APPENDIX

(B)

APPENDIX

Table B1: Correlation matrix - Bombay stock exchange

	Sensex	*er Discretiona*	*nsumer Durab*	*Energy*	*Finance*	*FMCG*	*Automobiles*	*Bank*	*asic Materia*	*Capital Good*	*Healthcare*	*Industrials*	*IT*	*Metal*	*Oil & Gas*	*Power*	*Realty*	*TECK*	*Telecom*
Sensex	1																		
Consumer D	0.94804603	1																	
Consumer D	0.9627346	0.93932289	1																
Energy	0.89287653	0.82186578	0.89538188	1															
Finance	0.98680902	0.96485626	0.97078819	0.87529629	1														
FMCG	0.9611502	0.9265088	0.93646295	0.79966382	0.95699241	1													
Automobiles	0.8812712	0.9332665	0.8188021	0.65042608	0.89723826	0.91361143	1												
Bank	0.98792216	0.95420828	0.96814797	0.86322751	0.99739216	0.95848151	0.892681	1											
Basic Materi	0.85166256	0.89761954	0.83183858	0.8502619	0.87472439	0.75911893	0.79971715	0.85459327	1										
Capital Gooc	0.78614768	0.78312352	0.70004367	0.74389894	0.78463734	0.63797536	0.70982453	0.77878216	0.87323209	1									
Healthcare	0.8610344	0.8478745	0.776171	0.61795391	0.8379538	0.90400914	0.92435612	0.84172268	0.63403718	0.61082619	1								
Industrials	0.80472479	0.85613252	0.71444206	0.69906189	0.8160515	0.70164346	0.83427516	0.80217524	0.90409618	0.95296861	0.72270463	1							
IT	0.96336709	0.89484096	0.92882434	0.81697325	0.9311275	0.95318233	0.84565024	0.9372916	0.72772727	0.65310717	0.888912	0.68811612	1						
Metal	0.04998389	0.05929825	-0.0251954	0.22192436	0.05467392	-0.1273309	0.01641768	0.03733511	0.46355962	0.50860867	-0.1850504	0.43150994	-0.1213956	1					
Oil & Gas	0.86656299	0.85214225	0.83227263	0.9121219	0.8740397	0.77186539	0.75013579	0.8607262	0.93756208	0.86853399	0.62090561	0.84836137	0.72596732	0.42061026	1				
Power	-0.2114486	-0.200749	-0.2785501	0.01220405	-0.216083	-0.4210285	-0.2908686	-0.2303541	0.15308729	0.37034025	-0.3984479	0.23419126	-0.3819808	0.81743952	0.17546376	1			
Realty	-0.361459	-0.3054785	-0.3515125	-0.1374704	-0.3817991	-0.5369316	-0.5065256	-0.3968845	-0.0977196	0.03872773	-0.5578252	-0.0688427	-0.4500445	0.41136885	-0.1079396	0.70818616	1		
TECK	0.96774167	0.9129732	0.92149063	0.82440212	0.93132801	0.93912643	0.85483534	0.93499429	0.75701504	0.70739234	0.89392528	0.74303603	0.99069668	-0.0760719	0.75405466	-0.3089566	-0.3583041	1	
Telecom	-0.240415	-0.1805994	-0.2993808	-0.0875022	-0.2736171	-0.3903916	-0.2789971	-0.2952446	-0.0339223	0.17535977	-0.2766943	0.12578551	-0.336096	0.34618471	-0.0003791	0.64805844	0.78737565	-0.2134097	1
Utilities	0.2789374	0.28137557	0.21402171	0.47546021	0.29688025	0.10104479	0.1920757	0.27346965	0.60709752	0.6931545	0.0346995	0.61025586	0.07927522	0.84584324	0.64196129	0.80343224	0.33741456	0.12787321	0.37243709

