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MODELS FOR FORECASTING THE DEMAND AND SUPPLY OF ELECTRICITY IN INDIA

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Abstract
Electrical Energy is one of the most fundamental parts of our universe. Energy has come to be known as a `strategic commodity' and any uncertainty about its supply can threaten the functioning of the economy, particularly in developing economies. Achieving Electric energy security in this strategic sense is of fundamental importance not only to India's economic growth but also for the human development objectives that aim at alleviation of poverty and unemployment and meeting the Millennium Development Goals Holistic planning for achieving these objectives requires quality energy statistics that is able to address the issues related to energy demand, energy supply and environmental effects of energy growth. In this paper, the Garch model is used to determine the market volatility in the demand and supplychains of electricity in Nigeria for 36 years, i.e. from 1970 to 2005 from the historic data obtained from the National Bureau of Statistics. The Harvey logistic model is used to predict the demand and supply of electricity in the country from 2005 to 2026

Key Words: Demand, Supply, Electricity, Garch, Logistic Model Etc.

INTRODUCTION

Electricity power supply is the most important commodity for the development of a nation. People become easily empowered to work and develop themselves when there is electricity power supply. This development takes place from domestic level to industrial level and can also be transferred from small to medium and to large scale level. Power consumption demand depends on the population and industrialization of a country. There is power equilibrium when the supply is equal to the demand, otherwise there is supply shortfall.

Models for pricing, forecasting and supply of electricity are often characterized by spikes. Electricity is non-storable, hence the market is volatility and will change with time, and that is, the volatility has heteroscedasicity behavior which is a kind of time varying variance There are several researches done on modeling and forecasting the demand and supply of electricity.

REVIEWOFLITERATURE

A predictionscenarioof future events and situations are called forecasts, and the act of making such predictions is called forecasting. Forecastingis the basic facet of decision making in different areas of life. The purpose of forecasting is to minimize the risk in decision making and reduce unanticipated cost. One of the most important works of an electric power utility is to correctly predict load requirements. In broad terms, power system load forecasting can be categorized into longterm and shortterm functions. Longterm load forecasting usually covers from one to ten years based on monthly, yearly values. Explicitly, it is intended for applications in capacity expansion, and long term capital investment return studies.In simplicity, forecasting is a system for quantitatively determining future load demand [9]. On one hand, long range planners consider a period of 20-30 years forecasts to ascertain sufficient generation and transmission as well as distribution plans of actions.

The literature of load forecasting can be traced back to at least 1918. In the early 1980s, the Load Forecasting Working Group of IEEE published two papers to compile the load forecasting bibliography To emphasize the modern developments in STLF, most of the papers reviewed in this chapter are published after 1980. In the past 40 years, the developments in STLF have been reviewed by many researchers from various perspectives. These literature reviews can be roughly categorized into two groups by whether there are experiments conducted during the review or not. The ones without experiments, or conceptual reviews, tend to review the literature on the conceptual level based on the developments, results, and conclusions from the original papers The ones with experiments, or experimental reviews, tend to implement, analyze,evaluate, and compare the different techniques reported in the literature using one or several new sets of data.

A notable review by Hippert et al. covered the papers that reported the application of ANN to STLF . The specific aim of this review was to clarify the skepticisms regarding the usage of ANN on STLF. Through a critical review and evaluation of around 40 representative journal papers published in the 1990s, the authors highlighted two facts that may have lead to the skepticisms. Firstly, the ANN models may be "over fitting" the data. This "over fitting" may be due to overtraining or over parameterization. Secondly, although all the proposed systems were tested on real data, most of the tests reported by the papers within the review were not systematically carried out. Some of themdid not provide comparison to standard benchmarks, and some did not follow standardstatistical procedures in reporting the analysis of errors.

RESEARCH OBJECTIVES

1. Data collection and compilation of data from National Bureau of Statistics.
2. GARCH model will be used to study changing volatility in demand and supply chain for a period of 36 years 1970 t0 2005.
3. To use Harvey logistics model to predict the demand and supply for India from 2015 to 2026.
4. To determine the market volatility in the demand and supply chains in electricity in India.
5. To verify the electrical power load with two forecasting models .
6. To predict the electricity demand and supply using forecasting models using SPSS.

METHODOLOGY

We shall use the GARCH models to study for changing volatility in demand and supply chain for period of 36 years, i.e. from 1970 to 2005. We will then make use of the Harvey logistic model to predict the demand and supply of electricity for country from 2015 to 2026.

