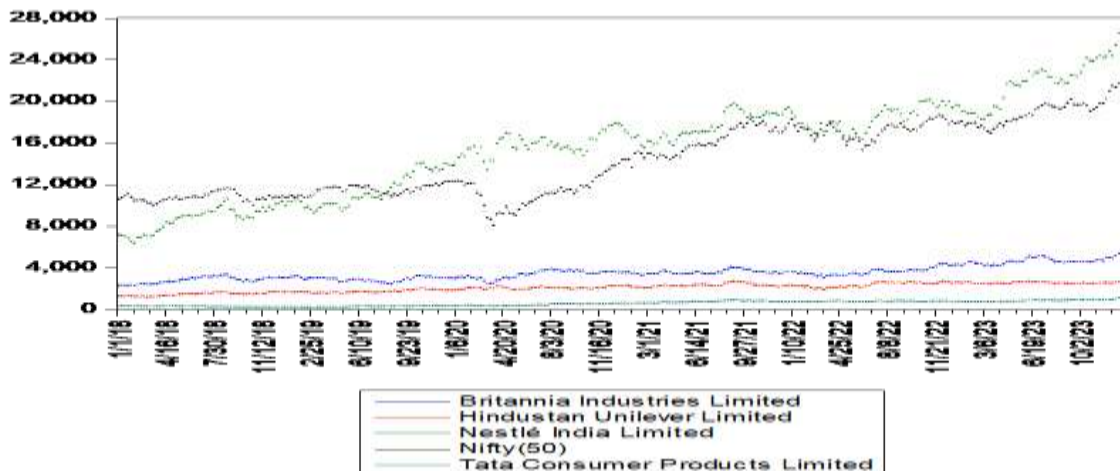


Table 1.3

Vector Auto regression Estimates - Tata Consumer Products Limited, Britannia Industries Limited, Nestle India Limited, Hindustan Unilever Limited and NIFTY 50

	Britannia Industries Limited	Hindustan Unilever Limited	Nestle India Limited	NIFTY 50	Tata Consumer Products Limited
Britannia Industries Limited (-1)	1.013633 (0.06932) [14.6224]	0.061726 (0.03965) [1.55668]	0.150769 (0.92036) [0.16381]	0.440917 (0.20558) [2.14475]	0.025717 (0.01325) [1.94135]
Britannia Industries Limited (-2)	-0.041188 (0.06992) [-0.58908]	-0.065542 (0.04000) [-1.63872]	-0.610248 (0.92832) [-0.65736]	-0.319068 (0.20736) [-1.53874]	-0.025368 (0.01336) [-1.89855]
Hindustan Unilever Limited (-1)	0.280835 (0.11858) [2.36830]	0.991741 (0.06783) [14.6209]	1.645757 (1.57439) [1.04533]	-0.000444 (0.35167) [-0.00126]	-0.020825 (0.02266) [-0.91899]
Hindustan Unilever Limited (-2)	-0.364494 (0.12155) [-2.99865]	-0.086069 (0.06953) [-1.23786]	-0.261692 (1.61385) [-0.16215]	-0.082135 (0.36048) [-0.22785]	0.000340 (0.02323) [0.01464]
Nestle India Limited (-1)	0.000647 (0.00438) [0.14756]	-5.04E-05 (0.00251) [-0.02011]	0.908402 (0.05819) [15.6104]	0.007813 (0.01300) [0.60111]	0.000723 (0.00084) [0.86335]
Nestle India Limited (-2)	0.011453 (0.00662) [1.72930]	0.006723 (0.00379) [1.77463]	0.022101 (0.08794) [0.25133]	-0.006642 (0.01964) [-0.33814]	0.002592 (0.00127) [2.04802]
NIFTY 50 (-1)	-0.037012 (0.02351) [-1.57412]	-0.030065 (0.01345) [-2.23539]	0.302632 (0.31218) [0.96943]	0.983036 (0.06973) [14.0977]	-0.004360 (0.00449) [-0.97041]
NIFTY 50 (-2)	0.033285 (0.02326) [1.43077]	0.026540 (0.01331) [1.99445]	-0.317072 (0.30887) [-1.02656]	-0.029120 (0.06899) [-0.42208]	0.004745 (0.00445) [1.06729]
Tata Consumer Products Limited (-1)	-0.495649 (0.36687) [-1.35102]	-0.130431 (0.20986) [-0.62152]	-19.18415 (4.87093) [-3.93850]	-0.559831 (1.08801) [-0.51455]	0.990042 (0.07011) [14.1215]
Tata Consumer Products Limited (-2)	0.536511 (0.36493) [1.47018]	0.205036 (0.20875) [0.98223]	18.94510 (4.84513) [3.91013]	1.065229 (1.08225) [0.98428]	-0.016868 (0.06974) [-0.24188]
C	121.0883 (63.0874) [1.91937]	119.0059 (36.0871) [3.29774]	177.9886 (837.609) [0.21250]	151.1108 (187.095) [0.80767]	0.670607 (12.0559) [0.05562]
R-squared	0.977162	0.979662	0.916075	0.992305	0.994145
Adj. R-squared	0.976405	0.978988	0.913296	0.992050	0.993951
Sum sq. resids	3238457.	1059640.	5.71E+08	28482364	118264.9
S.E. equation	103.5537	59.23462	1374.879	307.1033	19.78903
F-statistic	1292.130	1454.699	329.6438	3894.256	5127.876
Log likelihood	-1890.877	-1716.040	-2700.305	-2231.137	-1372.874
Akaike AIC	12.15257	11.03540	17.32463	14.32676	8.842644
Schwarz SC	12.28422	11.16706	17.45629	14.45841	8.974300
Mean dependent	3482.346	2063.305	15538.23	14323.47	536.1922
S.D. dependent	674.1526	408.6455	4669.218	3444.269	254.4434