Author's estimation

Table B2: Correlation matrix – National stock exchange

	NIFTY 50	*nancial servic*	*Media*	*Pharma*	*Commodities*	*Infrastructure*	*Consumption*	*Service sector*	*Private banks*	*PSU Banks*
Financial services	0.98864447	1								
Media	0.66289155	0.59479949	1							
Pharma	0.79665985	0.7356202	0.63331062	1						
Commodities	0.79945245	0.76909119	0.6850662	0.50582136	1					
Infrastructure	0.1323528	0.0920582	0.37366874	-0.1345502	0.466392866	1				
Consumption	0.9842009	0.97298607	0.67344535	0.82548817	0.735078917	0.029366084	1			
Service sector	0.99544703	0.99578472	0.63396705	0.76371171	0.770781114	0.118184224	0.980119719	1		
Private banks	0.98804056	0.99091091	0.65870941	0.77966252	0.763986565	0.057253894	0.983780673	0.991740709	1	
PSU Banks	0.25310917	0.20583198	0.34796778	0.28213255	0.582294368	0.24780306	0.163511048	0.203024201	0.220502914	1
India Manufacturing	0.92840213	0.8945936	0.76394159	0.8534021	0.78078955	0.078490202	0.937476621	0.909676509	0.923643046	0.33102831

Author's estimation

The correlation matrix shows the correlation amongst the various sectors and the yellow marked cells show high correlation.

Table B3: Adjusted Pearson goodness of fit test – BSE Sensex

Adjusted Pearson Goodness of Fit Test - BSE Sensex					
	Group	20	30	40	50
SGARCH	Statistic	25.91	40.54	52.3	52.14
	p-value	0.13279	0.07551	0.07556	0.35279
EGARCH	Statistic	23.02	34.91	33	47.16
	p-value	0.2364	0.2077	0.7393	0.5481
GJR GARCH	Statistic	25.38	29.5	46.35	54.84
	p-value	0.1484	0.4391	0.1951	0.2628
APARCH	Statistic	23.75	26.81	44.43	51.59
	p-value	0.206	0.5819	0.2536	0.3729

Source: Author's estimation

Table B4: Adjusted Pearson goodness of fit test – NSE Nifty50

Adjusted Pearson Goodness of Fit Test - NSE Nifty50					
	Group	20	30	40	50
SGARCH	Statistic	25.21	35.9	42.38	60.13
	p-value	0.1536	0.1766	0.3272	0.1325
EGARCH	Statistic	17.71	29.64	37.6	50.32
	p-value	0.5416	0.4324	0.5336	0.4208
GJR GARCH	Statistic	23.94	39.58	40.82	54.15
	p-value	0.19861	0.09103	0.39044	0.28435
APARCH	Statistic	22.19	26.43	38.57	48.75
	p-value	0.2751	0.6024	0.4892	0.483

Source: Author's estimatio

Table B5: Information criterion of BSE Sectoral indices

BSE - Sectors	GARCH Models	Akaike	Hannan-Quinn
Automobiles	SGARCH	-5.8105	-5.8056
	EGARCH	-5.8252	-5.8198
	GJR GARCH	-5.822	-5.8165
	APARCH	-5.822	-5.8165
	FIEGARCH	-5.814715	-5.809852
Bank	SGARCH	-5.5086	-5.5037
	EGARCH	-5.5237	-5.5182
	GJR GARCH	-5.523	-5.5175
	APARCH	-5.5241	-5.518
	FIEGARCH	-5.519257	-5.514395
Basic Materials	SGARCH	-5.6164	-5.6115
	EGARCH	-5.6257	-5.6203
	GJR GARCH	-5.6278	-5.6223
	APARCH	-5.6278	-5.6217
	FIEGARCH	-4.833731	-4.828868
Capital goods	SGARCH	-5.5456	-5.5407
	EGARCH	-5.5537	-5.5482
	GJR GARCH	-5.5546	-5.5491
	APARCH	-5.5559	-5.5498
	FIEGARCH	5.542559	-5.537696
Consumer durables	SGARCH	-6.1278	-6.123
	EGARCH	-6.1423	-6.1368
	GJR GARCH	-6.1439	-6.1385
	APARCH	-6.1448	-6.1387
	FIEGARCH	-6.117513	-6.112651
Consumer durables	SGARCH	-5.6155	-5.6107
	EGARCH	-5.621	-5.6155
	GJR GARCH	-5.6196	-5.6142
	APARCH	-5.6211	-5.615
	FIEGARCH	-5.620003	-5.61514
Energy	SGARCH	-5.7986	-5.7937
	EGARCH	-5.8023	-5.7968