Estimation of the GARCH (1,1) Model

The descriptive statistics and other properties of return series such as mean, variance, mean, median, kurtosis, skewness, standard deviation etc. have serious implications for modeling. This is due to the fact that they provide good decision for the distribution and process that drives it.

We shall estimate the parameters α_0 ,α_1 ,and α_2 of the

GARCH (1,1) model using the Matlab. From the estimation we wish to obtain the market volatility. The GARCH model is given as

$$y_t \quad c \quad \varepsilon_t, \sigma_t^2 \quad \alpha_0 \quad \alpha_1 \sigma_{t-1}^2 \quad \alpha_2 \varepsilon_{t-1}^2$$

Where

y_tRepresents the returns

ε_t Represents the error term (white noise)

σ_t^2 Represents the variance at time t

σ_{t-1}^2 Represents the variance at a previous time t-1

ε_{t-1}^2 Represents the error term at a previous time t-1

The data analyzed in this study consist of both the demand and supply available data for electricity for the Nigerian electricity market. Each data is represented by a series of 36 data points, so there are two different series with a total of 72 data points. Their time plots are presented in Figure 1. All computations and analysis are done using the matrix laboratory (MATLAB) software package and the statistical package for social sciences (SPSS).

DATA COLLECTION

Table 1. Descriptive statistics for the return series

	SAMPLE SIZE	MEAN	MIN	MAX	STD DEV	SKEW	KURT
SUPPLY	36	0.0809	-0.8048	1.0160	0.2499	0.333	9.763
DEMAND	36	0.7310	-0.4690	0.7135	0.1725	0.542	7.015

Skew is a measure of heavy tails and asymmetry distribution and kurtosis of too many observation about the mean for a distribution

The Matlab code for estimating the garchparameters is:

```
>>whos
```

```
>> y=price2ret (demand);

>> [coeff, errors, LLF, innovations, sigma, summary]

=garchfit (y);

>>garchdisp (coeff, errors);
```

From the Garch Parameter we Obtain the results as follows

Statistics Table for Supply

supply	$z_t=z_t-z_{t-1}$	lnz_t	$z_t=p_t$	$z_{t-1}=p_t$	p_tq_t	q_t^2
176.6	176.6	5.1739	5.1739			
215.4	38.8	3.6584		3.6584	18.7215	13.3839
255.4	40.0	3.6889	3.6889			
299.7	44.3	3.7910		3.7910	13.9846	14.3717
261.1	-38.6	3.6533	3.6533			
395.4	134.3	4.8978		4.8978	17.8931	23.9884
468.7	73.3	4.2946	4.2946			
538.0	69.3	4.2384		4.2384	18.2022	17.9640
522.7	15.3	2.7279	2.7279			
710.7	188	5.2364		5.2364	14.2844	27.4199
815.1	104.4	4.6482	4.6482			
887.7	72.6	4.2850		4.2850	19.9175	18.3612
973.9	86.2	4.4567	4.4567			
994.6	20.7	3.0301		3.0301	13.5042	9.1815
1025.5	30.9	3.4308	3.4308			

Statistics Table for Demand

consumption	$y_t=Y_t-Y_{t-1}$	lny_t	$y_t=w_t$	$y_{t-1}=u_t$	w_tu_t	u_t^2
145.3	145.3	4.9788	4.9788			
181.1	35.8	3.5779		3.5779	17.8136	12.8014
211.1	30.0	3.4012	3.4012			
232.7	21.6	3.0727		3.0727	10.4509	9.4415
266.2	33.5	3.5115	3.5115			
318.7	52.5	3.9608		3.9608	13.3121	15.6879
369.8	51.1	3.9338	3.9338			
435.7	65.9	4.1881		4.1881	16.4751	17.5402
504.4	68.7	4.2297	4.2297			
460.1	-44.3	3.7910		3.7910	16.0348	14.3717
536.9	76.8	4.3412	4.3412			
335.9	-210	5.3033		5.3033	23.0227	28.1250
685.6	349.7	5.8571	5.8571			
696.7	11.1	2.4069		2.4069	14.0975	5.7932
625.5	-71.2	4.2655	4.2655			
717.4	91.9	4.5267		4.5267	19.2830	20.4367

