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«ΕΦΑΡΜΟΓΗ ΟΙΚΟΝΟΜΕΤΡΙΚΩΝ ΜΕΘΟΔΩΝ ΔΙΑΧΕΙΡΙΣΗΣ ΡΙΣΚΟΥ ΣΤΙΣ ΑΓΟΡΕΣ ΟΨΕΩΣ ΚΑΙ ΠΡΟΘΕΣΜΙΑΣ ΤΩΝ ΝΑΥΛΑΓΟΡΩΝ ΔΕΞΑΜΕΝΟΠΛΟΙΩΝ»

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ΧΡΙΣΤΟΠΟΥΛΟΣ ΑΠΟΣΤΟΛΟΣ

ΑΘΗΝΑ, ΟΚΤΩΒΡΙΟΣ 2015

ΠΕΡΙΛΗΨΗ

Η μεταβολή των τιμών των ναύλων αποτελεί μια σημαντική πηγή κινδύνου για όλους τους εμπλεκόμενους στις αγορές των ναυλαγορών δεξαμενόπλοιων, συμπεριλαμβανομένων των πλοιοκτητών, των ναυλωτών, των εμπόρων (traders), των τραπεζών, των Hedge Funds κλπ. Η εργασία αυτή ερευνά τον κίνδυνο της μεταβολής των ναύλων στις δύο πιο δημοφιλείς διαδρομές καθαρών φορτίων (διυλισμένα πετρελαιοειδή προϊόντα) και στις δύο πιο δημοφιλείς διαδρομές βρώμικων φορτίων (ακατέργαστο πετρέλαιο και βιομηχανικά καύσιμα), χρησιμοποιώντας ιστορικές τιμές από το Μάιο του 2007 μέχρι το Σεπτέμβρη του 2015 για τις διαδρομές TC2 και TD3 και από τον Απρίλιο του 2008 μέχρι το Σεπτέμβρη του 2015 για τις διαδρομές TC5 και TD7.

Η ανάλυση των αποδόσεων στις ναυλαγορές όψεως και προθεσμίας, υποδεικνύει ιστορικές κατανομές χαρακτηριζόμενες από υψηλές κορυφώσεις και συνωστισμένες άκρες. Ο καθορισμός μιας μεθόδου διαχείρισης κινδύνου που θα λαμβάνει υπόψιν της αυτά τα χαρακτηριστικά των κατανομών, κρίνεται μεγάλης σημασίας. Για την ποσοτικοποίηση του ρίσκου χρησιμοποιήθηκε η προσέγγιση Value at Risk (VaR), μια μέθοδος που αποφέρει αποτελέσματα εύκολα κατανοητά και γρήγορα επικοινωνήσιμα. Ένα ευρύ φάσμα παραμετρικών και μη παραμετρικών Value at Risk μεθόδων εφαρμόστηκε στις τιμές όψεως και προθεσμιακών συμβολαίων μελλοντικής εκπλήρωσης πλησιέστερου μήνα και πλησιέστερου τριμήνου και των τεσσάρων διαδρομών. Τα αποτελέσματα υποδεικνύουν σημαντικό κίνδυνο και στις τέσσερις διαδρομές. Η διαδικασία εξέτασης των αποτελεσμάτων (backtesting process) εκτελείται σε δύο βήματα. Στο πρώτο εξετάζεται η στατιστική σημαντικότητα των αποτελεσμάτων και στο δεύτερο εξετάζεται η οικονομική τους ακρίβεια. Σύμφωνα με τα αποτελέσματα, τα μοντέλα που θα πρέπει να χρησιμοποιούνται για τη τη διαχείριση του ρίσκου των ναυλαγορών δεξαμενόπλοιων είναι το απλό GARCH και τα μη παραμετρικά μοντέλα. Τα αποτελέσματα επαληθεύθηκαν και στις θέσεις ανόδου και στις θέσεις καθόδου.

ABSTRACT

The fluctuation of the freight rates (shipping freight risk) is an important source of risk for all participants in the tanker shipping markets including ship-owners, charterers, traders, hedge funds, banks, etc. This study examines the freight rate risk involved in the two most popular clean tanker routes (by clean meaning transportation of oil refined products) and two most popular dirty tanker routes (by dirty meaning transportation of crude oil or industrial fuel oil), using historical prices from May 2007 to September 2015 for the routes TC2 (Clean Route from Rotterdam to New York) and TD3 (Dirty Route from Ras Tanura to Chiba) and from April 2008 to September 2015 for the routes TC5 (Clean Route from Ras Tanura to Yokohama) and TD7 (Dirty Route from Sullom Voe to Wilhelmshaven).

The analysis of the historical returns of both spot and future prices reveals historical distributions with high peaks and fat tails. The establishment of a risk management method that could capture these distribution characteristics is of paramount importance. For the quantification of the risk, the Value at Risk approach is used, a method easily understood and communicated by all participants. A range of parametric and non-parametric Value at Risk methods is applied to the four routes spot, one month and three months front future price returns. The results suggest substantial freight rate risk at all four routes. The backtesting process of the Value at Risk models is conducted in two stages, with the first one by means of statistical accuracy of the results and the second one by means of economic accuracy. According to the results, the simple GARCH and non-parametric models should be preferred for risk management purposes, for both spot and future markets. The results are aligned between long and short positions.

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Chapter 1: Introduction

The purpose of this study focuses on establishing a framework which measures the level of the risk exposure for participants in physical and paper tanker freight markets. In order to develop and implement efficient and sound risk management methods, the tanker freight volatility should also be investigated. The price movement is represented by the worldscale's point fluctuations of four major tanker routes, with two of them represent the clean oil products trading and two represent the crude oil trading. For the purpose of this study, the author focuses on TC2, TC5, TD3 and TD7 routes. For each route the spot prices, the 1-Month front and the 3-Months (Quarter) front FFA prices are investigated. At the end of this thesis, the researcher offers suggestions on the most efficient Value at Risk methods for spot, 1-Month front and 3-Months font both in long and short positions, applied in all four routes. To the best of author's knowledge, it is the first time that a study compares the performance between parametric and non-parametric models in the tanker freight futures markets. Also, there are hardly any studies focusing on all market's participants by presenting results for both long and short positions.

The spot freight prices are determined through interaction of supply and demand for freight services. Freight markets are prevailed by conditions of perfect competition. The demand for wet freight services is inelastic as the freight cost represents only a small fraction of the price of the transported commodities. Indeed, the demand is affected by a numerous factors, such as world economic conditions, international seaborne trade, seasonality etc. Similarly, the supply is also affected by a numerous factors such as freight revenue, fleet productivity, shipbuilding production, scrapping levels and service speed.

Shipping freight prices are highly sensitive to shocks in supply and demand. Considering also the huge capital requirements, the seasonality, the sensitivity to the energy markets and the condition of the global economy, freight markets are quite challenging for all participants. Thus, exploring and developing a risk management framework that could capture such peculiar conditions is of paramount importance.

Further in this study, the author focuses on measuring the tanker freight volatility, in order to establish a framework for measuring risk for all the participants in tanker freight markets, whether they are engaged in the physical or paper markets or if they are long or short. The tool that is used for risk measurement purposes, is the Value at Risk method (VaR), a highly used risk management instrument in the banking circles. In few words, Value at Risk informs the user about what is the largest loss that could experience with a certain probability. This method has gained a lot of attention due to its simplicity, making it easily communicated and understood.

The remainder of the paper is structured in the following order. As soon as the topic of this research has been introduced and the foundations of the study have been set, the author investigates the existed research that has been argued. More specifically, chapter two focuses on the literature review where secondary research is applied. Chapter three presents the «The Tanker Market» where the author provides information of the shipping industry and more precisely on how the tanker market operates. Furthermore, chapter four documents the methodology used in this study, which includes: value at risk methodology, non-parametric approach, parametric approach, distributional assumptions and back testing. Following, chapter five presents the data, chapter six the empirical analysis of the findings while chapter seven provides a reasonable conclusion with suggestions on best practice Value at Risk methods.

1.1 Aims and Objectives

In order to explore and develop a risk management framework, this thesis focuses on the historical distribution of freight rates in the shipping tanker market through a secondary research and examines the freight rate volatility using several parametric and non-parametric models.

Particularly, through a primary research this paper aims to provide a deep analysis by quantifying freight rate risk using Value-at-Risk methods where in order to support the evidences, the author back tests the Value-at-Risk using statistical tests. In conclusion, the study aims to offer the best models for each route in spot, 1-Month and 3-Month front for both long and short positions.

Chapter 2: Literature Review

Although Value at Risk methodology for assessing risk exposure has been adapted by many financial institutions and trading companies for many years, it has only been used in shipping very recently, following the growth in the forward freight agreements (FFA) market and the involvement of shipping companies in trading FFAs. As a result, research in the area of the application, relevance and importance of VaR in shipping and FFA markets has been very limited. The accurate calculation of VaR in freight rate markets is important as it will enable the market participants in the freight markets to quantify the freight rate risk that they are exposed to so as to develop effective hedging schemes subsequently. Additionally, it is very important to have knowledge of the possible extreme fluctuations of freight rates since freights are currently viewed as an alternative investment and thus it is urging to quantify the risk profile of this asset class. Lastly, VaR is frequently used to set the margin requirements in the fast developing freight exchange derivatives so as to ensure it grows even further. In the words of Angelidis and Skiadopoulos, "this is of particular importance given that freight derivatives, namely forward freight agreements (FFA's), freight futures and freight options, can be used to hedge freight rate risk" (Angelidis and Skiadopoulos, 2008, pp.449). In their study Angelidis and Skiadopoulos attempt to measure the risk for freight rates through a number of parametric and non-parametric approaches, as well as through adopting an Extreme Value Theory method, for four Baltic exchange indices. They notice that freight rate risk is higher in the tanker freight markets than in the dry freight sector, and conclude that the simplest non-parametric models are superior methods for calculating freight.

Abouarghoub attempts to measure Value at Risk for shipping freight rates of five dirty tanker routs by computing the following models FHS, GARCH-t(d) and EVT, and compering the results with benchmarks such as HS and risk metrics. According to his research, the deployment of EVT could capture extreme non-normality and leverage effects (Abouarghoub, 2008).

Nomikos and Alizadeh in their work "Shipping Derivatives and Risk Management" presented for the first time a comprehensive methodology for the Value at Risk Estimation, The authors provide a complete and thorough overview of the practicalities of the shipping market. The methodologies include analysis and measurement of the impact of financial risks in shipping investments and the selection of the right strategies to mitigate relevant risks (Nomikos and Alizadeh, 2009).

Abouarghoub and Mariscal in their paper analyze freight volatilities for tanker freight returns, since they recognize it as a major issue for participants in freight markets. The understanding of freight volatility measures is vital in improving ship-owners profitability, and reducing financial risk exposure for investors and shipping portfolio managers. In detail, the study focuses in the five most liquid dirty tanker routes. They measure the risk exposure by using a non-parametric and a parametric method based on a GARCH model structure combined with an extreme value approach to measure conditional volatility. They also introduce a two state regime markov-switching framework to investigate the possibility of two different volatility structures in shipping tanker freight markets. The authors conclude that FHS based methods produce the most accurate results and also that tanker freight volatility depends on high and low state, something that explains the volatility clusters. "The vast and growing shipping derivative markets provide the necessary hedging tools for ship-owners and charterers to manage their freight risk exposures, provided those exposures are fully-understood" (Abouarghoub and Mariscal, 2011, pp.23). Further on the literature, Kavussanos and Dimitrakopoulos focus on four dirty routes and two Baltic indices. They investigate the distributions of the indices and the routes and examine the volatility with the usage of several Value-at-Risk methods. They conclude that simpler risk measurement methods should be selected in preference to more complex methods for freight rates.

The thesis contributes to the literature by examining the performance of several parametric and non-parametric Value at Risk models, in capturing the risk of the shipping freight future tanker markets and attempts to establish a risk management framework for all its participants. Furthermore, contributes with illustrations and characteristics of the distributions and examines the volatility of the spot tanker freight rates for a more recent time period compared to existing research.

Chapter 3: The Tanker Market

Tankers are ships that transport liquids, gases, or specialized items. In the shipping market these commodities are referred to as "wet cargos" while grain or coal are referred to as "dry cargos". In comparison, there are two major types of oil tankers; crude and product tankers. Crude tankers transport the various grades of crude oil, industrial fuel oil and some condensates while on the other hand, product tankers transport refined petroleum products such as gasoline, jet fuel and diesel.

Beyond the two major tanker sectors of crude and product there are multiple sub-sectors which are generally based on vessel size. The five major sub-sectors or also known as “asset classes” of crude tankers are classified as: Very Large Crude Carriers (VLCC), often referred to as supertankers given their size as the largest tankers in the world; Suezmaxes which are the largest vessels that can navigate through the Suez Canal; Aframaxes often used as utility vessels; Panamaxes with maximum beam of 32m and Handysizes that are engaged in regional trades.

Oppositely, the product market has four asset classes: The Long Range 2 (LR2) which are equivalent in size to Aframaxes; the Long Range 1 (LR1) which are also referred to as the Panamax class; the Medium Range 2 (MR2); the Medium Range 1 (MR1) which are also referred to as the Handysizes class and the recently built LR3 carriers, equivalent to Suezmaxes vessels. It is worth mentioning that the largest tankers in the world today are the ULCCs (ultra-large crude carriers) although the manufacturing stopped in 2003. Likewise, there are also small product carriers, however their volumes and trade patterns primarily serve niche markets.

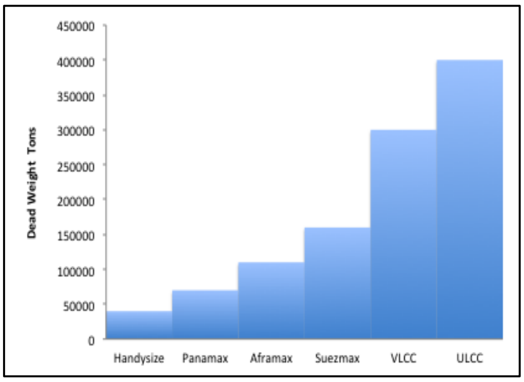


Figure 1: Crude Tankers Dwt (Source: Clarksons)

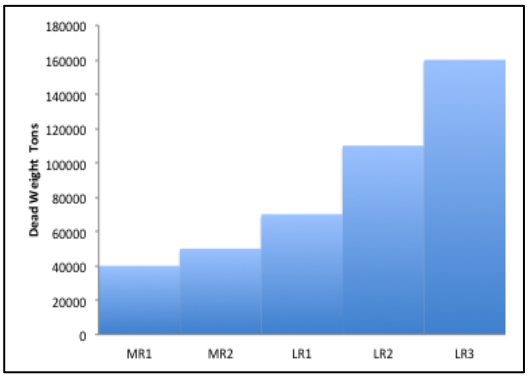


Figure 2: Product Tankers Dwt (Source: Clarksons)

Crude Tankers Crude oil is transported from production sites to refiners or terminals.

VLCC (~300,000 dwt) have a carrying capacity of ~2M barrels of crude oil and are typically used to transport oil from the Middle East and West Africa to Asia, North America, and Europe.

Suezmaxes (~160,000 dwt) have a carrying capacity of ~1M barrels of crude oil and are typically used to transport oil from West Africa and the Middle East to North America and Asia.

Aframaxes (~110,000 dwt) have a carrying capacity of ~700k barrels of crude oil and are most versatile of the major tanker classes due to their size. Aframaxes have accessibility to the majority of ports and waterways. Major trade regions for Aframaxes include the Caribbean, North Sea, Mediterranean, and intra-Asia.

Panamax (~70,000 dwt) have a carrying capacity of ~450k and are the largest vessels that can navigate the Panama Canal. Their beam is about 32 meters.

Handysizes (~40,000 dwt) have a carrying capacity of ~250k. Due to their LOA (Length over all) of less than 185 meters, these vessels can be facilitated by more ports than the remaining, something that engages them also in regional trades.

Product Tankers. Refined petroleum products are transported in smaller quantities and product tankers have segmented tanks allowing the transportation of multiple cargoes. Refined products are transported from refineries and terminals to end users and terminals.

LR2s (~110,000 dwt) are the largest product tanker asset class and are classified as Aframaxes. LR2s are primarily used on long-haul product cargo voyages such as the Middle East to Far East.

LR1s (~70000 dwt) are also referred to as Panamaxes. LR1s are used for both long-haul and regional trades.

MR2s (~50,000 dwt) are the workhorse of industry and is by far the largest of the product tanker sub-sectors in terms of number of ships. The bench mark MR trade is from Europe to the US and is referred to as the TC2 voyage.

MR1s (~40,000 dwt) are typically used for short-haul trades.

Whether crude or product, tankers generally have a useful life of 20-25 years.

3.1 Wet Cargo

The major commodities carried on tankers are crude oil, from now-on referred as "crude" (unprocessed oil) and refined products (diesel, gasoline, fuel oil, heating oil, kerosene, jet fuel).

Likewise, product tankers are also classified as "Dirty" or "Clean" where Dirty include products such as fuel oil and crude oil while gasoline and jet fuel are classified as Clean. In addition, product tankers can be classified as chemical tankers that carry organics such as crude and natural gas derivatives; inorganics such as sulfuric and phosphoric acids, fertilizer, and edible oils such as palm and soybean oil. Whereas other specialized tankers carry asphalt and bitumen, fruit juice, methanol, waste, phosphoric acid, molten sulphur, and slop reception. Not surprisingly, the product tanker market is a traders market with arbitrage opportunities driving some cargo moves.

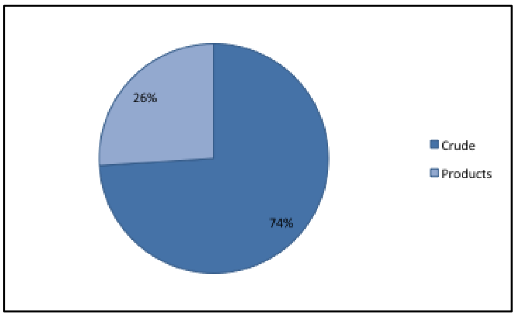


Figure 3: Seaborne Split Wet Cargoes (Source: Clarksons)

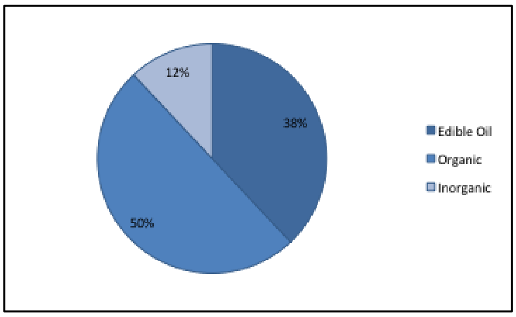


Figure 4: Seaborne Split Chemical Cargoes (Source: Clarksons)

3.2 Chartering

One of the main sources of income of ship owners is by charging customers for the transportation of crude and products cargoes. Contrariwise a ship broker mediates the details of the contract such as cargo, location, delivery date and the charter rate. While charterers or customers include National oil companies, major integrated oil companies, traders, refiners, governments, etc.

The three ways to employ a vessel are: on a spot charter, on a time charter, or on contract of affreightment (COA).

Spot Charters are short-term voyages (usually one trip) that capture current market pricing. At spot charters the ship owner pays voyage expenses (e.g fuel, port charges) and vessel operating expenses. The spot market is volatile and the most profitable in an up-cycle, tending ship owners wanting their vessels to be on the spot market in a rising market.

Time Charters are long-term contracts and tend to be less volatile than spot rates both on the downside and the upside. Unlike spot charters, charterers pay voyage expenses where ship owner pays vessel operating expenses. Time charters provide more stability of earnings and are more profitable than spot charters in a down cycle. For example, bareboat charter is a type of time charter where the charterer pays for both voyage and operating expenses with a fixed rate to the ship owner.

Contract of Affreightment (COA) is an agreement between a ship owner and a charterer for one or multiple cargoes whereby the owner provides a ship to the charterer for carry a specified amount of cargo over a stated time period. COAs benefit larger owners since they provide the guaranteed employment and flexibility. In addition, no vessel is specified and the delivery date(s) are flexible.

Indeed the methods of payment as well as the freight calculations and cost allocations vary depending on the type of charter contract agreed. As mentioned above, for the spot charters the ship owner is responsible for the voyage costs, while for the time charters responsible is the charterer.

As Alizadeh and Nomikos state in their work, assuming that shipping freight markets are efficient, there should not be any difference between the discounted present value from an n period TC^n contract and the discounted present value earnings from a of spot voyage with n duration also (Alizadeh and Niminos, 2009).

$$\frac{TC^n}{(1+r)^i} = \frac{WS \times FR - VC}{(1+r)^i}$$

Equation 1: TC earnings should equal TCE earnings

For the purpose of comparing net operating earnings from TC contracts with net operating earnings from spot contacts, a TCE (Time Charter Equivalent) is calculated for the spot voyages.

$$\frac{WS \times FR - VC\ (Bunkers + Port\ Expenses + Broker\ Commissions)}{Voyage\ Days^{1}}$$

Equation 2: TCE calculation

[1] The voyage days are calculated from time of completion of last discharge operation of previous voyage to time of completion of last discharge operation of current voyage.

3.3 Fixing on Spot or Time Charter

As expected spot charters are more profitable and more volatile over the cycle assuming that more risk means more return. Undeniably, one of the most important factors that define the chartering strategy of ship owners is their expectation of the market. A bullish owner for example would most likely keep his fleet on spot to maximize exposure to a potentially rising spot market. On the other hand, a bearish owner would seek security of fixed rate charters to manage through a soft patch. At the same time, vessel operating costs are relatively fixed giving owners a high degree of operating leverage.

Additionally, while counter party risk is always a concern the two things benefit tanker charter contracts are: The UK law which gives customers little wiggle room in their contracts except for bankruptcy and the value of the cargo. For example, at today's oil price a VLCC customer would have to use the vessel 2,000 days at $60k/d to equal the value of the crude on board.