	GJR GARCH	-5.8062	-5.8007
	APARCH	-5.8026	-5.7965
	FIEGARCH	-5.787319	-5.782456
Finance	SGARCH	-5.6213	-5.6003
	EGARCH	-5.6042	-5.6147
	GJR GARCH	-5.6213	-5.6152
	APARCH	-5.6152	-5.6152
	FIEGARCH	-5.56728	-5.563026
FMCG	SGARCH	-6.1378	-6.1329
	EGARCH	-6.1385	-6.1331
	GJR GARCH	-6.1412	-6.1357
	APARCH	-6.1369	-6.1308
	FIEGARCH	-6.136235	-6.131373
Healthcare	SGARCH	-6.2582	-6.2533
	EGARCH	-6.2619	-6.2565
	GJR GARCH	-6.2626	-6.2572
	APARCH	-6.2564	-6.2504
	FIEGARCH	-6.183339	-6.179084
Industrials	SGARCH	-5.7247	-5.7198
	EGARCH	-5.7346	-5.7291
	GJR GARCH	-5.7353	-5.7299
	APARCH	-5.7367	-5.7306
	FIEGARCH	-5.70626	-5.701397
IT	SGARCH	-5.7736	-5.7687
	EGARCH	-5.7804	-5.775
	GJR GARCH	-5.7767	-5.7712
	APARCH	-5.7836	-5.7776
	FIEGARCH	-5.786526	-5.781663
Metal	SGARCH	-5.1393	-5.1344
	EGARCH	-5.1441	-5.1387
	GJR GARCH	-5.1473	-5.1418
	APARCH	-5.1468	-5.1407
	FIEGARCH	-5.132203	-5.12734
Oil & Gas	SGARCH	-5.6667	-5.6618
	EGARCH	-5.6683	-5.6628

	GJR GARCH	-5.6723	-5.6668
	APARCH	-5.6724	-5.6663
	FIEGARCH	-5.666239	-5.661377
Power	SGARCH	-5.7787	-5.7739
	EGARCH	-5.7833	-5.7778
	GJR GARCH	-5.7834	-5.7779
	APARCH	-5.7843	-5.7782
	FIEGARCH	-5.768572	-5.76371
Realty	SGARCH	-4.7729	-4.768
	EGARCH	-4.7725	-4.767
	GJR GARCH	-4.7742	-4.7687
	APARCH	-4.7747	-4.7686
	FIEGARCH	-4.763691	-4.758828
TECK	SGARCH	-5.9549	-5.95
	EGARCH	-5.9632	-5.9578
	GJR GARCH	-5.9602	-5.9547
	APARCH	-5.9661	-5.9601
	FIEGARCH	-5.966815	-5.961952
Telecom	SGARCH	-5.2505	-5.2456
	EGARCH	-5.2509	-5.2454
	GJR GARCH	-5.254	-5.2485
	APARCH	-5.2537	-5.2476
	FIEGARCH	-5.250621	-5.245758
Utilities	SGARCH	-5.8709	-5.866
	EGARCH	-5.8719	-5.8665
	GJR GARCH	-5.8753	-5.8699
	APARCH	-5.8751	-5.869
	FIEGARCH	-5.797077	-5.792822