Source: Yahoofinance (Author's own calculation)

The Vector Auto regression (VAR) estimates reveal dynamic correlations between the selected companies—Britannia Industries Limited,

Hindustan Unilever Limited, Nestle India Limited, and Tata Consumer Products Limited—and the NIFTY 50 index. The coefficients for each lag

show the short-term impact of prior values on company stock returns. The statistically significant coefficients, as demonstrated by t-statistics and accompanying p-values, emphasise the need of using lagged values to make accurate predictions. Furthermore, the inclusion of a constant (C) in the model improves the overall explanatory power. The R-squared values, which range from 0.9161 to 0.9941, suggest that the model accounts for a

significant amount of variance in the dependent variables. The lag order selection criteria suggest that a lag of one is recommended based on both the Akaike information. The lag order selection criteria indicate that a lag of 1 is favoured based on both the Akaike Information Criterion (AIC) and the Schwarz Criterion (SC), emphasising the importance of using the most recent past observations in forecasting.

Table 1.4

Lag Order Model - Tata Consumer Products Limited, Britannia Industries Limited, Nestle India Limited, Hindustan Unilever Limited and NIFTY 50

Exogenous variables: C						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-11712.40	NA	9.76e+26	76.33482	76.39552	76.35910
1	-9602.926	4136.485	1.24e+21	62.75522	63.11940*	62.90085*
2	-9577.204	49.60065	1.23e+21*	62.75051*	63.41819	63.01751
3	-9562.685	27.52397	1.32e+21	62.81880	63.78996	63.20716
4	-9543.379	35.97064	1.37e+21	62.85589	64.13055	63.36561
5	-9534.395	16.44765	1.52e+21	62.96022	64.53837	63.59131
6	-9511.461	41.23555*	1.54e+21	62.97369	64.85532	63.72613
7	-9496.887	25.73031	1.65e+21	63.04161	65.22673	63.91542
8	-9482.548	24.84802	1.78e+21	63.11106	65.59967	64.10623

Source: Yahoofinance (Author's own calculation)

According to both the Akaike Information Criterion (AIC) and the Schwarz Criterion (SC), the ideal lag order for the Vector Autoregression (VAR) model is lag 2. The log-likelihood (LogL) values fall as the lag order rises, reaching a minimum at lag 2. This implies that using the most current historical data is best for capturing the dynamic interactions between Britannia Industries Limited, Hindustan Unilever Limited, Nestle India

Limited, Tata Consumer Products Limited, and the NIFTY 50 index. Negative log-likelihood values for higher lag orders (2–8) may indicate overfitting or a loss of model parsimony. The chosen lag order strikes a balance between model complexity and explanatory power, ensuring that the VAR model accurately depicts the dataset's temporal dependencies.

Table 1.5

The least squares regression analysis - Tata Consumer Products Limited, Britannia Industries Limited, Nestle India Limited, Hindustan Unilever Limited and NIFTY 50

Dependent Variable: D(NIFTY 50)				
Method: Least Squares				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	134.8211	192.4547	0.700534	0.4841
D(NIFTY 50 (-1))	0.019696	0.070279	0.280258	0.7795
D(NIFTY 50 (-2))	0.000973	0.070602	0.013782	0.9890
D(Britannia Industries Limited (-1))	0.320920	0.213362	1.504105	0.1336
D(Britannia Industries Limited (-2))	0.083953	0.219519	0.382442	0.7024
D(Hindustan Unilever Limited (-1))	0.108037	0.368213	0.293408	0.7694
D(Hindustan Unilever Limited (-2))	-0.278583	0.379378	-0.734314	0.4633
D(Nestle India Limited (-1))	0.007790	0.020608	0.377977	0.7057
D(Nestle India Limited (-2))	0.061093	0.055069	1.109374	0.2682
D(Tata Consumer Products Limited (-1))	-1.149120	1.091765	-1.052533	0.2934
D(Tata Consumer Products Limited (-2))	-1.153864	1.140016	-1.012146	0.3123
NIFTY 50 (-1)	-0.048434	0.017876	-2.709478	0.0071
Britannia Industries Limited (-1)	0.127688	0.064556	1.977942	0.0489