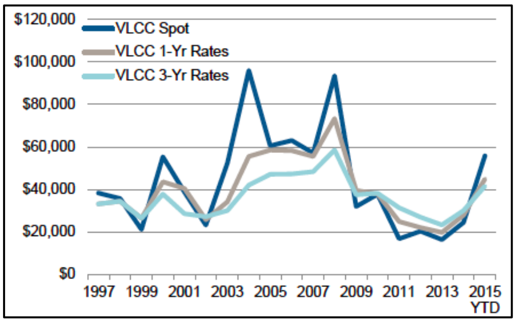


Figure 5: VLCC Charter Rates (Source: Clarksons, Credit Suisse

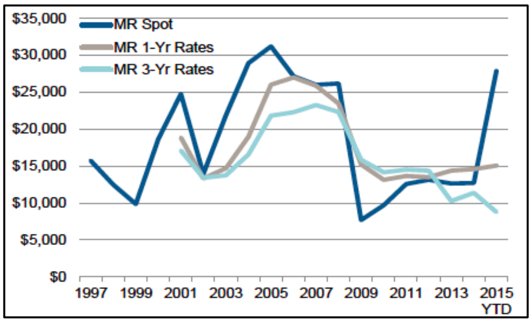


Figure 6: MR Charter Rates (Source: Clarksons, Credit Suisse, ICAP)

3.4 Charter Rates Drive Asset Prices

Usually the value of a ship is the value of its cash flows thus near term charter rates drive vessel values. Looking at figure 7, the 1-Yr VLCC time charter rate and 5-year old VLCC asset prices, the correlation is strong at 0.9. Also, as seen in figure 8 the correlation is also strong for MRs and the 1-Yr time charter rate and 5-year old prices with a correlation of 0.9. The correlation with spot rates and vessel values was also strong but below time charter rates owing to volatility.

3.4.1 New build Values Driven by the Ship Building Cycle

Similarly, charter rates drive second hand asset prices while the correlation between rates and new build prices is much weaker. That is because new build prices are more of a reflection of cost of production and the shipbuilding industry's pricing power. For example, turnaround time between ordering a ship and taking delivery of that ship is 24-30 months. Thus, the near term charter market has virtually no impact on a new build tankers earnings ability.

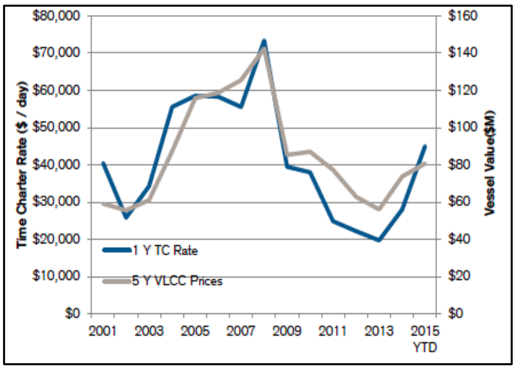


Figure 7: 1 year TC VLCC Rates and 5 year old VLLCC Prices (Source: Clarksons, Credit Suisse)

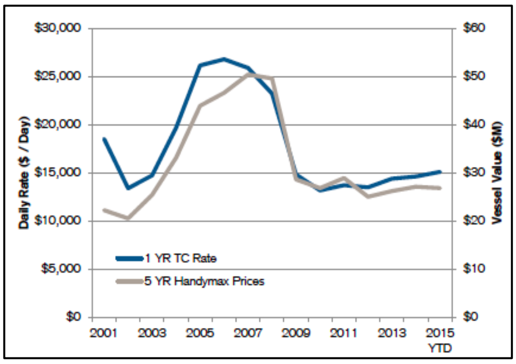


Figure 8: 1 year MR rates and 5 year old Prices (Source: Clarksons, Credit Suisse)

3.5 Charter Rates and Utilization

3.5.1 Formation of spot rates is supply-demand equilibrium.

As is commonly accepted, the industries' and markets' spot freight rates are dependent on supply and demand factors. The shipping industry considered as a global industry is affected by several factors worldwide, while various routes might be influenced differently by the same occurrence. Table 1 below, summarizes the most important factors affecting the supply and demand, and hence the formation of spot freight rates.

Demand	Supply
World Economy	World Fleet
Seaborne Commodity trades	Fleet productivity
Average haul	Shipbuilding production
Random shocks	Scrapping and losses
Transport Costs	Freight Revenue

Table 1: Factors affecting Supply-Demand (Source: Stopford, 2009)

Although the Tanker's fleet utilization is difficult to track, the outcome gives an indication of the strength of the tanker market. However, most public companies often quote that their tanker fleet utilization range is up to 90% high even though it can be rather misleading since it does not capture the industry as a whole. On the other hand, vessels on time charter have 100% utilization for the vessel owner and this is because the owner is paid on a daily rate regardless of whether the vessel is on duty or not. However in the spot market the utilization is volatile, hence many of the larger tanker owners that focused on the spot market do not report utilization.

3.5.2 High utilization drives charter rates higher

The supply and demand balance is tight while there is a scarcity of ships (current status of the market). In up-cycles all ships regardless of quality, tend to find employment. On the flip side, on low utilization where there are too many ships but not enough cargoes, the charter rates drop. Likewise, weak markets see tonnage lay idle in search of work.

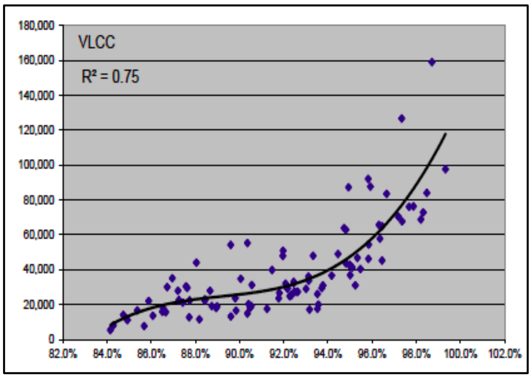


Figure 9: VLCC utilization versus spot rates (Source: Marsoft, Credit Suisse)

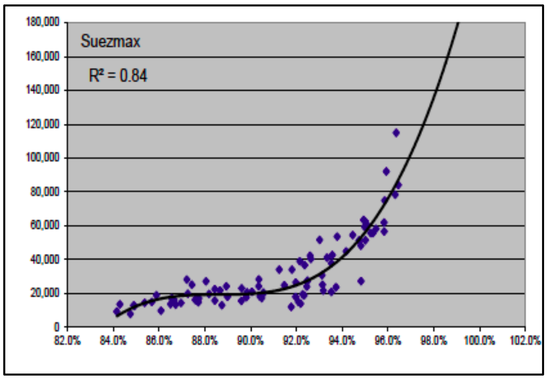


Figure 10: Suezmaxes utilization versus spot rates (Source: Marsoft, Credit Suisse)

3.5.3 Utilization and Rates Not A Linear Relationship

It is worth mentioning that in late 2014 an increase in VLCC utilization drove spot charter rates to over $70,000/d in November from $10,000/d at the end of September. As a result, higher utilization can drive exponential spikes in charter rates. Nevertheless, utilization can also go down which could push spot rates lower quickly.

3.6 World Scale

World tanker nominal freight scale is usually referred to as "Worldscale". This is an index provided as a joint venture between two non-profit organizations, the Worldscale Association Limited (London) and the Worldscale Association Inc. (New York). Both companies are under control of a Management Committee, consisting of senior brokers from leading tanker broking firms in London and New York.

	TC2	TC5	TD3	TD7
2005	7.56	13.14	13.39	4.45
2006	8.52	14.19	15.16	4.74
2007	9.97	17.47	17.72	5.09
2008	10.2	17.8	18.05	5.4
2009	13.78	24.71	25.00	6.53
2010	10.53	18.42	18.72	5.59
2011	12.56	22.33	22.61	6.3
2012	14.95	26.65	26.95	7.11
2013	16.30	29.68	29.98	7.36
2014	15.48	27.85	28.13	7.73
2015	15.41	27.21	27.53	7.85

Table 2: Worldscale flat rate quoted as USD/mt per day (Source: Worldscale)

Based on Stopford study, Worldscale flat rate represents the cost of chartering a tanker for a specific voyage at a given period of time. Additionally, the flat rate is quoted in Worldscale 100, which is the price in dollars per ton for carrying oil at the given rate (Stopford 2009). When the spot price or contract is given in Worldscale points, it represents a percentage of the flat rate value. For instance, if the quoted price for TD3 is 65 Worldscale points it means 65% of the flat rate. If the flat rate is 10 USD/mt per day it means that the actual price per metric ton is USD 10 * 65% = 6.5 USD/mt per day. In order to obtain the amount of freight this rate has to be multiplied by the total tons of the cargo. If an FFA contact is the case, then actual contract value results from the product of this rate with the lot size and the number of lots.

In order for the flat rates to be calculated the following assumptions are taken into consideration:

World Scale	
Vessel	Panamax
Service Speed	14,5 knots
Bunkers Consumption	55 tons/day
Port Time	4 days
Canal Transit Time (PNM)	24 hrs
Canal Transit Time (SZ)	30 hrs
Bunker Price	Last year's avg prices

Table 3: Worldscale Flat Rate Assumptions (Source: Worldscale)

The flat rate is then calculated in order for the resulted TCE (Time Charter Equivalent) to equal $ 12,000 per day.

Depending of the vessel size and the supply & demand equilibrium, the Worldscale points for a specific voyage are agreed accordingly. For example, a Panamax vessel with a voyage from Middle East Gulf to North Asia will be fixed with a higher Worldscale points from a VLCC due to the economies of scale that must favor the charterer of the second one. Similarly, if the demand for tanker transportation decrease within a year, the Worldscale points will be decreased also.

3.7 Freight Market Derivatives

Alizadeh and Nomikos state that "the derivatives market consists of financial instruments for trading in future levels of freight rates. The first exchange was established in the early 1980s. Ship owners, charterers and other parties involved in shipping wanted to apply the financial risk-management techniques, such as hedging using forwards, futures, swaps and options" (Alizadeh & Nomikos, 2009). This resulted in the first daily freight index, the Baltic Freight Index (BFI), published by the Baltic Exchange in January 1985. The BFI was first produced by a board of shipbrokers around the world, which gave their valuation of dry cargo routes. Traders could then buy or sell standardized contracts, known as futures contracts, for settlement against the BFI. All of the traders were registered with a clearinghouse and their portfolio was "marked to market" at the close of each trading day. The registration of trades with a clearinghouse was done in order to deal with the credit risk. "Since 1985 the derivatives market has developed, but the Baltic Exchange is still the leading exchange" (Alizadeh & Nomikos, 2009). Today there are more than 40 daily routes, forward prices, a sale and purchase index, fixture lists and market reports available at the Baltic Exchange.

	Dirty Routes	
TD1	Ras Tanura (MEG) - LOOP (USG)	280k
TD2	Ras Tanura (MEG) - Singapore (SPORE)	260k
TD3	Ras Tanura (MEG)- Chiba (JPN)	260k
TD4	Off Bonny (WAF) - LOOP (USG)	260k
TD5	Off Bonny (WAF) - Philadelphia (USAC)	130k
TD6	Novorossiysk (BS) - Augusta (MED)	130k
TD7	Sullom Voe (NS) - Wilhelmshaven (CONT)	80k
TD8	Mina al Ahmadi (KWT) - Singapore (SPORE)	80k
TD9	Puerto la Cruz (CARIBS) - Corpus Christi (USG)	70k
TD10	Aruba (CRBS) - New York (USAC)	50k
TD19	Ceyhan (MED) - Lavera (MED)	80k

Table 4: Baltic International Tanker Dirty Routes

Clean Routes		
TC1	Ras Tanura (MEG) - Yokohama (JPN)	75k
TC2	Rotterdam (UKC)- New York (USAC)	37k
TC3	Aruba (CRBS) - New York (USAC)	30k
TC4	Singapore (SPORE)- Chiba (JPN)	260k
TC5	Ras Tanura (MEG)-Yokohama (JPN)	55k

Table 5: Baltic International Tanker Clean Routes

The shipping derivatives market is still a developing market and is characterized by low volumes in several routes. Tanker derivatives give a trader an opportunity to take a position in the tanker freight market. Derivatives then can be used to reduce the risk exposure to an existing position, or speculate to possibly increase profits. As seen on Alizadeh and Nomikos study, the tanker derivatives market contains several financial instruments, and Forward Freight Agreements (FFA) are the most frequently used derivatives in shipping today (Alizadeh and Nomikos, 2009).

In an attempt to define the FFA, Alizadeh and Nomikos described it as an "agreement between two counterparties to settle a freight rate or hire rate, for a specified quantity of cargo or type of vessel, for one or a basket of the major shipping routes in the dry bulk or the tanker market at a certain day in the future" (Alizadeh and Nomikos, 2009). The underlying asset of these contracts is a freight rate assessment for the appurtenant shipping route.

In the late 1990s FFA replaced futures contracts, which allowed the trader to customize the contract. The FFAs key feature are also known as principal-to-principal contracts, usually arranged by a broker. However, it can also be traded on screens provided by a number of freight derivatives brokers (Stopford, 2009). The arrangement of FFAs is similar to the way shipping has traditionally arranged time charters but no physical commitments are involved.

FFAs are traded either over-the counter (OTC) or through hybrid exchanges. The Figure below presents the trading structure for the FFA market.

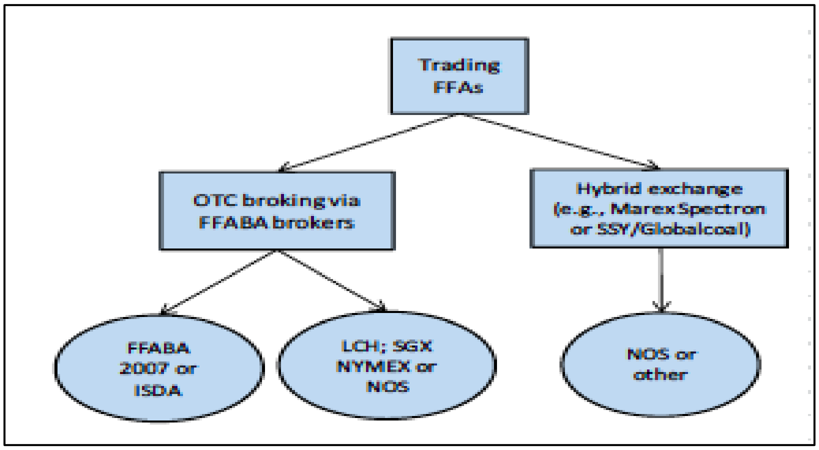


Figure 11: Trading structure for the FFA market (Source: Alizadeh & Nomikos, 2009)

The leading hybrid exchanges are Marex Spectron, previously International Maritime Exchange (IMAREX), SSY and Globalcoal, which all provide a marketplace for standardized FFAs. They are then cleared straight through the Norwegian Futures and Options Clearing House (NOS). Trades executed through Marex Spectron are known as "straight-through clearing", which means that the trades are automatically cleared (Stopford, 2009).

The contract prices are quoted in Worldscale points. Equation 1 describes the calculation of the FFA contract value.

$$Contract\ Value = No\ Lots\ \times Lot\ Size\ \times World\ Scale\ Flat\ Rate\ \times (Contract\ Price\ \div 100)$$

Equation 3: Contract Value Calculation

Chapter 4: Methodology

4.1 Descriptive statistics

4.1.1 Distribution theory

The normal distribution has been extended used in academia although it is broadly known that the normal distribution theory does not hold in most of the real world situations. The reason is that distributions of the returns often have high peaks and fat-tails, a very important fact to consider when developing risk management methods.

There are many applications of the bell-shaped normal distribution. In fact, many variables will follow a normal distribution. If the price of an asset is log normally distributed the returns should be normally distributed, this is for example an assumption in the Black-Scholes-Merton option pricing formula. According to Bodie et al. the reasons why investment management is far more tractable when rates of returns are assumed to exhibit a normal distribution are the following:

1. The normal distribution is symmetric and the probability of any positive deviation above the mean is identical to a negative deviation of the same magnitude. Absent symmetry, measuring risk as the standard deviation of returns is inadequate.

2. The normal distribution belongs to a special family of distribution characterized as "stable" because when assets with normally distributed returns are used to construct a portfolio, the portfolio returns are also normally distributed.

3. Scenario analysis is greatly simplified when only two parameters (mean and standard deviation) need to be estimated to obtain the probabilities of future scenarios.

These three reasons are to "blame" for the popularity of the assumption that prices and returns are normally distributed, since they simplify investment and risk management analysis. Nevertheless, has been empirically proved that high peak and fat tails do exist in the real world. Villfredo Pareto was one from the first that looked at the fat-tailed distributions of income and developed an early theory for such distributions in the late 1800s (Haug, 2007). Pearson in his work introduced the idea that actual distributions differed from the normal distributions in terms of peakness, where Wesley C. Mitchell, on the other hand, was the first to empirically detect and describe fat-tailed distributions in price data in 1915.

Based on Mandelbrot and to the best of his knowledge, Oliver and Mills in their studies accordingly, were the first who provided the unquestionable evidence that empirical distributions of price changes are usually too "peaked" to be normally distributed (Mandelbrot, 1963). But then, in the late 1960s and early 1970s, several ground breaking models were published assuming that normal distribution existed in reality, although it had been proven otherwise already in the beginning of the 19th century. The distribution theory has however regained its attention in academia from the 1980s onwards. Researchers have attempted to develop normality tests against heavy tailed and high peaked distributions (Ruppert 1987; Bonett and Seier 2002; Gel, Miao and Gastwirth 2007; Gel ad Gastwirth 2008; Jarque and Bera 1980; Bowman and Shenton 1975), something that has contributed to enlighten the presence of fat-tails and high-peaks.

4.1.2 Coefficient of kurtosis

The coefficient of kurtosis, also known as the fourth moment of a variable around its mean, is a statistical measure used to describe the "peakness" of a distribution. The term of kurtosis originated from Greek, meaning bulging or convexity. Karl Pearson was the first to use the concept of kurtosis. The normal distribution is considered a mesokurtic distribution and has an estimated sample kurtosis of 3 (Karl, 1905). A distribution with a higher peak than a normal distribution's, also known as leptokurtic distribution, results a sample kurtosis >3. This practically means that very small and very large returns, are more likely to occur, in opposition to the medium-sized returns that are more frequently expected if K=3. On the other hand, if the sample kurtosis is <3, the sample distribution is relatively flat compared to the normal distribution. A flat distribution is also called a platykurtic distribution. Modern definitions of kurtosis acknowledge the fact that kurtosis will be influenced by both the peakness and the tail weight of a distribution and can be formalized in many ways (Ruppert 1987). However this thesis reports the Fischer kurtosis, also known as excess kurtosis (K-3). This is an adjusted version of the Pearson kurtosis, where a normal distribution has an estimated sample kurtosis of 0. The sample Fisher kurtosis is given by the following formula.

$$\boldsymbol{K} = \left\{\frac{\boldsymbol{n}(\boldsymbol{n}+\mathbf{1})}{(\boldsymbol{n}-\mathbf{1})(\boldsymbol{n}-\mathbf{2})(\boldsymbol{n}-\mathbf{3})}\sum\left(\frac{\boldsymbol{x_i}-\overline{\boldsymbol{x}}}{\boldsymbol{\sigma}}\right)^{\mathbf{4}}\right\} - \frac{\mathbf{3}(\boldsymbol{n}-\mathbf{1})^{\mathbf{2}}}{(\boldsymbol{n}-\mathbf{2})(\boldsymbol{n}-\mathbf{3})}$$

Equation 4: Calculation of Fischer Kurtosis, where n is the number of observations

4.1.3 Coefficient of Skewness

The coefficient of skewness indicates whether or not the distribution of a sample or population is skewed around its mean. Except from kurtosis, Karl Pearson was also the first to introduce the term skewness (Pearson, 1895).

$$S = \frac{n}{(n-2)(n-3)} \sum \left(\frac{x_i - \bar{x}}{\sigma}\right)^3$$

Equation 5: Calculation of Skewness, where n is the number of observations

If the coefficient of skewness S = 0, the distribution of the sample is symmetric around its mean. It has been empirically observed in literature that actual distributions of returns are often slightly skewed to either the left or the right. If S > 0; the distribution is positively skewed with a majority of positive observations. On the other hand, if S < 0, the distribution is negatively skewed with a majority of negative observations.

4.1.4 Jarque-Bera Normality Test

The most broadly used normality test is the Bowman and Shenton statistic. The test derived by Carlos Jarque and Anil K. Bera also known as the Jarque-Bera Lagrangian Multiplier test or Jarque-Bera test (JB test), (Jarque and Bera, 1980). This is a goodness-of-fit test of whether a sample has kurtosis and skewness equal to the normal distribution of K=0 and S=0. However, the JB test and other classical normality tests do not necessarily work very well under all conditions and sample sizes. Although the JB test turns out to be superior in power to its competitors for symmetric distributions with relatively long tails, the test is poor for small samples, asymmetric distributions and distributions with short tails (Thadewald and Böning 2007; Mantalos 2010b). To overcome this problem different modifications or approaches to the JB test have been suggested. Mantalos in his study tested the power of these modifications on different sample sizes and concluded that his own method of creating robust "sample" critical values for the JB test is superior to the other evaluated tests for all sizes of samples (Mantalos, 2010a). Nonetheless there is no available criticism in literature for his method. However, the research done by Mantalos shows that all tests perform well for large samples. Since, this thesis use more than seven years of daily data, the samples can be considered large enough. Hence, the JB-statistic is sufficient to test for normality.

$$JB = \frac{n}{6}\left(S^2 + \frac{1}{4}K^2\right)$$

Equation 6 : Calculation of JB, where K is the Fischer's Kurtosis, S is the Skewness and n is the number of observations

4.2 Value at Risk Methodology

Value at risk refers to maximum amount in money terms, which an investor is likely to lose over some period of time at a specific confidence level. In fact, Value at Risks are calculated from the 90th to 99.9th percentiles, depending for the reason are calculated for; in this thesis value at risks are calculated at the 90^{th}, 95^{th} and 99^{th} confidence levels. VaR is estimated in the form:

$$VaR = SD \times Z_a$$

Equation 7: VaR Estimation

Where SD is standard deviation and Z is standardized returns, which are assumed to be i.i.d. N(0,1) . This thesis attempts to contribute in the study of modelling freight rate volatility and measure the risk exposure. Once, an appropriate forecast for standard deviation is calculated with one of the models that will be used, same is substituted in the Value at Risk formula to obtain one step ahead estimate of the maximum loss. Thus the value at Risk is computed using a two-step process. Firstly, an appropriate method is set up for estimating the conditional volatility and secondly a distribution assumption is used for the returns. This thesis uses the normal distribution, the Student's t distribution and the generalized error distribution to compute one day 1%, 5% and 10% Value at Risks estimates.

