

Contents

Chapter number	Description	Page number
Chapter 1	Introduction	
1.1	Introduction	1
1.2	World LNG Business	2
1.3	LNG imports to India	4
1.4	International Natural Gas Prices	7
1.5	International LNG Ship Chartering prices	8
1.6	Need for Study	8
1.7	Business Problem	9
1.8	Report Outline	9
Chapter 2	Literature Review	
2.1	Database, Journals and Reports	10
2.2	Objectives of Literature review	12
2.3	Natural-gas trade and markets	12
2.4	Volatility	26
2.4.1	Volatility in Energy Prices	27
2.4.2	Volatility in shipping freight markets	47
2.4.2.1	Dry bulk markets	47
2.4.2.2	Tanker markets	48
2.4.3	Volatility in Ship building prices	58
2.5	Research gap	62
Chapter 3	Research Methodology	
3.1	Research Design	63
3.2	Statement of the problem	64
3.2.1	Research questions	64
3.3	Objectives of the study	64
3.4	Scope of the Study	65
3.4.1	Objective 1	65
3.4.2	Objective 2	65
3.4.3	Objective 3	65
3.5	Data Collection	65
3.5.1	Objective 1	65
3.5.2	Objective 2	66
3.5.3	Objective 3	66
3.6	Tools for analysis	66
3.6.1	Unit root tests	66
3.6.1.1	Basic unit root theory	66
3.6.1.2	Augmented Dicky Fuller test	67
3.6.1.3	Kwiatkowski, Phillips, Schmidt and Shin (KPSS) test	68

3.6.2	Modelling for Objective 1	68
3.6.2.1	Simple Univariate GARCH model	68
3.6.2.2	Exponential GARCH (EGARCH)	69
3.6.3	Modelling for objective 2	70
3.6.3.1	EGARCH model	71
3.6.4	Modelling for objective 3	71
3.6.4.1	Simple Univariate GARCH model	71
3.6.4.2	EGARCH model	71
3.7	Software	71
Chapter 4	Elements of LNG Value Chain	
4.1	LNG value chain process	72
4.2	Natural gas production and consumption	73
4.3	Liquefaction plants	74
4.4	Floating Liquefaction Natural Gas	78
4.5	LNG Shipping	78
4.5.1	LNG fleet	79
4.6	Regasification terminals for receiving LNG	82
4.6.1	Growth of Regasification terminals	82
4.7	LNG markets and Pricing mechanism	85
4.7.1	Natural gas pricing mechanism	85
4.7.2	Asia region	88
4.7.3	Asia Pacific region	88
4.7.4	Short Term and Spot LNG markets	89
Chapter 5	Volatility Analysis	
5.1	Results for Objective 1	91
5.1.1	Stationarity test results	91
5.1.2	Descriptive Statistics for Henry Hub prices	92
5.1.3	Henry Hub prices volatility	93
5.1.4	Descriptive statistics for Japanese Crude Cocktail prices (JCC)	95
5.1.5	Japanese Crude Cocktail prices volatility	96
5.1.6	Heteroskedasticity	97
5.1.7	Autocorrelation	98
5.1.8	EGARCH results	99
5.2	Results for Objective 2	101
5.2.1	Unit root test results	101
5.2.2	Descriptive statistics for Long term charter rates	102
5.2.3	Descriptive statistics for Short term charter rates	103
5.2.4	EGARCH results	104
5.2.5	Heteroskedasticity	106
5.2.6	Q test results	107
5.3	Results for objective 3	108

5.3.1	Unit root test results	108
5.3.1.1	Augmented Dicky fuller test results	108
5.3.1.2	KPSS test results	109
5.3.2	Descriptive Statistics for New Ship Building prices	110
5.3.3	Volatility clustering, Autocorrelation and Persistence	110
5.3.4	GARCH results	111
5.3.5	EGARCH results	114
Chapter 6	Conclusions	
6.1	Objective 1	118
6.2	Objective 2	118
6.3	Objective 3	119
6.4	Scope for further study	120
Chapter 7	Bibliography	121
Annexure AI	Monthly Indexed Prices of Japanese Crude Cocktail and Henry Hub	144
Annexure AII	Monthly Long term and Short Term Charter rates for LNG Shipping	147
Annexure AIII	Monthly LNG New Ship building prices	151
Annexure AIV	LNG Liquefaction Capacity installed	155
Annexure AV	LNG liquefaction capacity under construction	163
Annexure AVI	List of LNG regasification capacity	166
Annexure AVII	List of LNG Regasification terminals under construction	175
Annexure AVIII	List of current LNG Shipping fleet	178
Annexure AIX	List of LNG Shipping order Book	217
Annexure AX	Profile of the Author	231