Source: Author's estimation

Table B6: Information criterion of NSE Sectoral as well as thematic indices

NSE - Sectors	GARCH Models	Akaike	Hannan-Quinn
Commodities index	SGARCH	-5.8118	-5.8069
	EGARCH	-5.8205	-5.815
	GJR GARCH	-5.8239	-5.8185
	APARCH	-5.8238	-5.8177
	FIEGARCH	-5.791223	-5.78636
India Consumption index	SGARCH	-6.3325	-6.3277
	EGARCH	-6.347	-6.3415
	GJR GARCH	-6.3501	-6.3446
	APARCH	-6.3456	-6.3395
	FIEGARCH	-6.338875	-6.334012
Financial services	SGARCH	-5.6052	-5.6003
	EGARCH	-5.6201	-5.6147
	GJR GARCH	-5.6206	-5.6152
	APARCH	-5.6213	-5.6152
	FIEGARCH	-5.567218	-5.563026
Infrastructure index	SGARCH	-5.7152	-5.7103
	EGARCH	-5.7244	-5.719
	GJR GARCH	-5.7264	-5.7209
	APARCH	-5.7265	-5.7205
	FIEGARCH	-5.713944	-5.709081
India Manufacturing index	SGARCH	-3.3838	-3.379
	EGARCH	-3.407	-3.4015
	GJR GARCH	-3.3887	-3.3832
	APARCH	-3.5145	-3.5084
	FIEGARCH	-3.378769	-3.373907
Media	SGARCH	-5.4895	-5.4846
	EGARCH	-5.4907	-5.4852
	GJR GARCH	-5.4935	-5.488
	APARCH	-5.493	-5.487
	FIEGARCH	-5.490187	-5.485325
Pharma	SGARCH	-5.4399	-5.435
	EGARCH	-5.2856	-5.2801
	GJR GARCH	-5.441	-5.4356

	APARCH	-5.4683	-5.4622
	FIEGARCH	-5.364118	-5.359256
Private bank	SGARCH	-5.5246	-5.5197
	EGARCH	-5.5396	-5.5342
	GJR GARCH	-5.5384	-5.5329
	APARCH	-5.5402	-5.5341
	FIEGARCH	-5.494108	-5.489853
PSU bank	SGARCH	-4.9418	-4.9369
	EGARCH	-4.95	-4.9445
	GJR GARCH	-4.9477	-4.9422
	APARCH	-4.9504	-4.9443
	FIEGARCH	-4.949489	-4.944627
Services sector	SGARCH	-6.0461	-6.0412
	EGARCH	-6.0643	-6.0588
	GJR GARCH	-6.065	-6.0595
	APARCH	-6.0616	-6.0555
	FIEGARCH	-6.013263	-6.009008

Source: Author's estimatio

Table B7: Granger causality of indices of Bombay stock exchange

NULL HYPOTHESIS	PROBABILITY
Automobiles does not granger cause bank	0.0173
Automobiles does not granger cause basic materials	0.0036
Automobiles does not granger cause capital goods	0.0379
Automobiles does not granger cause consumer durables	0.0015
Automobiles does not granger cause energy	0.0314
Automobiles does not granger cause finance	0.0023
Automobiles does not granger cause industrials	0.0032
Bank does not granger cause automobiles	0.0266
Bank does not granger cause capital goods	0.0003
Bank does not granger cause consumer durables	0.004
Bank does not granger cause finance	8.00E-11
Basic materials does not granger cause automobiles	9.00E-229
Basic materials does not granger cause bank	1.00E-193
Basic materials does not granger cause capital goods	3.00E-142
Basic materials does not granger cause consumer durables	4.00E-146
Basic materials does not granger cause FMCG	4.00E-119
Basic materials does not granger cause healthcare	4.00E-131
Basic materials does not granger cause IT	4.00E-38
Basic materials does not granger cause metal	4.00E-118
Basic materials does not granger cause oil & gas	2.00E-119
Basic materials does not granger cause power	3.00E-68
Basic materials does not granger cause realty	8.00E-25
Basic materials does not granger cause Teck	2.00E-57
Capital goods does not granger cause consumer durables	0.001
Capital goods does not granger cause industrials	4.00E-06
Capital goods does not granger cause utilities	0.0072
Consumer durables does not granger cause automobiles	0.0243
Consumer durables does not granger cause basic materials	0.0057
Consumer durables does not granger cause energy	0.0205
Consumer durables does not granger cause finance	0.0173
Consumer durables does not granger cause healthcare	0.0173
Consumer durables does not granger cause power	0.0128