4.2.1 Volatility estimation

Volatility is one of the most important and widely used measures in finance, and the standard deviation of the returns is often used as a measure for the total risk of an asset (Brooks, 2008). Estimating volatilities is necessary for the valuation of derivatives and the calculation of Value-at-Risk. The simplest and the most straight forward way to estimate volatility is to calculate the historical constant variance and then the standard deviation of a sample or a population. However, the historical constant standard deviation is not a precise measure of the volatility (Hull, 2012). Mandelbrot was the first to discover and mention the phenomenon of volatility clustering. He noticed that a large price change tends to be followed by another large price change and vice versa (Mandelbrot, 1963). This discovery has inspired academics to investigate and model the behavior of variance in financial time series, and today it is a well-known fact that volatility is usually are time-varying or stochastic (Alizadeh and Nomikos, 2009). Assuming constant volatility, may lead to incorrect estimates of the actual risk. Thus, it is important to deeply understand the volatility.

Over the past decades several volatility estimation models or methods have been developed. For instance, the Rolling Window, the Exponential Weighted Moving Average (EWMA) model, the GARCH and its extensions, and stochastic volatility models, with the last have been initially developed by Heston 1993; Hagan et al.2002; Bookstaber and Pomerantz 1989. However, there is no best-fit model for capturing the volatility in general. The empirical use of stochastic volatility models has been more limited due to difficulties attached to their estimation of their parameters (Alizadeh and Nomikos, 2009).

4.2.1.1 Parametric Volatility Measurements

4.2.1.1.1 Rolling Window

Klein in his study tried to capture the dynamics of the volatility of stocks using a Rolling Window, also called moving-window or moving-average-variance. This method is based on the most recent observations in a time series and detects if the volatility changes over time (Klein, 1977). For example, for a sample of 1,000 observations, the volatility can be estimated by calculating the standard deviation of the first 100 observations. One observation is then excluded at the beginning of the sample and one is included at the end. Continuing this way gives a continuous series of 901 observations with volatility for the 100 previous observations.

There are no firm rules concerning the choice of data sampling frequency or the number of lags to include (Andreou and Ghysels, 2002). The sampling frequency depends on the available time series and the research purpose. The Fama and MacBeths method that used monthly data and 60-month lags, has been widely used in academia. Another way is to use daily data and take monthly sums, using only returns within one calendar month (French, Schwert and Stambaugh, 1987). However, this method’s resulted volatilities would be constant for each calendar month. The Rolling Window is not a very accurate method. Nevertheless, practitioners compute daily volatilities using this scheme applied to a daily and monthly sampling frequency, in order to provide an illustrative overview of the volatility and its variation over time (Alizadeh and Nomikos, 2009).

The most common parametric Value at Risk method that uses the rolling window volatility estimates is the model building approach.

4.2.1.1.2 Exponentially Weighted Moving Average (EWMA)

EWMA is estimated by the following equation

$$\sigma_n^2 = \lambda\sigma_{n-1}^2 + (1-\lambda)\varepsilon_{n-1}^2$$

Equation 8: EWMA calculation (Source: Hull (2012) page 500)

Where σ^2 is the variance rate, ε is the daily percentage change in the variable and λ is a constant between zero and one. It has been proved that λ=0.90-0.98 is sufficient to capture the dynamics of time varying volatility, and in this thesis will be used λ=0.94, which is best suited for daily data and also used by Risk Metrics (Hull 2012, Alizadeh and Nomikos 2009).

4.2.1.1.3 GARCH Model

Engle at his work described ARCH as "a mean zero, serially uncorrelated processes with non-constant variances conditional on the past, but constant unconditional variances". ARCH models can be very accurate in estimating time series volatilities (Engle, 1982). In addition, according to Danielsson the behavior of the time series is driven by three statistical characteristics (Danielsson, 2011):

1. volatility clusters
2. fat tails
3. nonlinear dependence

Following Mandelbrot and Nelson studies, they both defined volatility clustering as the phenomenon where large returns tend to be followed by large returns and small returns by small returns. Thus, periods of large returns are followed by periods of small returns and vice versa (Mandelbrot 1963; Nelson, 1991).

The distribution characteristic of fat tails practically means that large positive or large negative observations in financial data occur more frequently as compared to the standard normal distribution. Nonlinear dependence explains the relationship between multivariate financial data. For example, nonlinear dependence between different assets can be observed during financial crisis, where many assets are likely to move together in the same direction relevant to some market conditions (Danielsson, 2011).

Letting ε_t be a random variable, where in this thesis it is the World Scale rate time series expressed in daily returns, with a zero mean and variance conditional on the past time series. According to Engle ε_t is calculated as:

$$\varepsilon_t = \sigma_t z_t$$

Equation 9: Standardized Returns

Where z_t is a sequence of independent, identically distributed random variables with zero mean and unit variance. Typically, the distribution of z_t is assumed to be normal or leptokurtic (Terasvirta, 2006). However this thesis uses normal, Student and GED distribution assumptions that are analyzed in depth in the forthcoming parts.

The conditional variance of the ARCH model of order q is estimated by:

$$\sigma_t^2 = w + \sum_{i=1}^{p} a_i \varepsilon_{t-i}^2$$

Equation 10: Calculation of Arch (q), where $w>0$, $a_i>0$

Bollerslev suggested that generalized ARCH models, also known as the GARCH models (Bollerslev, 1986). The GARCH (q, p) is estimated by:

$$\sigma_t^2 = w + \sum_{i=1}^{p} a_i \varepsilon_{t-i}^2 + \sum_{i=1}^{q} \beta_i \sigma_{t-i}^2$$

Equation 11: Calculation of Garch (q, p)

For the calculation of the plain GARCH model, it is necessary to be imposed conditions, such as $w > 0, a_i > 0, \beta_i > 0$ and $\sum_{i=1}^{p} a_i + \sum_{i=1}^{q} \beta_i < 1$ in order positive, stationary and non-explosive conditional variance to be obtained. The significance of the parameter β_i indicates the dependence of the current value of the conditional variance on its lagged values. If the parameters of the lagged squared errors and variance are not statistically significant, then the variance in equation is constant.

The number of the lagged error p and variance q terms in the variance equation is called the order of ARCH (p) or GARCH (p, q) model.

This study uses GARCH models of orders q=1 and p=1 in estimating VaR for their simplicity and reliability that it offers, since it captures the dynamics of the variance quite adequately. GARCH (1, 1) is estimated by:

$$\sigma_t^2 = w + a_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2$$

Equation 12: Calculation of Garch (1, 1), where $w > 0$, $a_1 > 0$, $b_1 > 0$

4.2.1.1.4 EGARCH Model

Back in 1991 Nelson in order to overcome three main drawbacks of ordinary GARCH models introduced the exponential GARCH model (Nelson, 1991). The three main drawbacks that he had noticed were the following:

1. The negative correlation between current and future returns that GARCH models failed to incorporate in the assumptions
2. Necessary parameter restrictions
3. The fact that GARCH models were not recognizing and considering the asymmetric variance effects

According to Terasvirta thesis, EGARCH (q, p) is estimated by:

$$\log \sigma^2 = w + \sum_{i=1}^{p} [a_i \varepsilon_{t-i} + \lambda_i(|\varepsilon_{t-i}| - \mathrm{E}|\varepsilon_{t-i}|)] + \sum_{i=1}^{q} \beta_i \log \sigma_{t-i}^2$$

Equation 13: Calculation of EGarch (q, p), where $a\varepsilon_{t-1}$ is a sign or asymmetry effect $\boldsymbol{\lambda_1}(|\boldsymbol{\varepsilon_{t-1}}| - \boldsymbol{E}|\boldsymbol{\varepsilon_{t-1}}|)$ is a magnitude effect

The functional form of the innovations, used in the model, allows the variance to respond differently to positive and negative shocks. So, if the coefficient of standardized residual is negative and significant, then negative shocks tend to increase the conditional variance and vice versa. The asymmetric effect of shocks with different sizes is captured by construction because the model is specified in exponential form. Thus, as long as the coefficient of the term which represents the difference between the size of the shock at time t and the expected value of the shock, is statistically significant, it indicates that larger than average shocks tend to increase the volatility relatively more compared to smaller than average shocks.

This thesis uses the EGARCH (1, 1) for simplicity and reliability reasons.

$$\log \sigma^2 = w + a_1 \varepsilon_{t-1} + \lambda_1(|\varepsilon_{t-1}| - \mathrm{E}|\varepsilon_{t-1}|) + \beta_1 \log \sigma_{t-1}^2$$

Equation 14: Calculation of EGarch (1, 1), where $a\varepsilon_{t-1}$ is a sign or asymmetry effect $\boldsymbol{\lambda_1}(|\boldsymbol{\varepsilon_{t-1}}| - \boldsymbol{E}|\boldsymbol{\varepsilon_{t-1}}|)$ is a magnitude effect

Where the part $\lambda_1(|\varepsilon_{t-1}| - \mathrm{E}|\varepsilon_{t-1}|)$ constitutes the magnitude effect. Since the logarithm is always positive, EGARCH models do not need implied positivity constraints. Also asymmetry depends on the coefficient a. For instance, when a<0, $\log \sigma_t^2$ would be greater than its mean w if $\varepsilon_{t-1} < 0$ and it would be smaller if $\varepsilon_{t-1} > 0$. This means that when a<0 negative news have greater effects than positive news. On the other hand, when a > 0 positive news have larger effects on the conditional variance than negative news. This shows us typical asymmetry of the financial time series. The meaning of $\mathrm{E}|\varepsilon_{t-1}|$ depends on the error distribution.

4.2.1.1.5 Integrated GARCH (IGARCH) model

Back in 1986 Engle and Bollerslev developed an extension of the GARCH model named the integrated GARCH (IGARCH) model. The IGARCH model restricts the sum of the parameters to equal to one which means that the return series is not covariance stationary and there is a unit root in the GARCH process (Jensen and Lange, 2007). Jensen and Lange noticed that "the conditional variance of the GARCH model converges in probability to the true unobserved volatility process even when the model is misspecified and the IGARCH effect is a consequence of the mathematical structure of a GARCH model and not a property of the true data generating mechanism" (Jensen and Lange, 2007). The restriction for IGARCH is

$$\sum_{i=1}^{p}[a_i] + \sum_{i=1}^{q}[\beta_i] = 1$$

IGARCH (1, 1) model:

$$\sigma_t^2 = w + a_1\varepsilon_{t-1}^2 + \beta_1\sigma_{t-1}^2$$

Equation 15: Calculation of IGarch (1, 1), where w > 0, $a_1 > 0$, $b_1 > 0$ and $a_1+b_1=1$

4.2.1.1.6 GJR-GARCH Model

The GJR-GARCH was originally proposed by Gloste, Jagannatham and Runkle. where the model assumes to reveal and take into account the asymmetry property of financial data in obtaining the conditional heteroskedasticity (Glosten, Jagannathan and Runkle, 1993). They suggested augmenting the GARCH variance specification with a new term, which is dummy variable taking the value of 1 when shock is negative and 0 if the shock is positive. The general form of the GJR-GARCH (q, p) is given by

$$\sigma_t^2 = w + \sum_{i=1}^{p}(a_i+\lambda_i I_{t-i})\varepsilon_{t-1}^2 + \sum_{i=1}^{q}\beta_i\sigma_{t-i}^2$$

Equation 16: GJR-Garch (q, p), where w > 0, a1 > 0, b1 > 0, λi>0 and $I_{t-1} = \{\begin{matrix} 1, if\,\varepsilon_{t-1} < 0 \\ 0, otherwise \end{matrix}$

In the above threshold GARCH (TGARCH) specification, when the shock is positive the coefficient of lagged error term is α_i and when the shock is negative the coefficient is $\alpha_i+\lambda_i$. Thus, the statistical significance of λ_i is regarded as evidence for asymmetric effect of shocks with different signs of volatility. If coefficient λ_i is positive and significant then negative shocks tend to have greater impact on volatility compared to positive shocks with the same magnitude. But, if λ_i is negative and significant, positive shocks tend to have greater impact on volatility compared to negative shocks.

GJR-GARCH (1,1) model:

$$\sigma_t^2 = w + (a_1 + \lambda_1 I_{t-1})\varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2$$

Equation 17: GJR-Garch (1, 1), where w > 0, a1 > 0, b1 > 0, $\lambda_1 > 0$ and $I_{t-1} = \begin{cases} 1, \text{if} \varepsilon_{t-1} < 0 \\ 0, \text{otherwise} \end{cases}$

4.2.1.1.7 The Power ARCH (PARCH) Model

Taylor suggested the standard deviation GARCH model, where the standard deviation is modeled rather than the variance. Ding et al. in their paper generalized it with the Power ARCH specification (Ding et al. 1993). In the Power ARCH model the power parameter δ of the standard deviation is estimated and the optional γ parameters are added to capture asymmetry of up to order *r*:

$$\sigma_t^\delta = w + \sum_{i=1}^{p} a_i(|\varepsilon_{t-i}| - \gamma_i\, \varepsilon_{t-i})^\delta + \sum_{i=1}^{q} \beta_i \sigma_{t-i}^\delta$$

Equation 18: Calculation of PGarch, where $\delta>0$, $|\gamma_i|\leq 1$ for all i= 1,…,r $\gamma i=0$ for i>r, and r≤p

The symmetric model sets $\gamma_i=0$ for all i. For $\delta=2$ and $\gamma_i=0$ for all i, the PARCH model transforms itself to a simply a standard GARCH specification. The model captures the asymmetric effects for $\gamma\neq 0$.

APARCH (1,1) model:

$$\sigma_t^\delta = a_1(|\varepsilon_{t-i}| - \gamma_i \varepsilon_{t-i})^\delta + \beta_1 \sigma_{t-i}^\delta$$

Equation 19: Calculation of PGarch (1,1) , where $\delta>0$, $|\gamma_1|\leq 1$ for all i= 1,…,r $\gamma 1=0$ for i>r, and r≤p

4.2.1.1.8 Augmented GARCH Models

Leading market indicators like world economic growth, shipping related indexes etc. could be incorporated in models as an alternative method of including market conditions into volatility. For instance a market indicator that could be incorporated in GARCH models is the slope of the freight forward curve (FFA Curve) or the term structure of freight rate. Alizadeh and Nomikos in their study investigate the relationship between the slope of the tanker freight forward curve and the volatility of FFAs using an augmented ARMA-TGARCH model of the following form

$$r_t = c_0 + \sum_{i=1}^{m} c_{1,i} r_{t-i} + \sum_{i=1}^{m} c_{2,i} \varepsilon_{t-1} + \varepsilon_t$$
$$\sigma_t^2 = w + (a_1 + \lambda_1 I_{t-1})\varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 + \gamma SL_{t-1}$$

Equation 20: Calculation of ARMA-TGarch X

Where SLt-1 is the slope of the forward curve measured as the difference between the natural logarithm of the current month and fourth month FFA rates.

4.2.1.1.9 Distributional Assumptions

When working with ARCH models the distributions that assumed to be followed by the returns are mainly the following: the normal (Gaussian) distribution, the Student's t-distribution, and the Generalized Error Distribution (GED). In this thesis for each of the distribution assumptions, the ARCH models are estimated by the method of maximum likelihood.

For instance, for the GARCH (1, 1) model with conditionally normal errors, the contribution to the log-likelihood for observation t is:

$$l_t = \frac{1}{2} log(2\pi) - \frac{1}{2} \log \sigma_t^2 - \frac{1}{2} (y_t - X_t{}'\theta)^2 / \sigma_t^2$$

Equation 21: Calculation of the log-likelihood with Normal Distribution assumption, where $\boldsymbol{\sigma_t^2}$ is the conditional variance

For the Student's t-distribution, the log-likelihood contributions are of the form:

$$l_t = \frac{1}{2} log\left(\frac{\pi(v-2)\Gamma(u-2)^2}{\Gamma((u+1)/2)^2}\right) - \frac{1}{2} \log \sigma_t^2 - \frac{(v+1)}{2} \log\left(1 + \frac{(y_t - X_t{}'\theta)^2}{\sigma_t^2 (v-2)}\right)$$

Equation 22: Calculation of the log-likelihood with t-distribution assumption, where v>2 controls the tail behavior

For the GED, the log-likelihood contributions are of the form:

$$l_t = -\frac{1}{2} log(\frac{\Gamma(1/r)^3}{\Gamma(3/r)(r/2)^2}) - \frac{1}{2}\log\sigma_t^2 - (\frac{\Gamma(3/r)(y_t - X_t{}'\theta)^2}{\sigma_t^2\Gamma(1/r)})^{r/2}$$

Equation 23: Calculation of the log-likelihood with GED Distribution assumption, where the tail parameter r>0. The GED distribution becomes normal for r=2 and fat tailed for r<2.

4.2.1.2 Non-Parametric Volatility Measurements

4.2.1.2.1 Historical Simulation (non – Parametric)

Historical Simulation is a resampling method that does not assume any particular distribution for the returns distributions, but rather uses the historical ones. The concept behind the inception of this model is that history repeat itself.

Suppose we observe data from day 1 to day t, and r_t is the return of portfolio on day t, then we get a series of return $\{r_{t+1-\tau}\}_{\tau=1}^{m}$.The value at risk at a confidence level p is calculated as the (100p)% of the sequence of past portfolio returns

$$\widehat{VAR}_{t+1}^{p} = percentile\{\{r_{\tau+1-\tau}\}_{\tau=1}^{m}, (100p)\%\}$$

Equation 24: Value at Risk estimation

The historical simulation is a non-parametric method that makes no specific distribution assumption about return distributions. This method also relies on the specified short historical moving window. This thesis estimates the Historical simulations 100 (using a rolling window of the past 100 daily returns), 250 (using a rolling window of the past 250 daily returns) and the full sample (including all observations up to day of calculated Value at Risk).

4.3 Backtesting

In order to assess the accuracy and performance of the Value at Risk models several backtesting methods have been developed. In the estimation process of Value at Risk models the confidence levels have to be included. Practically, for a model to work well it is expected that the times that actual returns excided the value at risk estimations must equal to the chosen percentile of the out of sample observations. For instance, if a 99% confidence level is chosen, it is expected to find exceptions in 1% of the out of sample observations. In this thesis the several Value at Risk models are backtested using the Kupiec's unconditional test, the Christoffersen's independence test, the Joint test and the Quantile Loss Function. For a perfect Value at Risk model, the exception sequence should be independently distributed over time as a Bernoulli variable.

4.3.1 Statistical Accuracy

4.3.1.1 Kupiec's Unconditional Coverage (UC) Test

Kupiec's UC Test that is developed in his paper, is based on null hypothesis that empirically determined probability matches the given probability i.e.

$H_0: p = \hat{p} = \frac{x}{T}$

$H_1: p \neq \hat{p} = \frac{x}{T}$

The null hypothesis is that observed failure rate $\hat{p}$ is equal to the failure rate suggested by the confidence level. The Likelihood ratio test statist is:

$$LR_{POF} = \left(\frac{(1-p)^{T-x}p^x}{[1-\frac{x}{T}]^{T-x}(\frac{x}{T})^x}\right)$$

Equation 25: Calculation of UC likelihood ratio, where T is the number of observations, x is the number of exceptions, c is the confidence level and p is the failure rate (1-c)

4.3.1.2 Christoffersen's Independence Test

Christoffersen's test not only covers the number of exceptions but considers also independence of them. In order for a model to be accurate, an exception at time t should not depend on whether or not an exception occurred on t-1.

H_0: Exemptions are independent
H_1: Exemptions are dependent

The test statistic is a likelihood ratio:

$$LR_{ind} = -2ln(\frac{(1-\Pi)^{n_{00}+n_{01}}\Pi^{\,n_{01}+n_{11}}}{(1-\Pi_0)^{n_{00}}{\Pi_0}^{n_{01}}(1-\Pi_1)^{n_{01}}{\Pi_1}^{n_{11}}})$$

Equation 26: Calculation of Ind likelihood ratio

Where, $\Pi_0 = \frac{n_{01}}{n_{00+}n_{01}}$, $\Pi_1 = \frac{n_{11}}{n_{10+}n_{11}}$ and $\Pi = \frac{n_{01}+n_{11}}{n_{01+}n_{00}+n_{10+}n_{11}}$. The n_{ij} is the number of days when condition j occurred assuming that condition i occurred on the previous day.

n(00) is no VaR violation at time I and on I-1 day.

n(01) is no VaR violation at time I but there is VaR violation on I-1 day

n(10) is VaR violation on time I but no VaR violation at time I-1 day

n(11) is VaR violation at time I followed at other VaR violation at time I-1 day

Then π_i is the probability of observing an exception conditional on state i of the previous day

Where, $I_t = \begin{matrix} 1, if\ violation\ occurs \\ 0, if\ no\ violation\ occurs \end{matrix}$

If Π_0, Π_1 or Π equals to zero, then the independence test cannot be performed.

Both LR_{uc} Ratio and LR_{ind} Ratio are asymptotically Chi-squared distributed with one degree of freedom. If the value of LR_{uc} Ratio or LR_{ind} statistics exceeds the critical value of the Chi-square distribution for given confidence level, the null hypothesis is rejected. The disadvantage of the unconditional test is that it measures only the number of exceptions and not their time dynamics. On the other hand, Christoffersen developed a test that could also be used to examine the independence of the exemptions.