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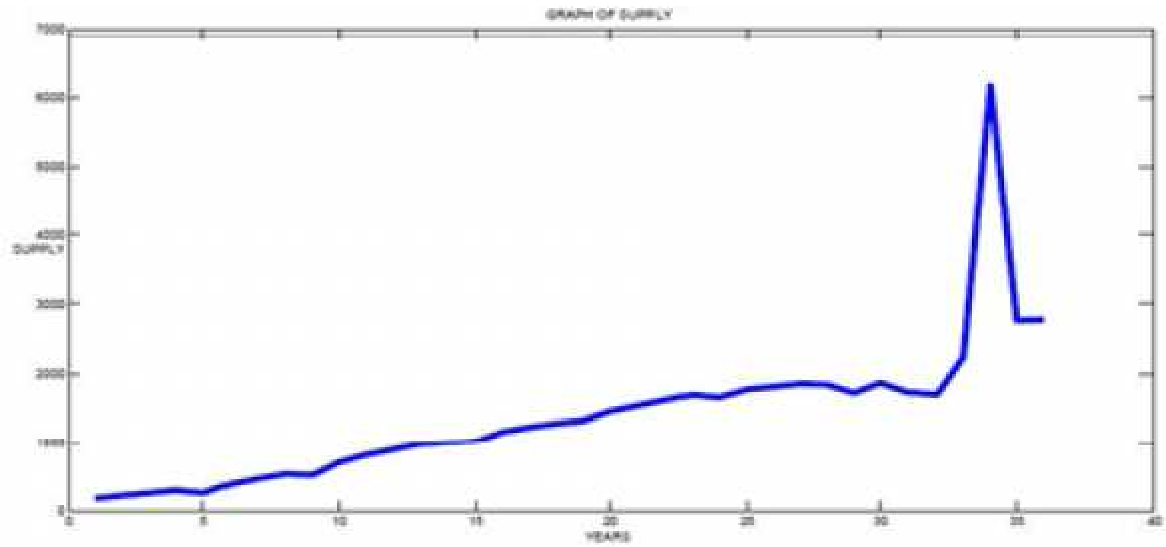
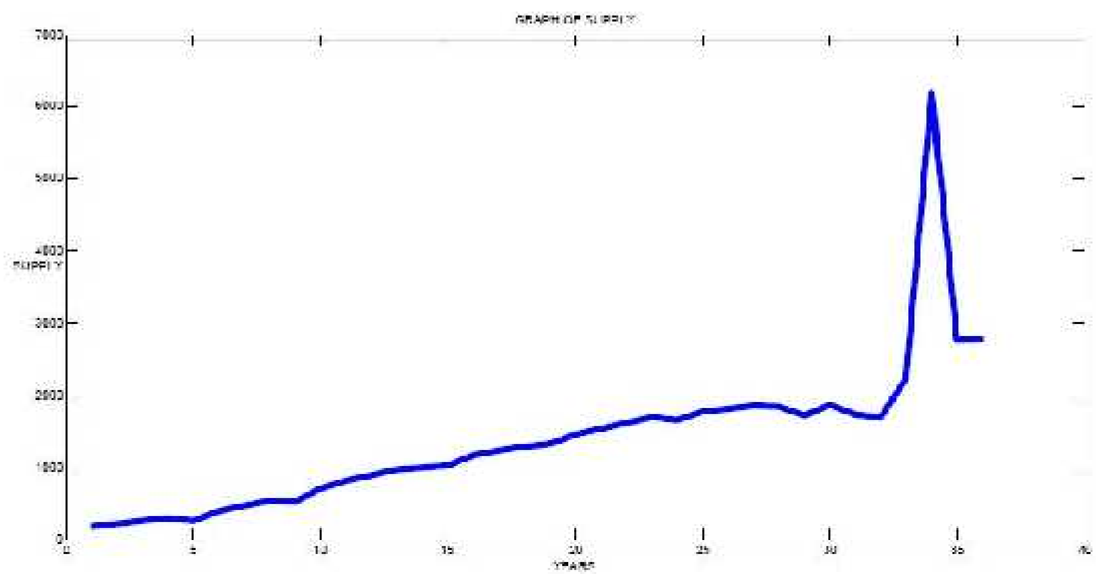
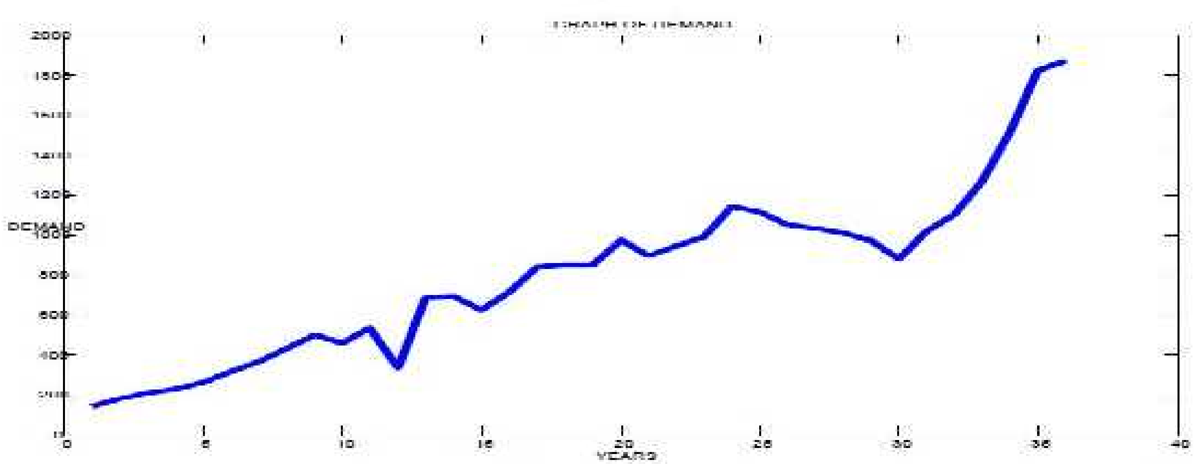
Results