Energy does not granger cause automobiles	6.00E-128
Energy does not granger cause bank	4.00E-135
Energy does not granger cause capital goods	6.00E-73
Energy does not granger cause consumer durables	3.00E-100
Energy does not granger cause FMCG	7.00E-88
Energy does not granger cause healthcare	3.00E-75
Energy does not granger cause IT	5.00E-40
Energy does not granger cause metal	5.00E-45
Energy does not granger cause oil & gas	6.00E-199
Energy does not granger cause power	3.00E-37
Energy does not granger cause realty	4.00E-15
Energy does not granger cause Teck	2.00E-52
Finance does not granger cause automobiles	3.00E-304
Finance does not granger cause bank	0
Finance does not granger cause capital goods	5.00E-166
Finance does not granger cause consumer durables	3.00E-236
Finance does not granger cause FMCG	5.00E-179
Finance does not granger cause healthcare	6.00E-138
Finance does not granger cause IT	7.00E-61
Finance does not granger cause metal	2.00E-65
Finance does not granger cause oil & gas	9.00E-134
Finance does not granger cause power	3.00E-58
Finance does not granger cause realty	1.00E-19
Finance does not granger cause Teck	5.00E-81
FMCG does not granger cause bank	6.00E-05
FMCG does not granger cause consumer durables	0.0108
FMCG does not granger cause finance	0.0003
FMCG does not granger cause IT	0.0012
FMCG does not granger cause power	0.0334
FMCG does not granger cause Teck	0.0006
Healthcare does not granger cause bank	0.0018
Healthcare does not granger cause consumer durables	0.0311
Healthcare does not granger cause power	0.0086
Industrials does not granger cause automobiles	2.00E-256
Industrials does not granger cause bank	4.00E-190

Industrials does not granger cause capital goods	1.00E-194
Industrials does not granger cause consumer durables	2.00E-129
Industrials does not granger cause FMCG	2.00E-102
Industrials does not granger cause healthcare	9.00E-122
Industrials does not granger cause IT	3.00E-30
Industrials does not granger cause metal	1.00E-69
Industrials does not granger cause oil & gas	6.00E-110
Industrials does not granger cause power	5.00E-69
Industrials does not granger cause realty	5.00E-25
Industrials does not granger cause Teck	1.00E-45
IT does not granger cause bank	0.0256
IT does not granger cause basic materials	0.003
IT does not granger cause consumer durables	0.0467
IT does not granger cause finance	7.00E-05
IT does not granger cause industrials	0.0449
Metal does not granger cause basic materials	0.0309
Metal does not granger cause utilities	5.00E-06
Oil & Gas does not granger cause basic materials	5.00E-07
Oil & Gas does not granger cause consumer durables	0.0254
Oil & Gas does not granger cause energy	0.0227
Oil & Gas does not granger cause finance	0.0039
Oil & Gas does not granger cause industrials	0.0022
Oil & Gas does not granger cause IT	0.0075
Oil & Gas does not granger cause realty	0.0363
Oil & Gas does not granger cause utilities	0.0305
Power does not granger cause capital goods	0.0064
Power does not granger cause consumer durables	0.0112
Power does not granger cause metal	0.0024
Power does not granger cause utilities	1.00E-09
Realty does not granger cause telecom	3.00E-05
Realty does not granger cause utilities	0.0156
Teck does not granger cause basic materials	0.0009
Teck does not granger cause finance	0.0003
Teck does not granger cause industrials	0.0112
Telecom does not granger cause automobiles	8.00E-33