4.3.1.3 Joint Test

The joint test statistic is calculated by combining Christoffersen's independence test with Kupiec's unconditional coverage test. With joint test is measured both the failure rate and the independence of the exceptions

H_0: $p = \hat{p} = \frac{x}{T}$ & the exemptions are independent
H_1: $p \neq \hat{p} = \frac{x}{T}$ & the exemptions are dependent
The test statistic is the calculated by adding Christoffersen's independence test with Kupiec's unconditional coverage test:

$$LR_{CC} = LR_{uc} + LR_{ind}$$

Equation 27: Calculation of joint test

The Joint Test is asymptotically Chi-squared distributed with two degrees of freedom.

4.3.2 Economic Accuracy

4.3.2.1 Loss Functions

The statistical adequacy of the Value at Risks estimates can be captured with the analyzed tests. However, these statistical metrics cannot compare the models and only advice if accepted for the required confidence level. According to Lopez study, the author suggested to measure the accuracy of the Value at Risk estimates on the basis of the discrepancy between actual returns and Value at Risk estimates. For this purpose he suggested the Loss Function:

$$\Psi_{t+1} = \begin{cases} 1 + (y_{t+1} - VaR_{t+1|t})^2, & if\, y_{t+1} < VaR_{t+1|t} \\ 0, & if\ y_{t+1} \geq VaR_{t+1|t} \end{cases}$$

Equation 28: Calculation of LF Ψ_{t+1}

If the estimated Value at Risk did not capture the actual volatility at time t, then the Ψt equals 1 plus the difference between the observed return and the calculated, while if no violation is observed at time t, Ψt equals with 0. According to this metric, a model is preferred over another if it yields a lower total loss value, calculated as the sum of these penalties: $\Psi = \sum_{t=1}^{T} \Psi_t$. The Loss function incorporates both the cumulative number and the magnitude of exceptions. In comparison to Kupiec's binomial function, Loss Function adds up the magnitude term, so the larger the failure the higher the penalty. However, Loss function does not consider the discrepancy between the no violating value at risk estimates and the actual returns. The knowledge of whether a Value at Risk is overestimating the forecasted values it's quite useful for better allocation of resources. For this reason, this study uses a modified version of the Loss Function, called Quintile Loss Function as proposed by Angelidis, Benos and Degiannakis (Angelidis, Benos and Degiannakis, 2003).

QLF has the following form:

$$\Psi_{t+1} = \begin{cases} (y_{t+1} - VaR_{t+1|t})^2, & if\, y_{t+1} < VaR_{t+1|t} \\ [Percentile\ (y, 100p)\ _1^T\ -\ VaR_{t+1|t}]^2\ , & if\ y_{t+1} \geq VaR_{t+1|t} \end{cases}$$

Equation 29: Calculation of QLF Ψ_{t+1}

Therefore at time t, Ψ_t equals either with the distance between the VaRt+1|t forecast and the 100p percentile of the historical return distribution, in case that the return is larger than the Value at Risk estimation, or by the excess loss ($(y_{t+1} - VaR_{t+1|t})^2$) term, if the realized return is smaller than the Value at Risk estimation. As with the Loss Function metric, a model will be preferred over another if it results the smaller amount.

Chapter 5: Data

The main goal of the thesis is to assess the capability of a number of alternative approaches to accurately capture the fluctuation of the freight for the main four tanker routes in both spot and futures markets (TC2, TC5, TD3, and TD7). As has already been stated, the freight spot and forward prices are quoted in Worldscale; a fraction of the flat rate. The full data sample is divided into an in-sample period, on which the model estimation section is based and an out-of-sample period over which Value at Risk performance is measured. The full data sample period for the routes TC2 (Clean Route from Rotterdam to New York) and TD3 TD3 (Dirty Route from Ras Tanura to Chiba) is from 22 May 2007 to 21 September 2015, while for the TD7 (Dirty Route from Sullom Voe to Wilhelmshaven) and TC5 (Clean Route from Ras Tanura to Yokohama) routes is from 24 April/2008 to 21 September 2015. The in-data sample period that used for the estimations for the routes TC2 and TD3 is from 22 May 2007 to 13 August 2013, while for the TD7 and TC5 routes is from 24 April 2008 to 7 November 2013. The out-of-sample period that used for the backtesting process is from 14 August 2013 to 21 September 2015 for the TC2 and TD3 routes, while for the TD7 and TC5 routes from 8 November 2013 to 21 September 2015. The period of the out-of-sample has been chosen in order to include both periods characterized by extreme returns like the financial crisis and periods characterized by returns close the average historical ones. Two different full sample periods used due to restricted availability of data for routes TC5 and TD7.

The data sample for the spot prices was downloaded from Clarkson Intelligence Network website, while the data sample for the one month and three months front future prices are provided from Baltic Exchange. All prices are expressed in World Scale.

For the purpose of this study, the author uses seven models of the ARCH family and three versions of the Historical Simulation in order to estimate the 1-day conditional variance, as presented and explained in the methodology section. Similar methodology has also been used by in the studies of Kavussanos and Dimitrakopoulos (2011), Angelidis and Skiadopoulos (2008) and Abouarghoub (2008). This study uses the Risk Metrics, GARCH (1, 1), IGARCH (1, 1), TGARCH (1, 1), EGARCH (1, 1), APARCH (1, 1) and an augmented

TGARCH (1, 1) that includes the slope curve of the difference between the spot and three months front prices. All GARCH family models have been estimated taking as an assumption for the standard returns the Normal, the Student's T and the Generalized Error Distributions. Except from the aforementioned parametric methods of calculating the conditional variance, this thesis uses also one non-parametric method, the Historical Simulation. Three Historical Simulation models are calculated here, the HS100 (based on the last 100 returns), the HS250 (based on the last 250 returns) and HSFS (based on the full Sample).

The estimation of the GARCH models has been performed using Maximum Likelihood Estimation (MLE) method, and was executed in Eviews program application. The Historical Simulations models are calculated in the excel program application.

In addition, the 1-day Value at Risk estimates have been calculated using the excel program application.

Finally, for the backtesting purpose, the 1-day Value at Risk estimates are compared with the actual 1-day returns. For the purposes of this thesis returns are computed in the following form:

$$R_{t+1} = \ln(S_{t+1}) - \ln(S_t)$$

Equation 30: Calculation of returns

Where S_t denotes spot price at time t and S_{t+1} spot prices at time t+1.

Both Kavussanos and Dimitrakopoulos (2011) and Angelidis and Skiadopoulos (2008) use tests to measure the statistical and the economic accuracy of their results. Both studies used an uncondional test, a conditional test, a joint test and the Loss function. Abouarghoub (2008) uses only statistical tests. This thesis uses the Kupiec's unconditional test, the Christoffersen's independence test, the Joint test and the Quintile Loss Function, with all of them have been estimated in the excel program application.

Chapter 6: Empirical work

This chapter is divided into two sections; one including the descriptive statistics of the raw data and returns along with a variety of illustrations and one including the Value at Risk results and their investigation. The selection process of the right model involves the evaluation of the backtesting results and the estimated coefficients. However, the used backtesting measures cannot compare different Value at Risk models directly. This is due to the fact that lower p-values do not indicate superiority of a model over another. For this reason, all models that results satisfying p-value scores are compared with each other using the Quintile Loss Function.

6.1 Historical Distributions: Descriptive Statistics and Illustrations

Table 6 presents the descriptive statistics for daily spot and future returns, for the shipping routes TC2, TC5, TD3 and TD7. Statistics are shown for full-samples. Full sample sizes are 2085 days for the TC2 and TD3 routes and 1855 days for the TC5 and TD7 routes.

Even though the excess skewness, the high kurtosis and the Jarque-Bera statistical scores clearly justify the non-normality of the distributions of all returns under investigation, the mean daily returns are quite close to zero, which clarifies the zero mean assumption. The autocorrelation of raw returns is also examined in order to test if the assumption of constant mean is valid. As presented in Figure 20 daily returns have very little autocorrelation. Evidence of volatility clustering is clear in graphs of daily returns in Figures 12. 13, 14 and 15 which suggest the presence of heteroscedasticity. These findings led to the adoption of the GARCH models discussed in the methodology section. Figures 16, 17, 18, 19 and 20 include graphs of QQ plots, returns, histograms and autocorrelations. All these combined with Figures 21, 22, 23 and 24 which plot the histograms against theoretical Normal distributions, demonstrate the defining characteristics of the tanker market; high volatility, seasonality, volatility clustering and fat-tailed distributions.

These characteristics further motivate the exploration of alternative approaches that could capture and incorporate tanker markets' peculiarities. Figures 21, 22, 23 and 24 which plot the histograms of past returns against a normal distribution curve, give an indication to what extent the histogram conform to the density of the normal distribution. In addition, they provide a portrayal of the returns' characteristics of the tanker freight markets; fatter tails and high peaks around zero than a normal's distribution. The fatter tails characteristic equal a higher probability of large losses than a normal distribution's. Excess skewness, if positive, means that the market exhibits large up moves but not equally large down moves and if negative vice versa. Such information could influence the shaping of trading strategies of the tanker markets participants.

(Please insert figures 12 – 24 about here)

Descriptive Statistics			
	TC2_Spot	**TC2_1M**	**TC2_3M**
Full Sample	22/MAY/2007-21/SEPTEMBER/2015		
In Sample	22/MAY/2007-13/AUGUST/2013		
Out of Sample	14/AUGUST/2013-21/SEPTEMBER/2015		
No of Obs	2085	2085	2085
Mean	158.11	158.32	154.69
Median	146.67	146.50	141.50
Maximum	386.25	353.00	305.00
Minimum	9.55	80.00	91.00
Std. Dev.	60.10	51.57	48.43
Skewness	1.33	1.21	1.23
Kurtosis	4.99	4.03	3.57
J-B	960.70	602.42	552.88

Descriptive Statistics			
	TC5_Spot	**TC5_1M**	**TC5_3M**
Full Sample	24/APRIL/2008-21/SEPTEMBER/2015		
In Sample	24/APRIL/2008-7/NOVEMBER/2013		
Out of Sample	8/NOVEMBER/2013-21/SEPTEMBER/2015		
No of Obs	1855	1855	1855
Mean	131.16	129.09	126.87
Median	119.04	116.00	114.50
Maximum	383.85	365.00	308.00
Minimum	48.54	57.00	73.00
Std. Dev.	56.88	47.75	35.08
Skewness	2.75	2.85	2.75
Kurtosis	10.68	11.50	11.25
J-B	6894.66	8085.60	7598.04

Descriptive Statistics			
	TD3_Spot	**TD3_1M**	**TD3_3M**
Full Sample	22/MAY/2007-21/SEPTEMBER/2015		
In Sample	22/MAY/2007-13/AUGUST/2013		
Out of Sample	14/AUGUST/2013-21/SEPTEMBER/2015		
No of Obs	2085	2085	2085
Mean	63.51	62.34	60.18
Median	52.28	54.00	51.59
Maximum	319.22	215.00	180.00
Minimum	25.36	30.00	30.50
Std. Dev.	39.68	30.84	26.30
Skewness	2.92	2.31	2.02
Kurtosis	12.85	9.04	7.67
J-B	11394.58	5028.34	3312.13

Descriptive Statistics			
	TD7_Spot	**TD7_1M**	**TD7_3M**
Full Sample	24/APRIL/2008-21/SEPTEMBER/2015		
In Sample	24/APRIL/2008-7/NOVEMBER/2013		
Out of Sample	8/NOVEMBER/2013-21/SEPTEMBER/2015		
No of Obs	1855	1855	1855
Mean	107.82	105.15	102.71
Median	97.08	100.00	99.00
Maximum	359.09	227.00	212.00
Minimum	61.59	69.00	72.00
Std. Dev.	37.61	25.06	22.33
Skewness	2.62	2.23	2.86
Kurtosis	12.29	8.93	12.73
J-B	8797.51	4263.61	9848.46

Table 6: Includes descriptive statistics for spot, 1 Month front and 3 Months front for TC2, TC5, TD3 and TD7 routes

6.2 Value at Risk Results

6.2.1 TC2

6.2.1.1 Spot

As per Table 6, TC2 spot returns' descriptive statistics indicate both excess kurtosis and skewness. More specifically the historical distribution is skewed on the right side (Fischer Skewness Statistic equals 0.52), which means that the market exhibits larger up moves than down moves. Same can be also confirmed by the study of the QQ plot on Figure 16 where it can be seen that the historical distribution deviates from the normal on the right side. Additionally, the distribution is leptokurtic with most of the returns being located around the average and on the tails. The autocorrelation test, which can be found on Figure 20 rejects any lagged correlation suspicion with all p-values equal to zero. The JB test clearly indicates distribution's non-normality.

Table 7, that includes the HIT sequences, suggests that both parametric and non-parametric models performed quite well for capturing the risk related to the long positions, with only exemption the VaR1% that have been calculated with parametric models assuming Generalized Error Distribution returns.

Considering all models' statistical accuracy, the shortlist concludes with the GARCH (1, 1)_N, IGARCH(1, 1)_N, IGARCH(1, 1)_T, EGARCH(1, 1)_N TGARCH(1, 1)_X_N, HS(250) and HS(FS) for long positions, while for short ones with the GARCH (1, 1)_N, IGARCH(1, 1)_N, IGARCH(1, 1)_T, EGARCH(1, 1)_N, HS(250) and HS(FS).

Nevertheless, considering also the auto-regression results the GARCH (1, 1)_N, TGARCH(1, 1)_X_N have being subtracted from the shortlist due to their statistical insignificance.

In terms of both statistical and economic accuracy, the models that should be selected for capturing TC2_S' risk for both long and short positions are the IGARCH(1, 1)_N, IGARCH(1, 1)_T, EGARCH(1, 1)_N and HS(250), with same to be in place for both long and short positions.

6.2.1.1.1 Value at Risk Statistics

TC2_S															
Out of Sample Obs	Average VaR			Minimum VaR			Maximum VaR			Hit Sequence Long %			Hit Sequence Short %		
526	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model															
GARCH (1,1)_N	-8.78%	-6.21%	-4.84%	-60.99%	-43.13%	-33.61%	-7.02%	-4.96%	-3.87%	1.14%	3.61%	7.79%	3.42%	5.51%	7.22%
GARCH (1,1)_T	-33.96%	-24.00%	-18.69%	-422.84%	-298.84%	-232.75%	-7.02%	-4.96%	-3.87%	0.19%	0.38%	0.38%	0.19%	0.38%	0.95%
GARCH (1,1)_GED	-6.72%	-6.17%	-5.48%	-79.11%	-72.62%	-64.55%	-3.49%	-3.20%	-2.85%	5.51%	6.08%	7.98%	6.08%	7.22%	7.41%
IGARCH (1,1)_N	-8.31%	-5.88%	-4.58%	-11.56%	-8.17%	-6.37%	-6.70%	-4.74%	-3.69%	1.14%	4.18%	6.84%	4.18%	6.84%	7.79%
IGARCH (1,1)_T	-9.00%	-6.36%	-4.95%	-36.09%	-25.50%	-19.86%	-2.11%	-1.49%	-1.16%	1.52%	4.94%	7.60%	3.61%	5.89%	8.37%
IGARCH (1,1)_GED	-5.93%	-5.44%	-4.84%	-7.57%	-6.94%	-6.17%	-5.15%	-4.72%	-4.19%	3.99%	5.32%	6.65%	6.84%	7.03%	7.41%
(GJR)TGARCH (1,1)_N	-8.72%	-6.17%	-4.81%	-42.59%	-30.12%	-23.47%	-6.50%	-4.60%	-3.58%	1.52%	5.32%	8.37%	2.85%	5.13%	7.03%
(GJR)TGARCH (1,1)_T	-31.40%	-22.19%	-17.29%	-373.05%	-263.65%	-205.35%	-14.74%	-10.42%	-8.12%	0.19%	0.38%	0.38%	0.19%	0.57%	1.14%
(GJR)TGARCH (1,1)_GED	-6.74%	-6.19%	-5.50%	-71.55%	-65.69%	-58.39%	-3.51%	-3.23%	-2.87%	5.70%	6.46%	8.17%	5.89%	6.84%	7.41%
EGARCH (1,1)_N	-8.74%	-6.18%	-4.82%	-77.38%	-54.72%	-42.65%	-6.69%	-4.73%	-3.69%	1.52%	5.51%	8.56%	2.09%	5.32%	6.65%
EGARCH (1,1)_T	-20.85%	-14.74%	-11.48%	-2144.37%	-1515.51%	-1180.37%	-8.45%	-5.97%	-4.65%	0.38%	0.57%	2.09%	0.95%	1.71%	2.66%
EGARCH (1,1)_GED	-7.21%	-6.62%	-5.88%	-432.87%	-397.38%	-353.23%	-3.50%	-3.21%	-2.86%	6.08%	7.22%	8.75%	5.70%	6.08%	7.22%
APARCH (1,1)_N	-8.47%	-5.99%	-4.67%	-18.35%	-12.97%	-10.11%	-2.50%	-1.77%	-1.38%	2.28%	6.65%	9.70%	2.47%	5.51%	7.60%
APARCH (1,1)_T	-14.59%	-10.31%	-8.03%	-96.04%	-67.88%	-52.87%	-5.04%	-3.56%	-2.77%	0.57%	1.33%	3.42%	1.14%	2.09%	3.42%
APARCH (1,1)_GED	-5.96%	-5.48%	-4.87%	-25.40%	-23.32%	-20.73%	-2.12%	-1.94%	-1.73%	5.70%	7.22%	8.56%	5.89%	6.46%	7.22%
TARCH (1,1)_X_N	-8.73%	-6.17%	-4.81%	-42.41%	-29.99%	-23.37%	-6.55%	-4.63%	-3.61%	1.52%	5.32%	8.17%	2.85%	5.13%	7.22%
TARCH (1,1)_X_T	-21.70%	-15.34%	-11.94%	-246.18%	-173.98%	-135.51%	-4.80%	-3.39%	-2.64%	0.19%	0.38%	0.76%	0.57%	1.33%	1.71%
TARCH (1,1)_X_GED	-6.67%	-6.12%	-5.44%	-67.51%	-61.98%	-55.09%	-1.74%	-1.60%	-1.42%	5.51%	6.27%	7.03%	6.08%	6.65%	7.41%
RISK METRICS	-16.45%	-11.63%	-9.07%	-211.23%	-149.39%	-116.42%	-3.19%	-2.25%	-1.76%	0.95%	4.37%	6.46%	3.42%	6.08%	7.41%
HS(100) Long	-24.88%	-5.59%	-3.80%	-275.11%	-7.97%	-5.65%	-5.33%	-2.95%	-2.11%	1.52%	4.75%	11.03%	-	-	-
HS(250) Long	-8.81%	-5.04%	-3.33%	-12.70%	-6.70%	-4.65%	-7.03%	-3.83%	-2.68%	1.14%	5.32%	11.98%	-	-	-
HS(FS) Long	-7.92%	-4.35%	-2.99%	-8.39%	-4.60%	-3.12%	-7.32%	-4.20%	-2.92%	1.71%	8.17%	13.69%	-	-	-
HS(100) Short	29.64%	7.44%	4.13%	9.54%	2.79%	1.52%	257.18%	12.93%	7.37%	-	-	-	1.14%	4.56%	9.51%
HS(250) Short	14.11%	7.02%	3.32%	10.33%	4.26%	2.18%	15.75%	8.47%	4.68%	-	-	-	1.33%	5.51%	10.65%
HS(FS) Short	11.22%	5.44%	3.33%	10.26%	5.37%	3.24%	12.31%	5.56%	3.43%	-	-	-	2.28%	7.03%	10.65%

Table 7: Represents Value at Risk results for TC2 route spot price returns. The first column presents the different model types that used to measure Value at Risk. The next nine columns present average, minimum and maximum VaR estimates at 1%, 5% and 10%, confidence levels, respectively. The last six columns present the HIT sequence as a percentage of the out-of-sample observations. HIT sequences are reported for both long and short positions.