Hindustan Unilever Limited (-1)	-0.055987	0.154663	-0.361991	0.7176
Nestle India Limited (-1)	-0.001697	0.016839	-0.100801	0.9198
Tata Consumer Products Limited (-1)	0.540526	0.300083	1.801255	0.0727
R-squared	0.060978	Mean dependent var		34.66699
Adjusted R-squared	0.013392	S.D. dependent var		310.6968
S.E. of regression	308.6093	Akaike info criterion		14.35195
Sum squared resid	28190946	Schwarz criterion		14.54390
Log likelihood	-2222.904	Hannan-Quinn criter.		14.42867
F-statistic	1.281437	Durbin-Watson stat		1.999106
Prob(F-statistic)	0.212463			

Source: Yahoofinance (Author's own calculation)

The least squares regression analysis on the changes in the NIFTY 50 index (D(NIFTY 50)) with respect to the lagged values and changes in the stock prices of Britannia Industries Limited, Hindustan Unilever Limited, Nestle India Limited, and Tata Consumer Products Limited indicated that the lagged change in NIFTY 50 (NIFTY 50 (-1)) has a statistically significant negative impact on the current change in the index, suggesting a short-term reversal effect. Additionally, Britannia Industries Limited's lagged stock returns (Britannia Industries Limited (-1)) exhibit a positive and

significant influence on the current change in the NIFTY 50. However, the Wald Test results on the coefficients associated with Tata Consumer Products Limited revealed that the joint significance of the variables at lags 1 and 2 is borderline (p-value = 0.0818), and the null hypothesis that these coefficients are jointly equal to zero cannot be decisively rejected. This implies that the inclusion of Tata Consumer Products Limited's lagged returns in the model may not be statistically significant for explaining the changes in the NIFTY 50 index.

Figure 1.2

CUSUM Graph- Tata Consumer Products Limited, Britannia Industries Limited, Nestle India Limited and NIFTY 50

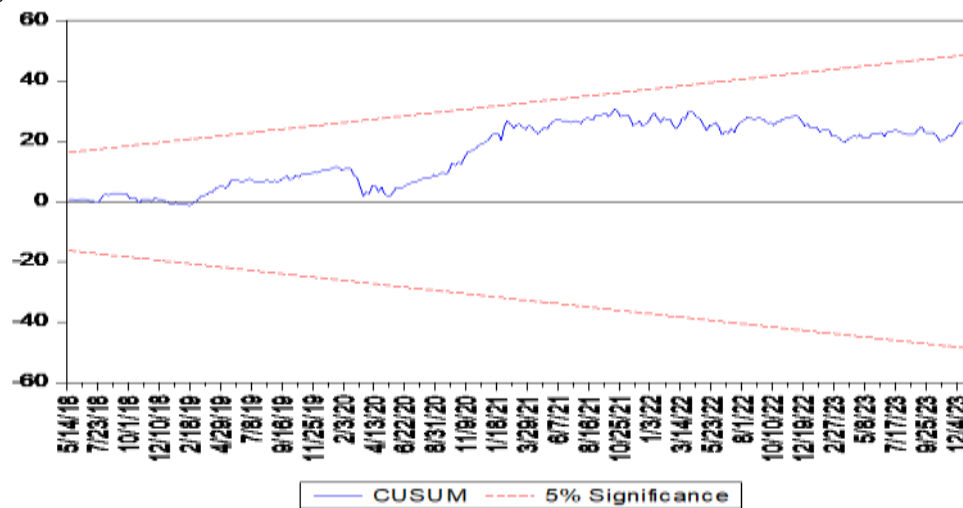


Table 1.6

Breusch-Godfrey Serial Correlation LM Test:- Tata Consumer Products Limited, Britannia Industries Limited, Nestle India Limited, Hindustan Unilever Limited and NIFTY 50

F-statistic	0.002150	Prob. F(2,294)	0.9979	
Obs*R-squared	0.004563	Prob. Chi-Square(2)	0.9977	
Dependent Variable: RESID				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5.656656	211.9268	-0.026692	0.9787
D(NIFTY 50 (-1))	0.034636	0.589341	0.058770	0.9532
D(NIFTY 50 (-2))	0.000751	0.381103	0.001971	0.9984