Telecom does not granger cause bank	8.00E-29
Telecom does not granger cause capital goods	6.00E-25
Telecom does not granger cause consumer durables	5.00E-23
Telecom does not granger cause FMCG	2.00E-24
Telecom does not granger cause healthcare	2.00E-25
Telecom does not granger cause IT	6.00E-10
Telecom does not granger cause metal	1.00E-15
Telecom does not granger cause oil & gas	1.00E-22
Telecom does not granger cause power	1.00E-16
Telecom does not granger cause realty	3.00E-09
Telecom does not granger cause Teck	5.00E-30
Utilities does not granger cause automobiles	2.00E-59
Utilities does not granger cause bank	2.00E-58
Utilities does not granger cause basic materials	0.0084
Utilities does not granger cause capital goods	2.00E-53
Utilities does not granger cause consumer durables	1.00E-38
Utilities does not granger cause energy	0.0006
Utilities does not granger cause FMCG	2.00E-33
Utilities does not granger cause healthcare	8.00E-42
Utilities does not granger cause industrials	0.0344
Utilities does not granger cause IT	5.00E-11
Utilities does not granger cause metal	2.00E-31
Utilities does not granger cause oil & gas	1.00E-57
Utilities does not granger cause power	6.00E-51
Utilities does not granger cause realty	7.00E-21
Utilities does not granger cause Teck	4.00E-18
Utilities does not granger cause telecom	0.0185
Consumer discretionary does not granger cause bank	0
Consumer discretionary does not granger cause capital goods	3.00E-173
Consumer discretionary does not granger cause finance	0.0524
Consumer discretionary does not granger cause metal	3.00E-80
Consumer discretionary does not granger cause power	1.00E-67
Industrials does not granger cause consumer discretionary	0.0069
Telecom does not granger cause consumer discretionary	0.0364
Utilities does not granger cause consumer discretionary	0.0017

Source: Author's estimation

Table B8: Granger causality of indices of National stock exchange

Null hypothesis	Probability
Manufacturing index does not granger cause commodities	0.0005
Commodities does not granger cause manufacturing index	1.00E-08
Commodities does not granger cause media	0.0002
Consumption does not granger cause financial services	0.0024
Infrastructure does not granger cause consumption	0.04
Manufacturing index does not granger cause consumption	0.0002
Consumption does not granger cause manufacturing index	6.00E-39
Media does not granger cause consumption	0.03
Consumption does not granger cause private bank	0.0014
Services sector does not granger cause consumption	0.0334
Consumption does not granger cause services sector	0.0006
Manufacturing index does not granger cause financial services	8.00E-06
Financial services does not granger cause manufacturing index	6.00E-21
Media does not granger cause financial services	0.058
Financial services does not granger cause media	0.0024
Pharmaceuticals does not granger cause financial services	0.0235
Private bank does not granger cause financial services	0.0019
Financial services does not granger cause private bank	0.0074
Services sector does not granger cause financial services	0.0553
Manufacturing index does not granger cause infrastructure	0.0358
Infrastructure does not granger cause media	4.00E-06
PSU banks does not granger cause infrastructure	0.0031
Media does not granger cause manufacturing index	2.00E-07
Manufacturing index does not granger cause media	0.0197
Pharmaceuticals does not granger cause manufacturing index	3.00E-15
Private bank does not granger cause manufacturing index	1.00E-30
Manufacturing index does not granger cause private bank	2.00E-05
Manufacturing index does not granger cause PSU banks	6.80E-03
Services sector does not granger cause manufacturing index	3.00E-25
Manufacturing index does not granger cause services sector	1.00E-04
Media does not granger cause pharmaceuticals	2.32E-02
Private bank does not granger cause media	2.09E-02

PSU banks does not granger cause media	4.00E-05
Services sector does not granger cause media	1.00E-03
Pharmaceuticals does not granger cause private bank	7.40E-03
Pharmaceuticals does not granger cause service sector	3.56E-02

Source: Author's estimation