6.2.1.1.2 Backtesting

TC2_S LONG												
Out of Sample Obs	PoF			LRind			LRcc			QLF		
526	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model												
GARCH (1,1)_N	0.101	2.351	3.052*	-	0.135	4.177**	-	2.486	7.229**	8.003	7.838	7.764
GARCH (1,1)_T	5.234**	39.457***	93.347***	-	-	-	-	-	-	101.585	56.868	38.078
GARCH (1,1)_GED	52.635***	1.220	2.532	0.288	0.626	0.744	52.923***	1.846	3.275	9.490	9.218	9.051
IGARCH (1,1)_N	0.101	0.782	6.473**	-	3.356*	6.858***	-	4.138	13.331***	7.143	7.343	7.444
IGARCH (1,1)_T	1.243	0.004	3.625*	-	4.277**	16.172***	-	4.281	19.798***	8.234	7.979	7.865
IGARCH (1,1)_GED	27.145***	0.113	7.331***	1.289	6.069**	4.885**	28.434***	6.182**	12.216***	7.555	7.312	7.461
(GJR)TGARCH (1,1)_N	1.243	0.113	1.645	-	1.352	4.766**	-	1.465	6.411**	8.081	7.880	7.800
(GJR)TGARCH (1,1)_T	5.234**	39.457***	93.347***				-			86.572	49.145	33.338
(GJR)TGARCH (1,1)_GED	56.178***	2.181	2.063	0.387	0.918	0.901	56.566***	3.099	2.964	9.554	9.282	9.105
EGARCH (1,1)_N	1.243	0.283	1.277	-	2.969*	6.369**	-	3.252	7.645**	8.684	8.186	7.988
EGARCH (1,1)_T	2.672	34.644***	52.327***	-	-	-	-			511.207	260.309	161.200
EGARCH (1,1)_GED	63.476***	4.845**	0.957	1.942	5.687**	8.101***	65.418***	10.533***	9.058**	29.399	26.135	22.456
APARCH (1,1)_N	6.402**	2.757*	0.055	-	7.496***	9.531***	-	10.253***	9.586***	7.561	7.594	7.620
APARCH (1,1)_T	1.161	20.805***	33.065***	-	-	-	-	-	-	13.912	11.302	9.976
APARCH (1,1)_GED	56.178***	4.845**	1.277	0.387	1.782	4.289**	56.566***	6.628**	5.566*	8.101	7.821	7.877
TARCH (1,1)_X_N	1.243	0.113	2.063	-	3.372*	5.273**	-	3.485	7.336**	8.072	7.875	7.796
TARCH (1,1)_X_T	5.234**	39.457***	81.415***	-	-	-	-			40.168	25.084	18.521
TARCH (1,1)_X_GED	52.635***	1.668	5.675**	-	-	0.176	-		5.852*	9.488	9.200	9.031
RISK METRICS	0.013	0.454	8.249***	-	2.942*	5.410**	-	3.396	13.659***	65.567	37.378	25.911
HS(100) Long	1.243	0.069	0.598	8.418***	4.784**	14.129***	9.661***	4.853*	14.728***	227.759	7.336	7.446
HS(250) Long	0.101	0.113	2.163	3.808*	13.145***	27.585***	3.908	13.258***	29.748***	7.134	7.302	7.410
HS(FS) Long	2.215	9.445***	7.215***	2.215	13.256***	38.370***	4.430	22.701***	45.585***	7.147	7.353	7.462

Table 8: Represents statistical tests of unconditional, independent and conditional coverage of the interval forecasts under each approach and Loss Function scores for the TC2 spot prices for long positions, denoted by LRuc, LRind and LRcc, respectively. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The tests for LRuc and LRind are $x_1^{1\%}$, $x_1^{5\%}$ and $x_1^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. The tests for LRcc are $x_2^{1\%}$, $x_2^{5\%}$ and $x_2^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. Critical values for $x_1^{1\%}$, $x_1^{5\%}$, $x_1^{10\%}$, $x_2^{1\%}$, $x_2^{5\%}$, $x_2^{10\%}$ are 6.63, 3.84, 2.7, 9.21, 5.99 and 4.6, respectively. If value of the likelihood ratio is larger than the critical value the Value at Risk model is rejected at the significance level.

TC2_S SHORT												
Out of Sample Obs	PoF			LRind			LRcc			QLF		
526	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model												
GARCH (1,1)_N	19.123***	0.283	4.936**	-	2.969*	5.687**	-	3.252	10.623***	5.124	4.965	5.385
GARCH (1,1)_T	5.234**	39.457***	76.301***	-	-	-	-	-	-	85.503	48.278	25.510
GARCH (1,1)_GED	63.476***	4.845**	4.253**	0.001	0.026	0.004	63.477***	4.871*	4.257	6.355	4.788	5.028
IGARCH (1,1)_N	30.024***	3.394*	3.052*	1.056	20.735***	22.635***	31.080***	24.128***	25.687***	6.987	6.376	6.557
IGARCH (1,1)_T	21.689***	0.838	1.645	4.835**	10.448***	22.763***	26.525***	11.287***	24.408***	6.615	6.104	6.282
IGARCH (1,1)_GED	78.855***	4.091**	4.253**	20.735***	23.717***	25.322***	99.590***	27.808***	29.575***	8.370	6.421	6.577
(GJR)TGARCH (1,1)_N	12.141***	0.019	5.675**	-	0.267	3.933**	-	0.286	9.608***	6.656	6.039	6.208
(GJR)TGARCH (1,1)_T	5.234**	34.644***	71.592***	-	-	-	-	-	-	71.428	40.648	22.136
(GJR)TGARCH (1,1)_GED	59.793***	3.394*	4.253**	0.500	0.109	0.004	60.293***	3.503	4.257	6.775	5.189	5.372
EGARCH (1,1)_N	4.814**	0.113	7.331***	-	0.175	4.885**	-	0.289	12.216***	6.958	6.118	6.219
EGARCH (1,1)_T	0.013	15.890***	43.203***	-	-	-	-	-	-	499.964	252.260	153.775
EGARCH (1,1)_GED	56.178***	1.220	4.936**	0.909	0.561	0.590	57.087***	1.781	5.526*	23.364	18.727	15.098
APARCH (1,1)_N	8.161***	0.283	3.625*	-	2.969*	6.982***	-	3.252	10.608***	7.020	6.318	6.464
APARCH (1,1)_T	0.101	11.887***	33.065***	-	-	-	-	-	-	7.161	6.906	6.591
APARCH (1,1)_GED	59.793***	2.181	4.936**	0.017	1.394	1.782	59.810***	3.575	6.718**	7.952	5.962	6.109
TARCH (1,1)_X_N	12.141***	0.019	4.936**	-	0.267	5.687**	-	0.286	10.623***	6.683	6.062	6.222
TARCH (1,1)_X_T	1.161	20.805***	59.319***	-	-	-	-	-	-	23.246	14.920	10.887
TARCH (1,1)_X_GED	63.476***	2.757*	4.253**	0.626	0.057	0.004	64.102***	2.814	4.257	6.922	5.303	5.473
RISK METRICS	19.123***	1.220	4.253**	5.419**	13.180***	17.236***	24.542***	14.399***	21.489***	54.856	30.603	20.773
HS(100) Short	0.101	0.218	0.145	3.808*	8.806***	30.436***	3.908	9.024**	30.581***	187.279	6.776	6.817
HS(250) Short	0.527	0.283	0.240	-	16.275***	29.473***	-	16.558***	29.713***	6.172	6.470	6.635
HS(FS) Short	6.402**	4.091**	0.240	1.229	23.717***	25.783***	7.631**	27.808***	26.023***	6.138	6.461	6.657

Table 9: Represents statistical tests of unconditional, independent and conditional coverage of the interval forecasts under each approach and Loss Function scores for the TC2 spot prices for short positions, denoted by LRuc, LRind and LRcc, respectively. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The tests for LRuc and LRind are $x_1^{1\%}$, $x_1^{5\%}$ and $x_1^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. The tests for LRcc are $x_2^{1\%}$, $x_2^{5\%}$ and $x_2^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. Critical values for $x_1^{1\%}$, $x_1^{5\%}$, $x_1^{10\%}$, $x_2^{1\%}$, $x_2^{5\%}$, $x_2^{10\%}$ are 6.63, 3.84, 2.7, 9.21, 5.99 and 4.6, respectively. If value of the likelihood ratio is larger than the critical value the Value at Risk model is rejected at the significance level.

6.2.1.2 FFA 1 Month

As per Table 6, TC2 FFA 1 month front's descriptive statistics indicate kurtosis and slight skewness. The skewness is slightly positive (Fischer Skewness Statistic equals 0.09). As per Figure 20 the returns do not seem to have any serial autocorrelation, since all p-values equal to zero. The JB score even though indicates distribution's non-normality, it is far smaller than TC2_Spot's and TC2_3M's, with that meaning that TC2_1M's historical distribution is a better proxy of the normal distribution than TC2_Spot's or TC2_3M's historical distribution. Same is depicted from Figure 21 that plots the historical distributions against the theoretical normal distribution.

Tables 11 and 12 suggest that both parametric and non-parametric models performed quite well for capturing the potential losses related to the long positions, with only exemption the VaR1% that have been calculated with parametric models that assuming Generalized Error Distribution returns. In terms of statistical accuracy, the models that have been shortlisted for both long and short positions are the GARCH(1, 1)_N, GARCH(1, 1)_T, IGARCH(1, 1)_T, EGARCH(1, 1)_T, APARCH(1, 1)_T, TGARCH(1, 1)_X_T, HS(100), HS(250) and HS(FS). After filtering for models with significant and with persistence less than one coefficients, the shortlist of the parametric models concludes to the GARCH (1, 1)_N, GARCH (1, 1)_T, IGARCH(1, 1)_T, EGARCH(1, 1)_T, APARCH(1, 1)_T.

Comparing now the finalists in terms of economic accuracy, the model that scores the best at VaR1% is HS(FS), while for VaR5% and VaR10% are GARCH (1, 1)_N, GARCH (1, 1)_T and IGARCH(1, 1)_T. The results are confirmed from both long and short positions.

6.2.1.2.1 Value at Risk Statistics

TC2_1M															
Out of Sample Obs	Average VaR			Minimum VaR			Maximum VaR			Hit Sequence Long %			Hit Sequence Short %		
526	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model															
GARCH (1,1)_N	-8.59%	-6.07%	-4.73%	-10.79%	-7.63%	-5.94%	-7.42%	-5.25%	-4.09%	2.47%	5.13%	8.94%	1.90%	4.75%	8.94%
GARCH (1,1)_T	-9.10%	-6.43%	-5.01%	-12.19%	-8.62%	-6.71%	-7.54%	-5.33%	-4.15%	1.71%	4.37%	7.22%	1.52%	3.99%	7.22%
GARCH (1,1)_GED	-6.07%	-5.58%	-4.96%	-9.91%	-9.10%	-8.09%	-4.96%	-4.55%	-4.05%	4.94%	6.46%	7.79%	5.13%	6.08%	7.98%
IGARCH (1,1)_N	-8.72%	-6.16%	-4.80%	-10.41%	-7.36%	-5.74%	-6.70%	-4.74%	-3.69%	2.09%	5.51%	8.17%	1.90%	4.37%	8.37%
IGARCH (1,1)_T	-8.83%	-6.24%	-4.86%	-10.87%	-7.68%	-5.98%	-6.63%	-4.69%	-3.65%	2.09%	5.32%	7.98%	1.90%	4.37%	7.79%
IGARCH (1,1)_GED	-5.89%	-5.40%	-4.80%	-6.56%	-6.02%	-5.35%	-5.07%	-4.65%	-4.14%	5.70%	6.46%	8.94%	4.37%	5.51%	8.17%
(GJR)TGARCH (1,1)_N	-8.66%	-6.13%	-4.78%	-10.15%	-7.18%	-5.59%	-7.63%	-5.40%	-4.20%	2.09%	4.94%	8.56%	1.71%	4.18%	8.37%
(GJR)TGARCH (1,1)_T	-9.15%	-6.47%	-5.04%	-22.74%	-16.07%	-12.52%	-7.93%	-5.60%	-4.36%	2.28%	4.94%	7.79%	1.71%	4.56%	7.98%
(GJR)TGARCH (1,1)_GED	-5.86%	-5.37%	-4.78%	-14.39%	-13.21%	-11.74%	-5.44%	-4.99%	-4.44%	5.70%	6.84%	8.94%	5.32%	5.89%	8.75%
EGARCH (1,1)_N	-8.96%	-6.33%	-4.94%	-10.37%	-7.33%	-5.71%	-7.31%	-5.17%	-4.03%	1.90%	4.56%	7.41%	1.71%	4.18%	7.98%
EGARCH (1,1)_T	-9.46%	-6.69%	-5.21%	-12.31%	-8.70%	-6.78%	-7.44%	-5.26%	-4.10%	1.33%	4.18%	7.03%	1.14%	3.99%	6.65%
EGARCH (1,1)_GED	-6.43%	-5.91%	-5.25%	-8.75%	-8.03%	-7.14%	-4.94%	-4.53%	-4.03%	4.75%	5.51%	6.84%	3.99%	5.13%	6.65%
APARCH (1,1)_N	-8.97%	-6.34%	-4.94%	-10.41%	-7.36%	-5.74%	-7.31%	-5.17%	-4.03%	1.90%	4.56%	7.41%	1.71%	4.18%	7.98%
APARCH (1,1)_T	-9.62%	-6.80%	-5.30%	-12.52%	-8.85%	-6.89%	-7.37%	-5.21%	-4.05%	1.52%	4.37%	6.84%	1.14%	3.80%	6.65%
APARCH (1,1)_GED	-6.54%	-6.00%	-5.34%	-8.62%	-7.91%	-7.04%	-5.35%	-4.91%	-4.36%	4.37%	5.13%	6.84%	3.80%	4.75%	6.65%
TARCH (1,1)_X_N	-8.61%	-6.09%	-4.74%	-10.69%	-7.56%	-5.89%	-7.42%	-5.25%	-4.09%	2.28%	5.13%	8.37%	1.90%	4.75%	8.56%
TARCH (1,1)_X_T	-9.15%	-6.46%	-5.03%	-22.90%	-16.19%	-12.61%	-7.91%	-5.59%	-4.36%	2.09%	4.94%	7.79%	1.71%	4.75%	7.98%
TARCH (1,1)_X_GED	-5.97%	-5.48%	-4.87%	-15.09%	-13.85%	-12.31%	-5.44%	-5.00%	-4.44%	5.70%	6.84%	8.37%	5.32%	5.70%	8.37%
RISK METRICS	-8.98%	-6.35%	-4.95%	-16.18%	-11.44%	-8.92%	-5.42%	-3.83%	-2.99%	2.28%	5.32%	8.37%	1.90%	4.56%	8.75%
HS(100) Long	-12.90%	-6.33%	-4.28%	-21.65%	-9.02%	-5.56%	-8.09%	-4.21%	-2.96%	0.76%	5.70%	11.41%	-	-	-
HS(250) Long	-13.76%	-6.08%	-3.98%	-16.45%	-9.28%	-4.92%	-11.87%	-5.31%	-2.84%	0.38%	5.51%	12.55%	-	-	-
HS(FS) Long	-11.09%	-5.06%	-3.58%	-11.12%	-5.25%	-3.69%	-11.01%	-4.92%	-3.42%	1.14%	7.60%	14.26%	-	-	-
HS(100) Short	12.47%	6.14%	4.38%	5.44%	3.36%	2.96%	20.91%	8.80%	5.58%	-	-	-	1.90%	5.70%	10.27%
HS(250) Short	10.09%	5.17%	4.09%	6.54%	3.92%	3.25%	12.85%	6.41%	5.02%	-	-	-	1.71%	7.03%	12.55%
HS(FS) Short	9.36%	4.98%	3.65%	9.21%	4.83%	3.47%	9.48%	5.10%	3.84%	-	-	-	1.33%	7.79%	14.64%

Table 10: Represents Value at Risk results for TC2 route 1-Month front FFA prices returns. The first column presents the different model types that used to measure Value at Risk. The next nine columns present average, minimum and maximum VaR estimates at 1%, 5% and 10%, confidence levels, respectively. The last six columns present the HIT sequence as a percentage of the out-of-sample observations. HIT sequences are reported for both long and short positions.

6.2.1.2.2 Backtesting

TC2_1M LONG												
Out of Sample Obs		PoF			LRind			LRcc			QLF	
526	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model												
GARCH (1,1)_N	8.161***	0.019	0.685	-	1.612	0.930	-	1.631	1.615	0.390	0.107	0.145
GARCH (1,1)_T	2.215	0.454	4.936**	-	-	1.928	-	-	6.864**	0.293	0.153	0.178
GARCH (1,1)_GED	42.451***	2.181	3.052*	0.379	1.394	1.151	42.831***	3.575	4.203	1.359	0.101	0.181
IGARCH (1,1)_N	4.814**	0.283	2.063	-	0.244	1.913	-	0.527	3.976	0.378	0.124	0.157
IGARCH (1,1)_T	4.814**	0.113	2.532	-	0.166	2.220	-	0.279	4.752*	0.363	0.137	0.166
IGARCH (1,1)_GED	56.178***	2.181	0.685	0.909	3.331*	2.084	57.087***	5.512*	2.768	1.427	0.077	0.148
(GJR)TGARCH (1,1)_N	4.814**	0.004	1.277	-	0.379	1.374	-	0.383	2.651	0.362	0.109	0.148
(GJR)TGARCH (1,1)_T	6.402**	0.004	3.052*	-	1.899	2.553	-	1.903	5.605*	0.348	0.191	0.204
(GJR)TGARCH (1,1)_GED	56.178***	3.394*	0.685	0.909	4.393**	2.084	57.087***	7.787**	2.768	1.465	0.099	0.164
EGARCH (1,1)_N	3.412*	0.218	4.253**	-	0.010	3.300*	-	0.228	7.553**	0.296	0.128	0.164
EGARCH (1,1)_T	0.527	0.782	5.675**	-		2.238	-	-	7.913**	0.226	0.186	0.204
EGARCH (1,1)_GED	39.215***	0.283	6.473**	0.035	1.233	2.574	39.251***	1.515	9.047**	1.178	0.109	0.212
APARCH (1,1)_N	3.412*	0.218	4.253**	-	0.010	3.300*	-	0.228	7.553**	0.294	0.129	0.164
APARCH (1,1)_T	1.243	0.454	6.473**	-	0.000	2.574	-	0.454	9.047**	0.202	0.202	0.216
APARCH (1,1)_GED	32.998***	0.019	6.473**	0.000	1.612	2.574	32.998***	1.631	9.047**	1.123	0.106	0.217
TARCH (1,1)_X_N	6.402**	0.019	1.645	-	3.807*	1.632	-	3.827	3.277	0.392	0.115	0.151
TARCH (1,1)_X_T	4.814**	0.004	3.052*	-	1.899	2.553	-	1.903	5.605*	0.352	0.193	0.205
TARCH (1,1)_X_GED	56.178***	3.394*	1.645	0.909	4.393**	3.124*	57.087***	7.787**	4.769*	1.409	0.104	0.177
RISK METRICS	6.402**	0.113	1.645	-	0.166	0.050	-	0.279	1.695	0.518	0.247	0.237
HS(100) Long	0.332	0.525	1.112	-	0.909	1.804	-	1.434	2.916	1.299	0.206	0.140
HS(250) Long	2.672	0.283	3.539*	-	2.969*	0.508	-	3.252	4.047	0.583	0.109	0.120
HS(FS) Long	0.101	6.524**	9.493***	-	4.898**	0.255	-	11.422***	9.747***	0.015	0.078	0.122

Table 11: Represents statistical tests of unconditional, independent and conditional coverage of the interval forecasts under each approach and Loss Function scores for the TC2 1-Month front FFA prices for long positions, denoted by LRuc, LRind and LRcc, respectively. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The tests for LRuc and LRind are $x_1^{1\%}$, $x_1^{5\%}$ and $x_1^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. The tests for LRcc are $x_2^{1\%}$, $x_2^{5\%}$ and $x_2^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. Critical values for $x_1^{1\%}$, $x_1^{5\%,}$ $x1^{10\%,,}$ $x_2^{1\%}$,$x_2^{5\%,}$ $x_{21}^{0\%}$ are 6.63, 3.84, 2.7, 9.21, 5.99 and 4.6, respectively. If value of the likelihood ratio is larger than the critical value the Value at Risk model is rejected at the significance level.

TC2_1M SHORT												
Out of Sample Obs		PoF			LRind			LRcc			QLF	
526	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model												
GARCH (1,1)_N	3.412*	0.069	0.685	-	2.216	0.930	-	2.284	1.615	0.100	0.119	0.130
GARCH (1,1)_T	1.243	1.204	4.936**	-	1.289	0.671	-	2.493	5.607*	0.091	0.168	0.159
GARCH (1,1)_GED	45.769***	1.220	2.532	0.267	0.561	0.176	46.035***	1.781	2.708	0.659	0.103	0.159
IGARCH (1,1)_N	3.412*	0.454	1.645	-	2.942*	1.632	-	3.396	3.277	0.110	0.142	0.146
IGARCH (1,1)_T	3.412*	0.454	3.052*	-	2.942*	1.151	-	3.396	4.203	0.115	0.155	0.153
IGARCH (1,1)_GED	32.998***	0.283	2.063	2.942*	1.118	0.751	35.940***	1.400	2.814	0.709	0.083	0.135
(GJR)TGARCH (1,1)_N	2.215	0.782	1.645	-	3.356*	1.632	-	4.138	3.277	0.080	0.120	0.132
(GJR)TGARCH (1,1)_T	2.215	0.218	2.532	-	0.670	0.029	-	0.888	2.561	0.159	0.209	0.186
(GJR)TGARCH (1,1)_GED	49.164***	0.838	0.957	0.175	0.017	1.141	49.339***	0.856	2.097	0.734	0.098	0.144
EGARCH (1,1)_N	2.215	0.782	2.532	-	3.356*	0.176	-	4.138	2.708	0.068	0.145	0.146
EGARCH (1,1)_T	0.101	1.204	7.331***	-	1.289	1.158	-	2.493	8.488**	0.085	0.203	0.181
EGARCH (1,1)_GED	27.145***	0.019	7.331***	1.289	1.612	1.158	28.434***	1.631	8.488**	0.543	0.117	0.189
APARCH (1,1)_N	2.215	0.782	2.532	-	3.356*	0.176	-	4.138	2.708	0.069	0.146	0.147
APARCH (1,1)_T	0.101	1.726	7.331***	-	1.550	1.158	-	3.276	8.488**	0.088	0.222	0.192
APARCH (1,1)_GED	24.365***	0.069	7.331***	1.550	2.216	1.158	25.915***	2.284	8.488**	0.500	0.114	0.191
TARCH (1,1)_X_N	3.412*	0.069	1.277	-	2.216	0.441	-	2.284	1.718	0.101	0.120	0.130
TARCH (1,1)_X_T	2.215	0.069	2.532	-	0.513	0.029	-	0.582	2.561	0.160	0.209	0.186
TARCH (1,1)_X_GED	49.164***	0.525	1.645	0.175	0.051	0.050	49.339***	0.576	1.695	0.697	0.104	0.156
RISK METRICS	3.412*	0.218	0.957	-	0.010	1.141	-	0.228	2.097	0.303	0.261	0.213
HS(100) Short	3.412*	0.525	0.041	-	2.598	1.330	-	3.123	1.372	26.432	6.530	3.330
HS(250) Short	2.215	4.091**	3.539*	2.215	0.757	3.310*	4.430	4.847*	6.849**	19.917	5.275	3.023
HS(FS) Short	0.527	7.445***	11.168***	-	0.006	3.814*	-	7.451**	14.982***	18.402	5.010	2.634

Table 12: Represents statistical tests of unconditional, independent and conditional coverage of the interval forecasts under each approach and Loss Function scores for the TC2 1-Month front FFA prices for short positions, denoted by LRuc, LRind and LRcc, respectively. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The tests for LRuc and LRind are $x_1^{1\%}$, $x_1^{5\%}$ and $x_1^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. The tests for LRcc are $x_2^{1\%}$, $x_2^{5\%}$ and $x_2^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. Critical values for $x_1^{1\%}$, $x_1^{5\%,}$ $x1^{10\%,,}$ $x_2^{1\%}$,$x2^{5\%,}$ $x_{21}^{0\%}$ are 6.63, 3.84, 2.7, 9.21, 5.99 and 4.6, respectively. If value of the likelihood ratio is larger than the critical value the Value at Risk model is rejected at the significance level.