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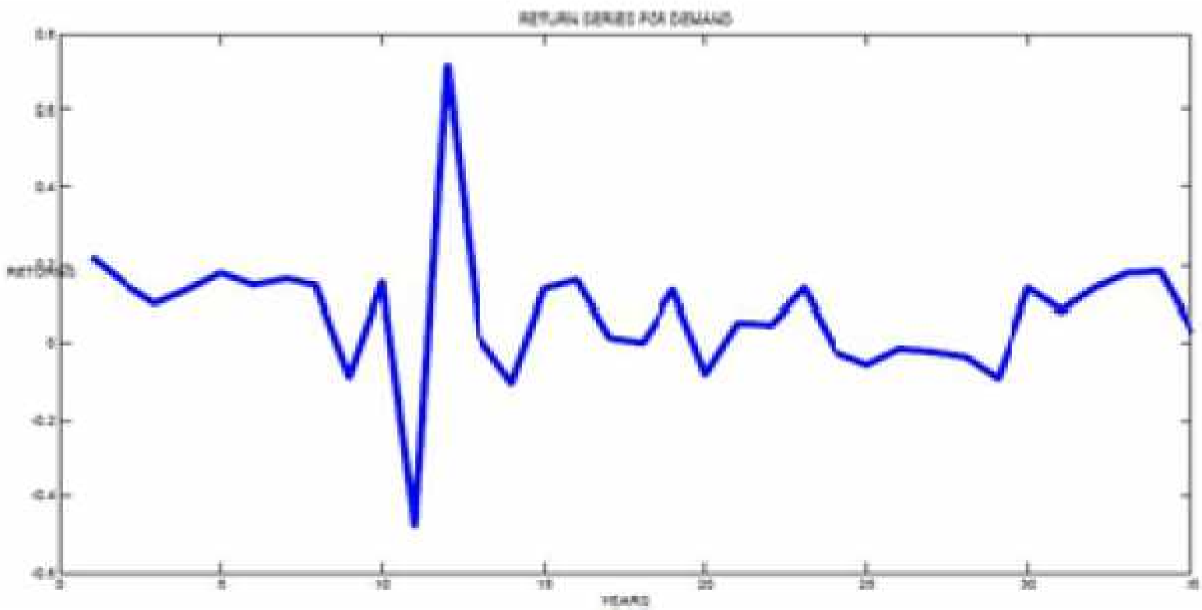