D(Britannia Industries Limited (-1))	0.004886	0.226988	0.021525	0.9828
D(Britannia Industries Limited (-2))	-0.011764	0.313028	-0.037581	0.9700
D(Hindustan Unilever Limited (-1))	-0.003566	0.373933	-0.009537	0.9924
D(Hindustan Unilever Limited (-2))	-0.003659	0.384782	-0.009510	0.9924
D(Nestle India Limited (-1))	7.90E-05	0.020738	0.003808	0.9970
D(Nestle India Limited (-2))	5.26E-05	0.055265	0.000952	0.9992
D(Tata Consumer Products Limited (-1))	0.022024	1.149836	0.019154	0.9847
D(Tata Consumer Products Limited (-2))	0.039327	1.292229	0.030434	0.9757
NIFTY 50 (-1)	0.001769	0.033235	0.053223	0.9576
Britannia Industries Limited (-1)	-0.004700	0.099620	-0.047181	0.9624
Hindustan Unilever Limited (-1)	0.003019	0.161980	0.018639	0.9851
Nestle India Limited (-1)	-3.31E-05	0.016933	-0.001955	0.9984
Tata Consumer Products Limited (-1)	-0.019323	0.428554	-0.045088	0.9641
RESID(-1)	-0.036921	0.613673	-0.060164	0.9521
RESID(-2)	-0.002002	0.397045	-0.005042	0.9960
R-squared	0.000015	Mean dependent var		1.90E-13
Adjusted R-squared	-0.057808	S.D. dependent var		301.0750
S.E. of regression	309.6549	Akaike info criterion		14.36476
Sum squared resid	28190533	Schwarz criterion		14.58070
Log likelihood	-2222.902	Hannan-Quinn criter.		14.45106
F-statistic	0.000253	Durbin-Watson stat		1.998641
Prob(F-statistic)	1.000000	Not Significant		

Source: Yahoofinance (Author's own calculation)

The Breusch-Godfrey Serial Correlation LM Test was used to detect serial correlation in the model's residuals. The resulting F-statistic of 0.002150, along with the associated p-value of 0.9979, indicates that there is insufficient evidence to reject the null hypothesis of no serial connection. This means that the residuals do not follow a systematic pattern across time, demonstrating the model's capacity to represent temporal

dependencies appropriately. The coefficients for the lagged variables and their corresponding p-values indicate that none of them significantly contribute to explaining the variation in the residuals. Furthermore, the model's goodness-of-fit measures, such as modified R-squared and information criteria, suggest that it may not be the best fit for describing the observed data.

Table 1.7

Wald Test:- Tata Consumer Products Limited, Britannia Industries Limited, Nestle India Limited, Hindustan Unilever Limited and NIFTY 50

Test Statistic	Value	df	Probability
F-statistic	1.977941	(5, 296)	0.0818
Chi-square	9.889706	5	0.0784
Null Hypothesis: (11)=C(12)=C(13)=C(14)=C(15)=0			
Normalized Restriction (= 0)	Value	Std. Err.	
C(11)	-1.153864	1.140016	
C(12)	-0.048434	0.017876	
C(13)	0.127688	0.064556	
C(14)	-0.055987	0.154663	
C(15)	-0.001697	0.016839	

Source: Yahoofinance (Author's own calculation)

The findings from the Wald Test show that certain coefficients in the model are all equal to zero. The F-statistic of 1.977941, with a corresponding p-value of 0.0818, indicates that at the 5% significance level, there is some evidence against the null hypothesis. Similarly, the Chi-

square test result of 9.889706, with a p-value of 0.0784, supports this conclusion. The null hypothesis, which states that the coefficients for variables C(11) through C(15) are all equal to zero, is not definitely rejected, but there is a hint of significance. The normalised constraints provide

information about the particular coefficients being examined. Notably, the coefficients for C(11), C(12), C(13), C(14), and C(15) come with their corresponding standard errors. The coefficients C(12) and C(15) appear to be near zero, implying a lack of relevance. Hence, there is no long run co-integration of Tata Consumer Products Limited, Britannia Industries Limited, Nestle India Limited, Hindustan Unilever Limited with NIFTY 50.

V. CONCLUSIONS

In summary, there is no long run co-integration of Tata Consumer Products Limited, Britannia Industries Limited, Nestle India Limited, Hindustan Unilever Limited with NIFTY 50. This implies, the absence of co-integration suggests that these variables do not move together in a stable manner over the long term. The individual stock prices of Tata Consumer Products Limited, Britannia Industries Limited, Nestle India Limited, and Hindustan Unilever Limited are not consistently influenced by the movements in the NIFTY 50 index over the observed time period. From an investor's perspective, this conclusion

implies that the performance of these specific companies is not strongly tied to the overall market represented by the NIFTY 50.

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