6.2.1.3 FFA 3 Months

As per Table 6, TC2 FFA 3 months front's descriptive statistics indicate negative skewness and kurtosis. The historical distribution is leptokurtic and skewed on the left side (Fischer Skewness Statistic equals -0.53). Looking on the Figure 16 that includes the QQ plots it can be clearly seen that some extreme returns are located on the right side of the normal distribution's diagram, a fact that illustrates the negative skewness. As per Figure 20 the returns do not seem to have any serial autocorrelation, since all p-values equal to zero. The JB test indicates distribution's non-normality.

Tables 14 and 15 suggest that the best performing models in terms of statistical accuracy are the GARCH (1, 1)_N, GARCH (1, 1)_T, EGARCH (1, 1)_N, EGARCH (1, 1)_T, HS(100), HS(250) and the HS(FS). Most of the parametric models were over-conservative resulting HIT sequences far below the confidence levels.

Non-parametric models superiority is supported in both terms of statistical and economic accuracy at 5% and 10% confidence levels. At 1% confidence level GARCH (1, 1)_N, GARCH (1, 1)_T and EGARCH (1, 1)_N performed better.

6.2.1.3.1 Value at Risk Statistics

TC2_3M															
Out of Sample Obs	Average VaR			Minimum VaR			Maximum VaR			Hit Sequence Long %			Hit Sequence Short %		
526	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model															
GARCH (1,1)_N	-5.45%	-3.85%	-3.00%	-18.73%	-13.25%	-10.33%	-4.42%	-3.13%	-2.44%	1.33%	3.80%	6.08%	1.90%	3.99%	5.89%
GARCH (1,1)_T	-7.20%	-5.09%	-3.97%	-10.96%	-7.75%	-6.03%	-5.85%	-4.13%	-3.22%	1.33%	1.90%	3.80%	0.95%	2.09%	2.85%
GARCH (1,1)_GED	-2.79%	-2.56%	-2.28%	-7.25%	-6.66%	-5.92%	-2.13%	-1.96%	-1.74%	7.03%	7.98%	8.37%	7.03%	7.22%	10.46%
IGARCH (1,1)_N	-5.09%	-3.60%	-2.81%	-7.58%	-5.36%	-4.18%	-3.02%	-2.13%	-1.66%	2.28%	4.56%	6.46%	2.28%	3.80%	6.46%
IGARCH (1,1)_T	-5.13%	-3.63%	-2.82%	-7.75%	-5.47%	-4.26%	-3.00%	-2.12%	-1.65%	2.28%	4.56%	6.46%	2.47%	3.80%	6.08%
IGARCH (1,1)_GED	-3.05%	-2.80%	-2.49%	-3.26%	-2.99%	-2.66%	-2.91%	-2.68%	-2.38%	5.51%	5.70%	7.60%	5.51%	6.27%	8.37%
(GJR)TGARCH (1,1)_N	-5.46%	-3.86%	-3.01%	-28.50%	-20.16%	-15.71%	-4.19%	-2.96%	-2.31%	2.28%	3.99%	6.46%	2.66%	4.37%	7.03%
(GJR)TGARCH (1,1)_T	-7.04%	-4.98%	-3.88%	-10.49%	-7.41%	-5.77%	-5.97%	-4.22%	-3.29%	1.33%	1.90%	3.80%	1.14%	1.90%	3.04%
(GJR)TGARCH (1,1)_GED	-3.72%	-3.42%	-3.04%	-9.02%	-8.28%	-7.36%	-2.14%	-1.97%	-1.75%	4.75%	5.13%	6.08%	4.94%	4.94%	5.70%
EGARCH (1,1)_N	-5.26%	-3.72%	-2.90%	-12.26%	-8.67%	-6.76%	-3.24%	-2.29%	-1.78%	1.90%	4.18%	7.22%	1.90%	4.94%	7.41%
EGARCH (1,1)_T	-6.89%	-4.87%	-3.79%	-12.42%	-8.78%	-6.83%	-4.95%	-3.50%	-2.73%	1.52%	2.09%	4.56%	1.33%	2.28%	3.80%
EGARCH (1,1)_GED	-2.77%	-2.54%	-2.26%	-7.91%	-7.27%	-6.46%	-2.56%	-2.35%	-2.09%	7.03%	7.60%	9.13%	6.27%	7.98%	9.51%
APARCH (1,1)_N	-5.03%	-3.56%	-2.77%	-10.68%	-7.55%	-5.89%	-2.90%	-2.05%	-1.60%	2.85%	4.37%	7.41%	1.90%	5.13%	8.37%
APARCH (1,1)_T	-7.68%	-5.43%	-4.23%	-14.23%	-10.06%	-7.83%	-4.96%	-3.51%	-2.73%	0.95%	1.90%	3.23%	0.95%	1.90%	2.85%
APARCH (1,1)_GED	-3.12%	-2.87%	-2.55%	-7.15%	-6.56%	-5.83%	-2.49%	-2.29%	-2.03%	5.32%	6.46%	7.98%	5.51%	6.84%	7.60%
TARCH (1,1)_X_N	-5.45%	-3.86%	-3.01%	-27.23%	-19.26%	-15.01%	-4.14%	-2.93%	-2.28%	2.28%	3.99%	6.46%	2.28%	4.37%	7.03%
TARCH (1,1)_X_T	-7.03%	-4.97%	-3.87%	-10.44%	-7.38%	-5.75%	-5.91%	-4.17%	-3.25%	1.52%	1.90%	3.80%	1.14%	2.09%	3.23%
TARCH (1,1)_X_GED	-3.00%	-2.75%	-2.44%	-6.76%	-6.21%	-5.52%	-2.45%	-2.25%	-2.00%	6.27%	7.03%	7.98%	6.08%	7.03%	8.17%
RISK METRICS	-5.19%	-3.67%	-2.86%	-13.39%	-9.47%	-7.38%	-2.39%	-1.69%	-1.32%	2.85%	5.32%	7.03%	2.47%	4.56%	7.22%
HS(100) Long	-9.32%	-3.49%	-2.15%	-14.81%	-6.80%	-4.07%	-3.11%	-1.53%	-1.35%	1.52%	5.13%	10.46%	-	-	-
HS(250) Long	-8.44%	-3.18%	-1.84%	-12.38%	-4.24%	-2.59%	-4.84%	-1.93%	-1.51%	1.33%	5.70%	11.41%	-	-	-
HS(FS) Long	-5.87%	-2.74%	-1.86%	-6.13%	-2.79%	-1.89%	-5.72%	-2.68%	-1.83%	1.71%	6.27%	10.84%	-	-	-
HS(100) Short	9.52%	3.37%	2.25%	2.59%	1.96%	1.49%	16.11%	5.32%	3.64%	-	-	-	1.33%	4.75%	9.70%
HS(250) Short	6.36%	2.94%	1.91%	3.14%	2.45%	1.47%	8.94%	4.41%	2.69%	-	-	-	2.09%	6.84%	11.22%
HS(FS) Short	5.05%	2.80%	1.94%	4.88%	2.71%	1.92%	5.32%	2.87%	1.98%	-	-	-	2.09%	6.65%	11.60%

Table 13: Represents Value at Risk results for TC2 route's 3-Months front FFA price returns. The first column presents the different model types that used to measure Value at Risk. The next nine columns present average, minimum and maximum VaR estimates at 1%, 5% and 10%, confidence levels, respectively. The last six columns present the HIT sequence as a percentage of the out-of-sample observations. HIT sequences are reported for both long and short positions.

6.2.1.3.2 Backtesting

TC2_3M LONG												
Out of Sample Obs	PoF			LRind			LRcc			QLF		
526	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model												
GARCH (1,1)_N	0.527	1.726	10.277***	-	-	0.001	-	-	10.278***	0.191	0.162	0.143
GARCH (1,1)_T	0.527	13.786***	28.716***	-	1.836	0.074	-	15.622***	28.789***	0.128	0.327	0.268
GARCH (1,1)_GED	82.853***	8.419***	1.645	2.238	2.220	1.632	85.091***	10.639***	3.277	0.614	0.074	0.081
IGARCH (1,1)_N	6.402**	0.218	8.249***	1.229	0.758	1.522	7.631**	0.976	9.772***	0.161	0.115	0.116
IGARCH (1,1)_T	6.402**	0.218	8.249***	1.229	0.758	1.522	7.631**	0.976	9.772***	0.161	0.119	0.119
IGARCH (1,1)_GED	52.635***	0.525	3.625*	0.104	0.051	1.265	52.738***	0.576	4.890*	0.518	0.052	0.075
(GJR)TGARCH (1,1)_N	6.402**	1.204	8.249***	-	-	0.918	-	-	9.167**	0.379	0.266	0.214
(GJR)TGARCH (1,1)_T	0.527	13.786***	28.716***	-	1.836	0.074	-	15.622***	28.789***	0.105	0.299	0.250
(GJR)TGARCH (1,1)_GED	39.215***	0.019	10.277***	0.513	1.612	4.209**	39.728***	1.631	14.486***	0.397	0.122	0.159
EGARCH (1,1)_N	3.412*	0.782	4.936**	-	0.007	1.928	-	0.789	6.864**	0.170	0.136	0.131
EGARCH (1,1)_T	1.243	11.887***	21.230***	-	1.510	0.670	-	13.397***	21.900***	0.128	0.292	0.242
EGARCH (1,1)_GED	82.853***	6.524**	0.459	0.757	1.265	3.223*	83.610***	7.788**	3.683	0.610	0.064	0.072
APARCH (1,1)_N	12.141***	0.454	4.253**	0.598	0.000	1.644	12.739***	0.454	5.897*	0.178	0.117	0.117
APARCH (1,1)_T	0.013	13.786***	35.409***	-	1.836	0.320	-	15.622***	35.729***	0.270	0.450	0.350
APARCH (1,1)_GED	49.164***	2.181	2.532	0.175	3.130*	2.220	49.339***	5.311*	4.752*	0.511	0.062	0.086
TARCH (1,1)_X_N	6.402**	1.204	8.249***	-	-	0.918	-	-	9.167**	0.362	0.258	0.210
TARCH (1,1)_X_T	1.243	13.786***	28.716***	-	1.836	0.074	-	15.622***	28.789***	0.105	0.297	0.248
TARCH (1,1)_X_GED	67.226***	4.091**	2.532	1.655	2.079	2.220	68.881***	6.169**	4.752*	0.544	0.062	0.080
RISK METRICS	12.141***	0.113	5.675**	0.598	6.375**	4.161**	12.739***	6.489**	9.836***	0.268	0.177	0.154
HS(100) Long	1.243	0.019	0.120	-	4.040**	3.549*	-	4.060	3.669	1.271	0.168	0.092
HS(250) Long	0.527	0.525	1.112	-	0.909	8.164***	-	1.434	9.276***	0.634	0.074	0.079
HS(FS) Long	2.215	1.668	0.399	2.215	0.420	6.009**	4.430	2.089	6.408**	0.024	0.053	0.071

Table 14: Represents statistical tests of unconditional, independent and conditional coverage of the interval forecasts under each approach and Loss Function scores for the TC2 3-Months front FFA prices for long positions, denoted by LRuc, LRind and LRcc, respectively. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The tests for LRuc and LRind are $x_1^{1\%}$, $x_1^{5\%}$ and $x_1^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. The tests for LRcc are $x_2^{1\%}$, $x_2^{5\%}$ and $x_2^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. Critical values for $x_1^{1\%}$, $x_1^{5\%,}$ $x1^{10\%,,}$ $x_2^{1\%}$,$x_2^{5\%,}$ $x_{21}^{0\%}$ are 6.63, 3.84, 2.7, 9.21, 5.99 and 4.6, respectively. If value of the likelihood ratio is larger than the critical value the Value at Risk model is rejected at the significance level.

TC2_3M SHORT												
Out of Sample Obs	PoF			LRind			LRcc			QLF		
526	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model												
GARCH (1,1)_N	3.412*	1.204	11.390***	-	-	0.500	-	-	11.890***	0.167	0.158	0.143
GARCH (1,1)_T	0.013	11.887***	40.470***	-	-	-	-	-	-	0.260	0.312	0.254
GARCH (1,1)_GED	82.853***	4.845**	0.120	0.176	0.259	0.012	83.030***	5.105*	0.132	0.383	0.078	0.079
IGARCH (1,1)_N	6.402**	1.726	8.249***	-	-	0.022	-	-	8.271**	0.115	0.112	0.110
IGARCH (1,1)_T	8.161***	1.726	10.277***	-	-	0.626	-	-	10.903***	0.119	0.116	0.112
IGARCH (1,1)_GED	52.635***	1.668	1.645	0.104	0.420	0.510	52.738***	2.089	2.155	0.303	0.051	0.068
(GJR)TGARCH (1,1)_N	10.077***	0.454	5.675**	-	0.000	0.176	-	0.454	5.852*	0.348	0.249	0.198
(GJR)TGARCH (1,1)_T	0.101	13.786***	37.875***	-	-	-	-	-	-	0.219	0.282	0.233
(GJR)TGARCH (1,1)_GED	42.451***	0.004	12.571***	-	-	-	-	-	-	0.242	0.125	0.156
EGARCH (1,1)_N	3.412*	0.004	4.253**	-	0.076	0.446	-	0.080	4.699*	0.127	0.123	0.118
EGARCH (1,1)_T	0.527	10.173***	28.716***	-	-	-	-	-	-	0.233	0.278	0.229
EGARCH (1,1)_GED	67.226***	8.419***	0.145	0.003	0.047	0.156	67.229***	8.466**	0.301	0.380	0.067	0.070
APARCH (1,1)_N	3.412*	0.019	1.645	-	0.267	0.031	-	0.286	1.676	0.121	0.107	0.106
APARCH (1,1)_T	0.013	13.786***	40.470***	-	-	-	-	-	-	0.444	0.435	0.334
APARCH (1,1)_GED	52.635***	3.394*	3.625*	0.288	0.109	0.001	52.923***	3.503	3.626	0.301	0.064	0.081
TARCH (1,1)_X_N	6.402**	0.454	5.675**	-	0.000	0.066	-	0.454	5.741*	0.328	0.237	0.191
TARCH (1,1)_X_T	0.101	11.887***	35.409***	-	-	-	-	-	-	0.219	0.281	0.232
TARCH (1,1)_X_GED	63.476***	4.091**	2.063	0.001	0.176	0.096	63.477***	4.267	2.159	0.327	0.065	0.077
RISK METRICS	8.161***	0.218	4.936**	-	-	0.259	-	-	5.195*	0.234	0.175	0.149
HS(100) Short	0.527	0.069	0.055	-	-	0.257	-	-	0.312	2.009	0.106	0.081
HS(250) Short	4.814**	3.394*	0.836	-	0.125	0.342	-	3.518	1.178	0.219	0.071	0.076
HS(FS) Short	4.814**	2.757*	1.425	-	1.158	0.001	-	3.915	1.427	0.030	0.051	0.068

Table 15: Represents statistical tests of unconditional, independent and conditional coverage of the interval forecasts under each approach and Loss Function scores for the TC2 3-Months front FFA prices for long positions, denoted by LRuc, LRind and LRcc, respectively. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The tests for LRuc and LRind are $x_1^{1\%}$, $x_1^{5\%}$ and $x_1^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. The tests for LRcc are $x_2^{1\%}$, $x_2^{5\%}$ and $x_2^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. Critical values for $x_1^{1\%}$, $x_1^{5\%,}$ $x1^{10\%,,}$ $x_2^{1\%}$,$x_2^{5\%,}$ $x_{21}^{0\%}$ are 6.63, 3.84, 2.7, 9.21, 5.99 and 4.6, respectively. If value of the likelihood ratio is larger than the critical value the Value at Risk model is rejected at the significance level.

6.2.2 TC5

6.2.2.1 Spot

As per Table 6, TC5 spot's historical distribution is leptokurtic and skewed on the left side (Fischer Skewness Statistic equals -2.28). Looking on the Figure 16 that includes the QQ plots, the negative skewness is being illustrated by the extreme returns that are located on the left of the normal distribution's diagram. As per Figure 20 the returns do not seem to have any serial autocorrelation, since all p-values equal to zero. The JB test clearly indicates distribution's non-normality.

According to Tables 16, 17 and 18 most of the parametric models are resulting over conservative results, with the HIT sequences being far below requested confidence levels. From Tables 17 and 18 , the remark that can be drawn is that no model passes all tests at all three confidence levels, however the models that passed the joint test at least at one confidence level are GARCH(1, 1)_T, GARCH(1, 1)_GED, IGARCH(1, 1)_N, TGARCH(1, 1)_T, TGARCH(1, 1)_GED, EGARCH(1, 1)_T, EGARCH(1, 1)_GED, APARCH(1, 1)_GED, TGARCH(1, 1)_X_T, HS(250) and HS(FS). Nevertheless, the list is narrowing after filtering for GARCH models with statistically significant coefficients. The only model from the shortlist that results significant coefficients is the EGARCH(1, 1)_T. Non-parametric models did not pass the joint test, however they all passed the unconditional test.

Comparing now the finalists in terms of economic accuracy, HS(250) and HS(FS) seem to be the best for TC5_S risk management's purpose, for both long and short positions.

6.2.2.1.1 Value at Risk Statistics

TC5_S															
Out of Sample Obs	Average VaR			Minimum VaR			Maximum VaR			Hit Sequence Long %			Hit Sequence Short %		
465	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model															
GARCH (1,1)_N	-4.56%	-3.22%	-2.51%	-18.77%	-13.28%	-10.35%	-3.98%	-2.81%	-2.19%	0.65%	1.94%	3.23%	0.43%	2.15%	5.16%
GARCH (1,1)_T	-4.08%	-2.88%	-2.25%	-35.27%	-24.93%	-19.42%	-1.87%	-1.32%	-1.03%	1.51%	3.23%	6.67%	1.29%	3.23%	5.81%
GARCH (1,1)_GED	-2.97%	-2.72%	-2.42%	-24.31%	-22.32%	-19.84%	-1.59%	-1.46%	-1.29%	2.80%	3.23%	3.87%	2.80%	3.01%	3.66%
IGARCH (1,1)_N	-3.72%	-2.63%	-2.05%	-4.43%	-3.13%	-2.44%	-3.35%	-2.37%	-1.85%	1.29%	3.01%	5.38%	1.51%	6.88%	10.32%
IGARCH (1,1)_T	-3.74%	-2.64%	-2.06%	-3.74%	-2.65%	-2.06%	-3.74%	-2.64%	-2.06%	1.51%	3.01%	4.95%	1.51%	6.45%	10.11%
IGARCH (1,1)_GED	-2.75%	-2.53%	-2.25%	-2.76%	-2.53%	-2.25%	-2.75%	-2.52%	-2.24%	3.01%	3.23%	4.52%	6.02%	6.88%	9.25%
(GJR)TGARCH (1,1)_N	-4.56%	-3.23%	-2.52%	-13.74%	-9.71%	-7.57%	-4.02%	-2.84%	-2.22%	0.65%	2.37%	3.44%	0.43%	1.72%	4.30%
(GJR)TGARCH (1,1)_T	-4.08%	-2.88%	-2.25%	-33.23%	-23.48%	-18.29%	-1.88%	-1.33%	-1.04%	1.51%	3.23%	7.10%	1.29%	3.01%	4.73%
(GJR)TGARCH (1,1)_GED	-2.97%	-2.73%	-2.42%	-22.58%	-20.73%	-18.43%	-1.59%	-1.46%	-1.30%	2.80%	3.44%	4.52%	2.37%	2.80%	3.44%
EGARCH (1,1)_N	-4.59%	-3.25%	-2.53%	-12.19%	-8.62%	-6.72%	-3.86%	-2.73%	-2.13%	0.86%	2.80%	4.52%	0.43%	1.08%	3.87%
EGARCH (1,1)_T	-3.87%	-2.73%	-2.13%	-34.22%	-24.19%	-18.84%	-2.10%	-1.48%	-1.16%	1.72%	4.09%	6.24%	0.65%	2.37%	5.59%
EGARCH (1,1)_GED	-2.81%	-2.58%	-2.30%	-18.65%	-17.12%	-15.22%	-1.72%	-1.58%	-1.40%	3.01%	4.09%	5.59%	2.15%	2.80%	4.30%
APARCH (1,1)_N	-4.47%	-3.16%	-2.46%	-16.24%	-11.48%	-8.95%	-3.89%	-2.75%	-2.15%	0.65%	2.37%	3.44%	0.43%	2.15%	4.95%
APARCH (1,1)_T	-3.99%	-2.82%	-2.20%	-27.91%	-19.73%	-15.36%	-1.63%	-1.15%	-0.89%	1.51%	3.01%	6.24%	1.29%	3.01%	5.16%
APARCH (1,1)_GED	-2.96%	-2.71%	-2.41%	-21.09%	-19.37%	-17.21%	-1.54%	-1.42%	-1.26%	2.80%	3.23%	4.30%	2.37%	3.01%	3.44%
TARCH (1,1)_X_N	-4.53%	-3.20%	-2.50%	-16.65%	-11.78%	-9.18%	-3.53%	-2.50%	-1.95%	0.65%	1.51%	3.01%	0.43%	1.94%	4.52%
TARCH (1,1)_X_T	-4.07%	-2.88%	-2.24%	-33.40%	-23.60%	-18.38%	-1.85%	-1.31%	-1.02%	1.51%	3.23%	6.88%	1.29%	3.01%	4.73%
TARCH (1,1)_X_GED	-2.87%	-2.63%	-2.34%	-8.34%	-7.66%	-6.81%	-2.54%	-2.33%	-2.07%	2.37%	2.37%	4.09%	3.01%	3.66%	6.24%
RISK METRICS	-2.34%	-3.62%	-2.56%	-6.81%	-8.30%	-5.87%	-1.49%	-1.05%	-0.82%	1.94%	3.87%	7.53%	2.37%	6.24%	9.89%
HS(100) Long	-5.41%	-2.19%	-1.57%	-12.44%	-3.91%	-2.07%	-2.39%	-1.54%	-1.03%	1.29%	4.09%	10.75%	-	-	-
HS(250) Long	-4.10%	-2.12%	-1.57%	-9.86%	-2.48%	-1.82%	-3.23%	-1.94%	-1.31%	0.86%	5.38%	9.68%	-	-	-
HS(FS) Long	-4.04%	-2.15%	-1.59%	-4.24%	-2.21%	-1.62%	-3.92%	-2.11%	-1.56%	1.08%	4.95%	9.46%	-	-	-
HS(100) Short	7.30%	4.11%	3.48%	5.72%	3.53%	3.04%	10.73%	4.62%	3.74%	-	-	-	0.00%	0.86%	2.37%
HS(250) Short	4.03%	2.84%	2.10%	3.29%	2.46%	1.65%	4.62%	3.38%	2.51%	-	-	-	1.29%	5.38%	10.54%
HS(FS) Short	6.21%	2.93%	1.86%	5.98%	2.83%	1.82%	6.46%	3.03%	1.93%	-	-	-	0.22%	5.38%	10.97%

Table 16: Represents Value at Risk results for TC**5** route**'s** spot price returns. The first column presents the different model types that used to measure Value at Risk. The next nine columns present average, minimum and maximum VaR estimates at 1%, 5% and 10%, confidence levels, respectively. The last six columns present the HIT sequence as a percentage of the out-of-sample observations. HIT sequences are reported for both long and short positions.