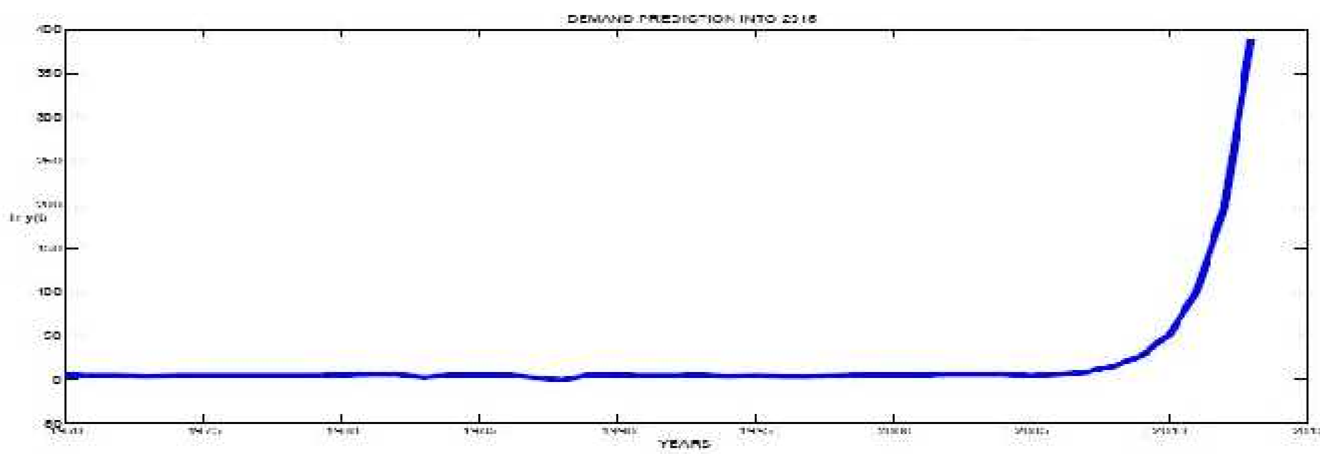

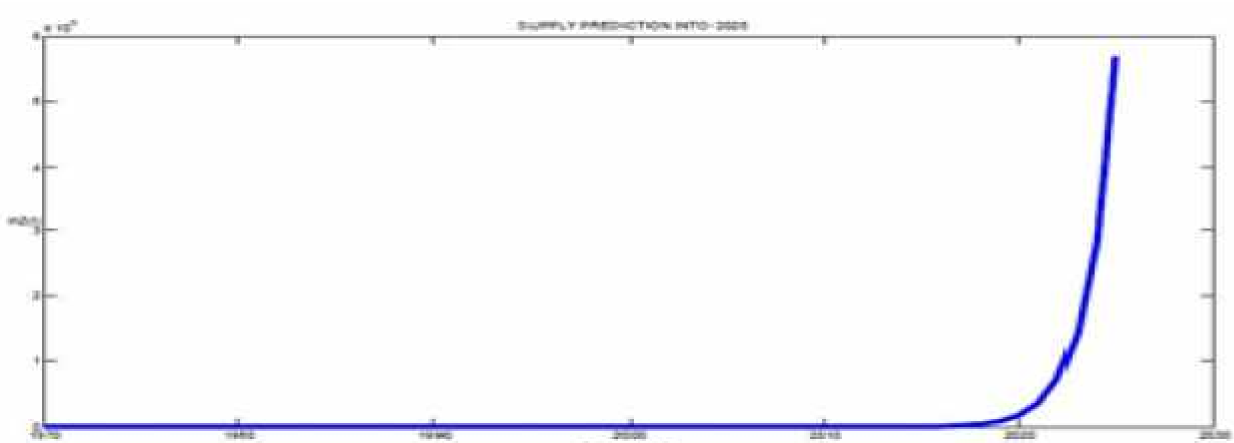

Fig 8: graph of supply prediction

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CONCLUSION

Forecasts are quite important for effective implementation of energy policies. he Indian power sector has an investment potential of Rs 15 trillion (US$ 237 billion) in the next 4–5 years,

India has set a target of achieving overall renewable energy installed capacity of 41,400 MW by 2017 and 72,400 MW by 2022. To achieve this target, India will have to add 40,130.39 MW of renewable energy installed capacity. To achieve a target of 72,000 MW of installed capacity for renewable energy India will have to invest around **US$ 46.22 billion**. Almost similar investment will be made in upgrading the transmission and distribution (T&D) infrastructure and old renewable plants which will reach their end of life. NOVONOUS estimates that India will have to invest **US$ 83.35 billion** in the renewable energy market till 2022thereby providing immense opportunities in power generation, distribution, transmission, and equipment,

Therefore is vast window of opportunities open to investors in power section in India

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