6.2.2.1.2. Backtesting

TC5_S LONG												
Out of Sample Obs		PoF			LRind			LRcc			QLF	
465	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model												
GARCH (1,1)_N	0.676	11.871***	31.372***	-	2.001	2.971*	-	13.872***	34.342***	0.090	0.100	0.076
GARCH (1,1)_T	1.039	3.505*	6.428**	-	0.455	0.428	-	3.960	6.856**	0.532	0.300	0.195
GARCH (1,1)_GED	10.183***	3.505*	24.731***	-	0.455	0.126	-	3.960	24.857***	0.298	0.224	0.202
IGARCH (1,1)_N	0.363	4.489**	13.057***	3.573*	12.936***	36.361***	3.936	17.425***	49.418***	0.021	0.029	0.032
IGARCH (1,1)_T	1.039	4.489**	15.913***	9.136***	26.141***	28.103***	10.175***	30.631***	44.017***	0.018	0.029	0.032
IGARCH (1,1)_GED	12.353***	3.505*	19.136***	26.141***	24.080***	20.027***	38.494***	27.585***	39.163***	0.097	0.025	0.040
(GJR)TGARCH (1,1)_N	0.676	8.372***	29.031***	-	5.274**	2.540	-	13.645***	31.571***	0.075	0.093	0.073
(GJR)TGARCH (1,1)_T	1.039	3.505*	4.797**	-	0.455	0.196	-	3.960	4.992*	0.522	0.295	0.193
(GJR)TGARCH (1,1)_GED	10.183***	2.659	19.136***	-	0.320	0.991	-	2.979	20.127***	0.294	0.222	0.199
EGARCH (1,1)_N	0.096	5.621**	19.136***	-	14.257***	20.027***	-	19.878***	39.163***	0.064	0.089	0.071
EGARCH (1,1)_T	2.006	0.870	8.337***	-	1.504	7.394***	-	2.374	15.731***	0.425	0.237	0.158
EGARCH (1,1)_GED	12.353***	0.870	11.758***	3.452*	1.504	6.351**	15.804***	2.374	18.109***	0.214	0.132	0.125
APARCH (1,1)_N	0.676	8.372***	29.031***	-	5.274**	2.540	-	13.645***	31.571***	0.090	0.097	0.074
APARCH (1,1)_T	1.039	4.489**	8.337***	-	0.619	0.757	-	5.108*	9.094**	0.405	0.232	0.154
APARCH (1,1)_GED	10.183***	3.505*	20.895***	-	0.455	1.232	-	3.960	22.126***	0.273	0.202	0.184
TARCH (1,1)_X_N	0.676	16.285***	33.850***	-	#NUM!	3.452*	-	-	37.302***	0.087	0.098	0.074
TARCH (1,1)_X_T	1.039	3.505*	5.579**	-	0.455	0.300	-	3.960	5.879*	0.523	0.295	0.193
TARCH (1,1)_X_GED	6.331**	8.372***	22.758***	5.274**	5.274**	4.231**	11.604***	13.645***	26.989***	0.097	0.040	0.053
RISK METRICS	3.228*	1.349	3.426*	6.924***	18.916***	44.353***	10.152***	20.265***	47.779***	0.093	0.060	0.050
HS(100) Long	0.363	0.870	0.286	-	17.461***	84.691***	-	18.331***	84.977***	0.472	0.030	0.030
HS(250) Long	0.096	0.135	0.054	-	30.253***	61.979***	-	30.388***	62.033***	0.121	0.023	0.028
HS(FS) Long	0.026	0.003	0.152	4.339**	28.103***	58.703***	4.365	28.106***	58.855***	0.012	0.022	0.027

Table 17: Represents statistical tests of unconditional, independent and conditional coverage of the interval forecasts under each approach and Loss Function scores for the TC5 spot prices for long positions, denoted by LRuc, LRind and LRcc, respectively. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The tests for LRuc and LRind are $x_1^{1\%}$, $x_1^{5\%}$ and $x_1^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. The tests for LRcc are $x_2^{1\%}$, $x_2^{5\%}$ and $x_2^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. Critical values for $x_1^{1\%}$, $x_1^{5\%,}$ $x1^{10\%,,}$ $x_2^{1\%}$,$x_2^{5\%,}$ $x_21^{0\%}$ are 6.63, 3.84, 2.7, 9.21, 5.99 and 4.6, respectively. If value of the likelihood ratio is larger than the critical value the Value at Risk model is rejected at the significance level.

TC5_S SHORT												
Out of Sample Obs		PoF			LRind			LRcc			QLF	
465	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model												
GARCH (1,1)_N	1.940	10.019***	14.441***	-	1.631	0.443	-	11.650***	14.884***	0.165	0.385	0.559
GARCH (1,1)_T	0.363	3.505*	10.540***	-	-	5.717**	-	-	16.256***	0.685	0.688	0.766
GARCH (1,1)_GED	10.183***	4.489**	26.820***	-	-	-	-	-	-	0.638	0.671	0.719
IGARCH (1,1)_N	1.039	3.118*	0.053	9.136***	33.793***	64.306***	10.175***	36.911***	64.359***	0.239	0.493	0.655
IGARCH (1,1)_T	1.039	1.897	0.006	9.136***	50.324***	55.538***	10.175***	52.221***	55.544***	0.232	0.491	0.654
IGARCH (1,1)_GED	55.044***	3.118*	0.300	36.095***	51.658***	60.010***	91.139***	54.776***	60.310***	0.461	0.524	0.598
(GJR)TGARCH (1,1)_N	1.940	13.951***	20.895***	-	2.436	0.023	-	16.387***	20.918***	0.148	0.377	0.558
(GJR)TGARCH (1,1)_T	0.363	4.489**	17.477***	-	-	5.736**	-	-	23.213***	0.675	0.684	0.768
(GJR)TGARCH (1,1)_GED	6.331**	5.621**	29.031***	-	-	-	-	-	-	0.636	0.667	0.716
EGARCH (1,1)_N	1.940	21.875***	24.731***	-	-	0.126	-	-	24.857***	0.132	0.368	0.554
EGARCH (1,1)_T	0.676	8.372***	11.758***	-	-	0.206	-	-	11.964***	0.618	0.687	0.784
EGARCH (1,1)_GED	4.677**	5.621**	20.895***	-	-	1.232	-	-	22.126***	0.585	0.633	0.696
APARCH (1,1)_N	1.940	10.019***	15.913***	-	-	0.599	-	-	16.512***	0.180	0.401	0.576
APARCH (1,1)_T	0.363	4.489**	14.441***	-	-	7.765***	-	-	22.206***	0.572	0.643	0.747
APARCH (1,1)_GED	6.331**	4.489**	29.031***	-	-	-	-	-	-	0.618	0.651	0.706
TARCH (1,1)_X_N	1.940	11.871***	19.136***	-	2.001	0.991	-	13.872***	20.127***	0.166	0.389	0.567
TARCH (1,1)_X_T	0.363	4.489**	17.477***	-	-	5.736**	-	-	23.213***	0.676	0.686	0.769
TARCH (1,1)_X_GED	12.353***	1.943	8.337***	0.619	0.210	4.576**	12.972***	2.153	12.912***	0.457	0.521	0.597
RISK METRICS	6.331**	1.393	0.006	1.315	28.559***	47.190***	7.646**	29.951***	47.196***	0.323	0.547	0.696
HS(100) Short	-	25.247***	42.215***	-	5.319**	5.274**	-	30.566***	47.489***	0.147	0.062	0.120
HS(250) Short	0.363	0.135	0.147	3.573*	30.253***	61.640***	3.936	30.388***	61.787***	0.184	0.009	0.014
HS(FS) Short	4.255**	0.135	0.471	-	30.253***	73.648***	-	30.388***	74.119***	0.004	0.004	0.012

Table 18: Represents statistical tests of unconditional, independent and conditional coverage of the interval forecasts under each approach and Loss Function scores for the TC5 spot prices for short positions, denoted by LRuc, LRind and LRcc, respectively. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The tests for LRuc and LRind are $x_1^{1\%}$, $x_1^{5\%}$ and $x_1^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. The tests for LRcc are $x_2^{1\%}$, $x_2^{5\%}$ and $x_2^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. Critical values for $x_1^{1\%}$, $x_1^{5\%,}$ $x1^{10\%,,}$ $x_2^{1\%}$,$x_2^{5\%,}$ $x_21^{0\%}$ are 6.63, 3.84, 2.7, 9.21, 5.99 and 4.6, respectively. If value of the likelihood ratio is larger than the critical value the Value at Risk model is rejected at the significance level.

6.2.2.2 FFA 1 Month

As per Table 6, TC5 1 Month's historical distribution is leptokurtic and skewed on the left side (Fischer Skewness Statistic equals -1.45). Figure 16 that include the QQ plots, is picturing the non-normality of the distribution with extreme returns being located on the left and right side of the normal distribution's diagram. Same is also confirmed by the JB test. As per Figure 20 the returns do not seem to have any serial autocorrelation, since all p-values equal to zero.

Table 20 suggests that both the parametric and the non-parametric models performed quite well for capturing the risk related to the long positions, with only exemption the 1-day Value at Risk estimates at 1% confidence level that have been calculated with parametric models that are assuming that the standard returns are following a Generalized Error Distribution. The models that passed most statistical tests for long positions are the GARCH(1, 1)_N, GARCH(1, 1)_T, IGARCH(1, 1)_N, TGARCH(1, 1)_N, TGARCH(1, 1)_T, EGARCH(1, 1)_N, APARCH(1, 1)_N, TGARCH(1, 1)_X_N, Risk Metrics, HS(100), HS(250) and HS(FS), while for short positions are the GARCH(1, 1)_N, IGARCH(1, 1)_N, IGARCH(1, 1)_T, TGARCH(1, 1)_N, TGARCH(1, 1)_N, EGARCH(1, 1)_N, APARCH(1, 1)_N, TGARCH(1, 1)_X_N and HS(250).

After comparing the models in terms of economic accuracy, the models that performed better for long positions are the GARCH(1, 1)_N, IGARCH(1, 1)_N, HS(100), HS(250) and HS(FS), while for short positions are the GARCH(1, 1)_N, IGARCH(1, 1)_N, HS(250) and HS(FS),

6.2.2.2.1 Value at Risk Statistics

TC5_1M															
Out of Sample Obs	Average VaR			Minimum VaR			Maximum VaR			Hit Sequence Long %			Hit Sequence Short %		
465	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model															
GARCH (1,1)_N	-5.63%	-3.98%	-3.10%	-6.89%	-4.88%	-3.80%	-4.91%	-3.47%	-2.71%	1.08%	5.38%	8.17%	0.86%	4.52%	8.17%
GARCH (1,1)_T	-6.59%	-4.66%	-3.63%	-8.22%	-5.81%	-4.53%	-5.74%	-4.05%	-3.16%	0.65%	4.09%	6.45%	0.86%	1.94%	5.81%
GARCH (1,1)_GED	-4.12%	-3.78%	-3.36%	-9.20%	-8.44%	-7.50%	-3.31%	-3.03%	-2.70%	4.95%	5.81%	7.74%	3.66%	5.16%	7.10%
IGARCH (1,1)_N	-5.37%	-3.80%	-2.96%	-7.22%	-5.10%	-3.98%	-4.26%	-3.02%	-2.35%	1.94%	5.59%	8.39%	1.29%	5.81%	8.82%
IGARCH (1,1)_T	-5.48%	-3.87%	-3.02%	-6.88%	-4.86%	-3.79%	-4.67%	-3.30%	-2.57%	2.15%	5.38%	8.39%	1.29%	5.38%	8.60%
IGARCH (1,1)_GED	-4.01%	-3.68%	-3.28%	-4.97%	-4.56%	-4.05%	-3.44%	-3.16%	-2.81%	4.95%	6.02%	7.96%	4.52%	6.02%	7.53%
(GJR)TGARCH (1,1)_N	-5.69%	-4.02%	-3.13%	-7.36%	-5.21%	-4.06%	-4.77%	-3.37%	-2.63%	0.86%	5.38%	7.74%	0.86%	4.52%	8.17%
(GJR)TGARCH (1,1)_T	-6.81%	-4.81%	-3.75%	-8.99%	-6.35%	-4.95%	-5.71%	-4.04%	-3.15%	0.65%	3.44%	5.81%	0.86%	1.94%	5.81%
(GJR)TGARCH (1,1)_GED	-4.14%	-3.80%	-3.37%	-10.58%	-9.71%	-8.63%	-3.36%	-3.08%	-2.74%	4.73%	6.02%	7.74%	3.44%	5.16%	7.10%
EGARCH (1,1)_N	-6.05%	-4.28%	-3.33%	-9.14%	-6.46%	-5.04%	-4.15%	-2.94%	-2.29%	0.65%	4.09%	7.10%	0.86%	3.66%	7.53%
EGARCH (1,1)_T	-7.34%	-5.18%	-4.04%	-10.58%	-7.48%	-5.82%	-5.46%	-3.86%	-3.00%	0.65%	1.94%	5.38%	0.65%	1.51%	4.30%
EGARCH (1,1)_GED	-3.98%	-3.66%	-3.25%	-6.18%	-5.68%	-5.05%	-2.72%	-2.50%	-2.22%	5.38%	6.45%	7.96%	4.73%	6.02%	7.74%
APARCH (1,1)_N	-6.01%	-4.25%	-3.31%	-9.27%	-6.55%	-5.11%	-4.09%	-2.89%	-2.25%	0.65%	4.09%	7.31%	0.86%	3.66%	7.53%
APARCH (1,1)_T	-7.55%	-5.33%	-4.15%	-11.44%	-8.09%	-6.30%	-5.50%	-3.89%	-3.03%	0.43%	1.08%	4.52%	0.65%	1.08%	4.09%
APARCH (1,1)_GED	-3.87%	-3.55%	-3.16%	-12.56%	-11.53%	-10.25%	-2.97%	-2.73%	-2.42%	6.24%	7.31%	8.82%	4.73%	6.45%	8.17%
TARCH (1,1)_X_N	-5.37%	-3.80%	-2.96%	-7.24%	-5.12%	-3.99%	-3.53%	-2.50%	-1.95%	1.51%	6.45%	7.96%	0.86%	3.87%	8.17%
TARCH (1,1)_X_T	-6.55%	-4.63%	-3.61%	-8.56%	-6.05%	-4.71%	-5.25%	-3.71%	-2.89%	0.65%	3.01%	6.67%	0.65%	1.72%	6.24%
TARCH (1,1)_X_GED	-3.92%	-3.60%	-3.20%	-8.96%	-8.23%	-7.31%	-3.28%	-3.01%	-2.68%	5.38%	7.10%	8.17%	4.52%	6.67%	7.53%
RISK METRICS	-5.27%	-3.73%	-2.91%	-9.81%	-6.94%	-5.41%	-2.57%	-1.82%	-1.41%	1.94%	5.38%	8.17%	2.37%	6.67%	8.82%
HS(100) Long	-6.74%	-4.01%	-2.66%	-7.91%	-6.12%	-4.14%	-3.88%	-2.27%	-1.69%	0.43%	5.38%	9.03%	-	-	-
HS(250) Long	-7.17%	-4.04%	-2.24%	-8.08%	-5.17%	-3.44%	-6.06%	-3.77%	-2.00%	0.65%	5.59%	10.32%	-	-	-
HS(FS) Long	-9.34%	-4.45%	-2.70%	-9.66%	-4.61%	-2.82%	-8.08%	-4.33%	-2.63%	0.00%	4.30%	9.89%	-	-	-
HS(100) Short	11.64%	5.36%	4.29%	10.66%	4.47%	3.92%	15.08%	8.70%	5.08%	-	-	-	0.22%	1.72%	3.01%
HS(250) Short	7.32%	3.61%	2.44%	4.08%	3.31%	1.83%	10.64%	4.26%	3.20%	-	-	-	1.51%	6.24%	10.75%
HS(FS) Short	9.08%	4.45%	2.91%	8.83%	4.20%	2.87%	9.71%	4.74%	2.99%	-	-	-	0.65%	2.58%	8.60%
HS(100) Short	8.00%	4.46%	3.63%	8.00%	3.49%	2.05%	8.00%	5.06%	4.24%	-	-	-	0.22%	1.94%	3.66%
HS(250) Short	4.62%	2.33%	1.48%	4.20%	2.02%	1.15%	5.06%	3.28%	1.82%	-	-	-	1.29%	6.24%	10.97%
HS(FS) Short	5.06%	2.62%	1.73%	4.82%	2.56%	1.70%	5.17%	2.67%	1.79%	-	-	-	1.08%	4.95%	9.03%

Table 19: Represents Value at Risk results for TC5 route 1-Month front FFA price returns. The first column presents the different model types that used to measure Value at Risk. The next nine columns present average, minimum and maximum VaR estimates at 1%, 5% and 10%, confidence levels, respectively. The last six columns present the HIT sequence as a percentage of the out-of-sample observations. HIT sequences are reported for both long and short positions.

6.2.2.2.2 Backtesting

TC5_1M LONG												
Out of Sample Obs	PoF			LRind			LRcc			QLF		
465	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model												
GARCH (1,1)_N	0.026	0.135	1.830	-	0.313	1.183	-	0.448	3.013	0.291	0.027	0.025
GARCH (1,1)_T	0.676	0.870	7.346***	-	0.064	0.002	-	0.933	7.349**	0.127	0.017	0.052
GARCH (1,1)_GED	37.578***	0.607	2.834*	-	0.123	0.018	-	0.729	2.852	0.727	0.053	0.043
IGARCH (1,1)_N	3.227*	0.330	1.414	2.001	0.206	0.954	5.229*	0.536	2.369	0.366	0.046	0.028
IGARCH (1,1)_T	4.676**	0.135	1.414	1.631	0.313	0.954	6.308**	0.448	2.369	0.327	0.036	0.026
IGARCH (1,1)_GED	37.578***	0.962	2.302	0.599	0.061	0.404	38.177***	1.023	2.706	0.746	0.048	0.033
(GJR)TGARCH (1,1)_N	0.096	0.135	2.834*	-	0.313	0.552	-	0.448	3.386	0.287	0.028	0.027
(GJR)TGARCH (1,1)_T	0.676	2.659	10.539***	-	0.320	0.123	-	2.979	10.662***	0.111	0.026	0.064
(GJR)TGARCH (1,1)_GED	34.345***	0.962	2.834*	-	0.961	0.018	-	1.922	2.852	0.726	0.055	0.047
EGARCH (1,1)_N	0.676	0.870	4.796**	-	0.064	0.196	-	0.933	4.992*	0.241	0.030	0.038
EGARCH (1,1)_T	0.676	11.871***	13.057***	-	2.001	0.313	-	13.872***	13.370***	0.078	0.049	0.094
EGARCH (1,1)_GED	44.313***	1.897	2.302	0.109	0.002	0.404	44.422***	1.899	2.706	0.768	0.056	0.034
APARCH (1,1)_N	0.676	0.870	4.0794**	-	0.064	0.115	-	0.933	4.194	0.249	0.032	0.038
APARCH (1,1)_T	1.940	21.875***	19.136***	-	-	0.003	-	-	19.139***	0.075	0.063	0.110
APARCH (1,1)_GED	58.776***	4.607**	0.750	0.757	0.923	1.623	59.533***	5.530*	2.373	0.827	0.090	0.053
TARCH (1,1)_X_N	1.039	1.897	2.302	-	0.002	0.001	-	1.899	2.303	0.404	0.062	0.036
TARCH (1,1)_X_T	0.676	4.489**	6.428**	-	0.619	0.428	-	5.108*	6.856**	0.142	0.019	0.049
TARCH (1,1)_X_GED	44.313***	3.830*	1.830	-	0.062	0.005	-	3.892	1.834	0.787	0.061	0.034
RISK METRICS	3.227*	0.135	1.830	-	0.313	0.005	-	0.448	1.834	0.464	0.085	0.046
HS(100) Long	1.940	0.135	0.498	-	0.313	1.350	-	0.448	1.848	0.138	0.063	0.050
HS(250) Long	0.676	0.330	0.053	-	0.179	0.000	-	0.509	0.054	0.057	0.021	0.044
HS(FS) Long	-	0.501	0.006	-	0.023	0.602	-	0.524	0.608	0.078	0.006	0.024

Table 20: Represents statistical tests of unconditional, independent and conditional coverage of the interval forecasts under each approach and Loss Function scores for the TC5 1-Month front FFA prices for long positions, denoted by LRuc, LRind and LRcc, respectively. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The tests for LRuc and LRind are $x_1^{1\%}$, $x_1^{5\%}$ and $x_1^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. The tests for LRcc are $x_2^{1\%}$, $x_2^{5\%}$ and $x_2^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. Critical values for $x_1^{1\%}$, $x_1^{5\%}$, $x1^{10\%}$, $x_2^{1\%}$, $x_2^{5\%}$, $x_{21}^{0\%}$ are 6.63, 3.84, 2.7, 9.21, 5.99 and 4.6, respectively. If value of the likelihood ratio is larger than the critical value the Value at Risk model is rejected at the significance level.

TC5_1M SHORT												
Out of Sample Obs	PoF			LRind			LRcc			QLF		
465	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model												
GARCH (1,1)_N	0.096	0.237	1.830	-	0.003	0.280	-	0.239	2.109	0.497	0.032	0.034
GARCH (1,1)_T	0.096	11.871***	10.540***	-	-	0.265	-	-	10.804***	0.264	0.033	0.053
GARCH (1,1)_GED	19.710***	0.025	4.797**	-	0.056	1.109	-	0.081	5.905*	1.037	0.059	0.055
IGARCH (1,1)_N	0.363	0.607	0.750	-	0.265	0.046	-	0.872	0.796	0.592	0.047	0.039
IGARCH (1,1)_T	0.363	0.135	1.055	-	0.109	0.101	-	0.244	1.156	0.545	0.038	0.035
IGARCH (1,1)_GED	31.209***	0.962	3.426*	0.003	0.367	0.055	31.212***	1.329	3.481	1.053	0.047	0.038
(GJR)TGARCH (1,1)_N	0.096	0.237	1.830	-	0.003	0.280	-	0.239	2.109	0.488	0.034	0.036
(GJR)TGARCH (1,1)_T	0.096	11.871***	10.540***	-	-	0.265	-	-	10.804***	0.232	0.044	0.064
(GJR)TGARCH (1,1)_GED	17.125***	0.025	4.797**	-	0.056	1.109	-	0.081	5.905*	1.036	0.061	0.057
EGARCH (1,1)_N	0.096	1.943	3.426*	-	-	0.725	-	-	4.150	0.416	0.042	0.049
EGARCH (1,1)_T	0.676	16.285***	20.895***	-	-	0.023	-	-	20.918***	0.162	0.074	0.092
EGARCH (1,1)_GED	34.346***	0.962	2.834*	0.002	0.061	0.018	34.348***	1.023	2.852	1.075	0.059	0.046
APARCH (1,1)_N	0.096	1.943	3.426*	-	-	0.725	-	-	4.150	0.428	0.044	0.049
APARCH (1,1)_T	0.676	21.875***	22.758***	-	-	0.064	-	-	22.822***	0.143	0.091	0.107
APARCH (1,1)_GED	34.346***	1.897	1.830	-	-	2.216	-	-	4.045	1.153	0.090	0.064
TARCH (1,1)_X_N	0.096	1.349	1.830	-	-	0.280	-	-	2.109	0.632	0.066	0.048
TARCH (1,1)_X_T	0.676	13.951***	8.337***	-	-	0.485	-	-	8.822**	0.284	0.039	0.055
TARCH (1,1)_X_GED	31.209***	2.473	3.426*	0.003	0.767	0.196	31.212***	3.240	3.622	1.107	0.063	0.046
RISK METRICS	6.331**	2.473	0.750	-	1.680	0.046	-	4.153	0.796	0.685	0.088	0.064
HS(100) Short	4.255**	13.951***	33.850***	-	-	0.619	-	-	34.469***	0.499	0.127	0.108
HS(250) Short	1.039	1.393	0.286	-	0.485	0.085	-	1.878	0.371	0.412	0.047	0.051
HS(FS) Short	0.676	6.911***	1.055	-	1.045	0.101	-	7.955**	1.156	0.007	0.020	0.031

Table 21: Represents statistical tests of unconditional, independent and conditional coverage of the interval forecasts under each approach and Loss Function scores for the TC5 1-Month front FFA prices for short positions, denoted by LRuc, LRind and LRcc, respectively. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The tests for LRuc and LRind are $x_1^{1\%}$, $x_1^{5\%}$ and $x_1^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. The tests for LRcc are $x_2^{1\%}$, $x_2^{5\%}$ and $x_2^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. Critical values for $x_1^{1\%}$, $x_1^{5\%}$, $x1^{10\%}$, $x_2^{1\%}$, $x_2^{5\%}$, $x_{21}^{0\%}$ are 6.63, 3.84, 2.7, 9.21, 5.99 and 4.6, respectively. If value of the likelihood ratio is larger than the critical value the Value at Risk model is rejected at the significance level.

6.2.2.3 FFA 3 Months

As per Table 6 TC5 3 Months' historical distribution is leptokurtic and skewed on the left side (Fischer Skewness Statistic equals -1.15). Examining the QQ plots on the Figure 16, it can be seen that TC5 FFA 3 months front contacts have experienced some extreme negative returns. According to Figure 20 the returns do not seem to have any serial autocorrelation, since all p-values equal to zero. JB test clearly suggests the non-normality of the distribution.

As per Tables 22 and 23 the models that resulted adequate scores close to or below the critical values of the statistical tests, are the GARCH(1, 1)_N, TGARCH(1, 1)_N, EGARCH(1, 1)_N, HS(100), HS(250) and HS(FS) for long positions, and the GARCH(1, 1)_N, HS(250) and HS(FS) for short positions. After filtering for minimum QLF scores, the best performers are the HS(250) and HS(FS) for both long and short positions.

6.2.2.3.1 Value at Risk Statistics

TC5_3M															
Out of Sample Obs	Average VaR			Minimum VaR			Maximum VaR			Hit Sequence Long %			Hit Sequence Short %		
465	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model															
GARCH (1,1)_N	-4.12%	-2.91%	-2.27%	-9.88%	-6.99%	-5.45%	-2.51%	-1.78%	-1.39%	1.08%	3.66%	6.67%	2.58%	5.38%	6.67%
GARCH (1,1)_T	-7.66%	-5.42%	-4.22%	-11.40%	-8.06%	-6.27%	-4.51%	-3.19%	-2.48%	0.00%	0.65%	0.86%	0.00%	1.29%	2.15%
GARCH (1,1)_GED	-2.29%	-2.11%	-1.87%	-6.03%	-5.53%	-4.92%	-1.54%	-1.41%	-1.26%	6.67%	7.74%	8.60%	6.67%	6.88%	7.96%
IGARCH (1,1)_N	-3.29%	-2.33%	-1.82%	-4.27%	-3.02%	-2.35%	-2.62%	-1.85%	-1.44%	2.37%	6.02%	9.03%	3.23%	6.02%	8.60%
IGARCH (1,1)_T	-3.28%	-2.32%	-1.81%	-4.42%	-3.12%	-2.43%	-2.40%	-1.69%	-1.32%	2.58%	6.24%	9.25%	3.44%	6.24%	8.82%
IGARCH (1,1)_GED	-2.68%	-2.46%	-2.19%	-2.73%	-2.51%	-2.23%	-2.62%	-2.41%	-2.14%	4.52%	5.59%	6.67%	4.95%	5.16%	7.53%
(GJR)TGARCH (1,1)_N	-4.11%	-2.91%	-2.27%	-10.04%	-7.10%	-5.54%	-2.55%	-1.80%	-1.41%	1.08%	3.44%	6.45%	2.58%	5.16%	6.88%
(GJR)TGARCH (1,1)_T	-12.02%	-8.50%	-6.62%	-18.53%	-13.09%	-10.20%	-7.75%	-5.48%	-4.27%	0.00%	0.00%	0.00%	0.00%	0.00%	0.22%
(GJR)TGARCH (1,1)_GED	-2.55%	-2.34%	-2.08%	-5.43%	-4.99%	-4.43%	-1.97%	-1.81%	-1.61%	4.95%	5.59%	6.88%	5.81%	6.24%	6.88%
EGARCH (1,1)_N	-4.05%	-2.86%	-2.23%	-8.42%	-5.96%	-4.64%	-2.40%	-1.69%	-1.32%	1.08%	4.30%	6.67%	2.80%	4.52%	6.88%
EGARCH (1,1)_T	-11.60%	-8.20%	-6.39%	-34.09%	-24.10%	-18.77%	-6.81%	-4.82%	-3.75%	0.00%	0.00%	0.00%	0.00%	0.00%	0.22%
EGARCH (1,1)_GED	-2.52%	-2.32%	-2.06%	-5.25%	-4.82%	-4.28%	-2.03%	-1.86%	-1.66%	5.38%	5.59%	6.88%	5.38%	6.45%	7.31%
APARCH (1,1)_N	-3.96%	-2.80%	-2.18%	-8.07%	-5.70%	-4.45%	-2.14%	-1.52%	-1.18%	1.08%	4.30%	6.88%	2.58%	4.95%	7.31%
APARCH (1,1)_T	-6.96%	-4.92%	-3.83%	-15.87%	-11.22%	-8.74%	-2.54%	-1.79%	-1.40%	0.43%	0.86%	2.37%	0.43%	1.51%	3.44%
APARCH (1,1)_GED	-2.37%	-2.18%	-1.94%	-5.81%	-5.33%	-4.74%	-1.20%	-1.10%	-0.98%	6.24%	7.31%	8.39%	6.45%	7.10%	8.39%
TARCH (1,1)_X_N	-4.11%	-2.91%	-2.27%	-10.03%	-7.09%	-5.53%	-2.56%	-1.81%	-1.41%	1.08%	3.23%	6.45%	2.58%	5.16%	6.88%
TARCH (1,1)_X_T	-11.56%	-8.17%	-6.36%	-17.27%	-12.21%	-9.51%	-7.42%	-5.25%	-4.09%	0.00%	0.00%	0.22%	0.00%	0.00%	0.43%
TARCH (1,1)_X_GED	-2.59%	-2.38%	-2.11%	-4.98%	-4.57%	-4.06%	-2.00%	-1.83%	-1.63%	4.95%	5.59%	6.67%	5.81%	6.02%	6.88%
RISK METRICS	-3.31%	-2.34%	-1.83%	-6.49%	-4.59%	-3.57%	-1.65%	-1.16%	-0.91%	2.15%	5.38%	10.11%	3.66%	6.24%	9.89%
HS(100) Long	-4.16%	-2.43%	-1.62%	-5.81%	-3.48%	-2.28%	-1.89%	-1.34%	-0.95%	1.94%	5.59%	10.97%	-	-	-
HS(250) Long	-4.54%	-2.25%	-1.51%	-5.01%	-2.79%	-1.95%	-4.14%	-1.87%	-0.96%	0.43%	6.24%	11.40%	-	-	-
HS(FS) Long	-5.18%	-2.67%	-1.76%	-5.42%	-2.82%	-1.79%	-5.00%	-2.56%	-1.74%	0.43%	4.73%	9.46%	-	-	-
HS(100) Short	8.00%	4.46%	3.63%	8.00%	3.49%	2.05%	8.00%	5.06%	4.24%	-	-	-	0.22%	1.94%	3.66%
HS(250) Short	4.62%	2.33%	1.48%	4.20%	2.02%	1.15%	5.06%	3.28%	1.82%	-	-	-	1.29%	6.24%	10.97%
HS(FS) Short	5.06%	2.62%	1.73%	4.82%	2.56%	1.70%	5.17%	2.67%	1.79%	-	-	-	1.08%	4.95%	9.03%

Table 22: Represents Value at Risk results for TC5 route 3-Months front FFA price returns. The first column presents the different model types that used to measure Value at Risk. The next nine columns present average, minimum and maximum VaR estimates at 1%, 5% and 10%, confidence levels, respectively. The last six columns present the HIT sequence as a percentage of the out-of-sample observations. HIT sequences are reported for both long and short positions.

6.2.2.3.2 Backtesting

TC5_3M LONG												
Out of Sample Obs		PoF			LRind			LRcc			QLF	
465	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model												
GARCH (1,1)_N	0.026	1.943	6.428**	-	0.210	0.003	-	2.153	6.431**	0.109	0.041	0.037
GARCH (1,1)_T	-	29.128***	69.552***	-	-	-	-	-	-	0.465	0.418	0.323
GARCH (1,1)_GED	66.459***	6.351**	1.055	0.003	0.289	0.836	66.462***	6.640**	1.891	0.342	0.037	0.022
IGARCH (1,1)_N	6.331**	0.962	0.498	-	0.961	0.217	-	1.922	0.716	0.142	0.014	0.011
IGARCH (1,1)_T	8.171***	1.393	0.300	-	0.757	0.318	-	2.150	0.618	0.148	0.016	0.012
IGARCH (1,1)_GED	31.209***	0.330	6.428**	0.003	0.206	0.428	31.212***	0.536	6.856**	0.243	0.007	0.015
(GJR)TGARCH (1,1)_N	0.026	2.659	7.347***	-	0.320	0.002	-	2.979	7.349**	0.107	0.040	0.037
(GJR)TGARCH (1,1)_T	-	-	-	-	-	-	-	-	-	2.574	1.721	1.185
(GJR)TGARCH (1,1)_GED	37.578***	0.330	5.579**	0.599	0.206	0.023	38.177***	0.536	5.602*	0.282	0.020	0.019
EGARCH (1,1)_N	0.026	0.501	6.428**	-	0.023	0.003	-	0.524	6.431**	0.090	0.027	0.029
EGARCH (1,1)_T	-	-	-	-	-	-	-	-	-	2.621	1.721	1.178
EGARCH (1,1)_GED	44.314***	0.330	5.579**	0.313	0.206	0.300	44.626***	0.536	5.879*	0.281	0.017	0.016
APARCH (1,1)_N	0.026	0.501	5.579**	-	0.023	0.023	-	0.524	5.602*	0.102	0.029	0.029
APARCH (1,1)_T	1.940	25.247***	42.215***	-	-	-	-	-	-	0.522	0.408	0.305
APARCH (1,1)_GED	58.776***	4.608**	1.414	0.021	0.120	0.674	58.798***	4.727*	2.088	0.328	0.037	0.026
TARCH (1,1)_X_N	0.026	3.505	7.347***	-	0.455	0.002	-	3.960	7.349**	0.105	0.039	0.036
TARCH (1,1)_X_T	-	-	88.098***	-	-	-	-	-	-	2.243	1.529	1.060
TARCH (1,1)_X_GED	37.578***	0.330	6.428**	0.599	0.206	0.003	38.177***	0.536	6.431**	0.272	0.017	0.018
RISK METRICS	4.677**	0.135	0.006	-	0.109	0.015	-	0.244	0.021	0.178	0.032	0.021
HS(100) Long	3.228	0.330	0.471	-	1.452	0.034	-	1.782	0.505	0.091	0.027	0.021
HS(250) Long	1.940	1.393	0.970	-	0.021	0.001	-	1.414	0.971	0.017	0.015	0.017
HS(FS) Long	1.940	0.072	0.152	-	0.002	0.191	-	0.074	0.342	0.003	0.004	0.010

Table 23: Represents statistical tests of unconditional, independent and conditional coverage of the interval forecasts under each approach and Loss Function scores for the TC5 3-Months front FFA prices for long positions, denoted by LRuc, LRind and LRcc, respectively. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The tests for LRuc and LRind are $x_1^{1\%}$, $x_1^{5\%}$ and $x_1^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. The tests for LRcc are $x_2^{1\%}$, $x_2^{5\%}$ and $x_2^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. Critical values for $x_1^{1\%}$, $x_1^{5\%,}$ $x1^{10\%,,}$ $x_2^{1\%}$,$x_2^{5\%,}$ $x_{21}^{0\%}$ are 6.63, 3.84, 2.7, 9.21, 5.99 and 4.6, respectively. If value of the likelihood ratio is larger than the critical value the Value at Risk model is rejected at the significance level.

TC5_3M SHORT												
Out of Sample Obs		PoF			LRind			LRcc			QLF	
465	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model												
GARCH (1,1)_N	8.171***	0.135	6.428**	-	0.109	0.767	-	0.244	7.196**	0.988	0.545	0.369
GARCH (1,1)_T		18.910***	45.357***	-	-	-	-	-	-	2.985	1.549	0.984
GARCH (1,1)_GED	66.459***	3.118*	2.302	0.767	0.931	1.966	67.227***	4.049	4.268	0.401	0.332	0.279
IGARCH (1,1)_N	14.670***	0.962	1.055	-	0.367	0.836	-	1.329	1.891	0.623	0.356	0.249
IGARCH (1,1)_T	17.125***	1.393	0.750	-	0.485	3.049*	-	1.878	3.799	0.624	0.356	0.249
IGARCH (1,1)_GED	37.578***	0.025	3.426*	-	-	1.509	-	-	4.935*	0.445	0.378	0.318
(GJR)TGARCH (1,1)_N	8.171***	0.025	5.579**	-	0.056	0.931	-	0.081	6.510**	0.980	0.542	0.367
(GJR)TGARCH (1,1)_T			88.098***	-	-	-	-	-	-	7.132	3.621	2.246
(GJR)TGARCH (1,1)_GED	51.387***	1.393	5.579**	0.265	0.485	0.931	51.652***	1.878	6.510**	0.439	0.370	0.311
EGARCH (1,1)_N	10.183***	0.237	5.579**	-	-	0.931	-	-	6.510**	0.927	0.513	0.349
EGARCH (1,1)_T			88.098***	-	-	-	-	-	-	7.001	3.559	2.208
EGARCH (1,1)_GED	44.314***	1.897	4.079**	-	0.619	1.302	-	2.516	5.381*	0.424	0.358	0.301
APARCH (1,1)_N	8.171***	0.003	4.079**	-	-	1.302	-	-	5.381*	0.892	0.495	0.337
APARCH (1,1)_T	1.940	16.285***	29.031***	-	-	-	-	-	-	2.715	1.412	0.904
APARCH (1,1)_GED	62.582***	3.830*	1.414	0.619	1.109	2.479	63.201***	4.939*	3.894	0.418	0.347	0.291
TARCH (1,1)_X_N	8.171***	0.025	5.579**	-	0.056	0.931	-	0.081	6.510**	0.981	0.542	0.367
TARCH (1,1)_X_T			80.987***	-	-	-	-	-	-	6.582	3.346	2.079
TARCH (1,1)_X_GED	51.387***	0.962	5.579**	0.265	0.367	0.931	51.652***	1.329	6.510**	0.445	0.376	0.316
RISK METRICS	19.710***	1.393	0.006	0.210	0.485	4.715**	19.921***	1.878	4.721*	0.683	0.387	0.270
HS(100) Short	4.255**	11.871***	26.820***	-	-	-	-	-	-	3.079	1.038	0.735
HS(250) Short	0.363	1.393	0.471	-	0.485	0.631	-	1.878	1.101	1.104	0.351	0.193
HS(FS) Short	0.026	0.003	0.498	-	-	0.217	-	-	0.716	1.293	0.417	0.230

Table 24: Represents statistical tests of unconditional, independent and conditional coverage of the interval forecasts under each approach and Loss Function scores for the TC5 3-Months front FFA prices for short positions, denoted by LRuc, LRind and LRcc, respectively. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The tests for LRuc and LRind are $x_1^{1\%}$, $x_1^{5\%}$ and $x_1^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. The tests for LRcc are $x_2^{1\%}$, $x_2^{5\%}$ and $x_2^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. Critical values for $x_1^{1\%}$, $x_1^{5\%,}$ $x1^{10\%,,}$ $x_2^{1\%}$,$x_2^{5\%,}$ $x_{21}^{0\%}$ are 6.63, 3.84, 2.7, 9.21, 5.99 and 4.6, respectively. If value of the likelihood ratio is larger than the critical value the Value at Risk model is rejected at the significance level.

6.2.3 TD3

6.2.3.1 Spot

As per Table 6, TD3 Spot's historical distribution is experiencing excess kurtosis and positive skewness with the relevant tests having resulted values of 14.28 and 0.42, respectively. Figure 16 that includes the QQ plots clearly depicts the positive skewness with extreme returns to be located on the right side of the normal distribution's diagram. Figure 20 that includes the autocorrelations, rejects any suspicion of serious autocorrelation between the returns with all p-values equal to zero. The JB test also suggests the non-normality of the distribution. These results are congruent with findings from earlier periods by Abouarghoub (2008) and Angelidis and Skiadopoulos (2008), who applied similar methodologies on freight indexes and spot price returns.

Referring to Tables 26 and 27, it can be seen that no model passed all statistical tests, however the GARCH(1, 1)_N, TGARCH_N, EGARCH(1, 1)_N, APARCH(1, 1)_N, HS(100), HS(250) and HS(FS) resulted satisfying results overall for both long and short positions. It can be justified from the results that even though the aforementioned models passed the unconditional coverage test almost at all levels, they failed at the independence test, thus also failing to the joint test. After filtering for statistically significant coefficients the models that models in the shortlist are GARCH(1, 1)_N and EGARCH(1, 1)_N.

Testing now for economic accuracy, by examining the QLF scores, the models that should be used for TD3-S' risk management are GARCH(1, 1)_N, HS(100), HS(250) and HS(FS), for both long and short positions.

6.2.3.1.1 Value at Risk Statistics

TD3_S															
Out of Sample Obs	Average VaR			Minimum VaR			Maximum VaR			Hit Sequence Long %			Hit Sequence Short %		
526	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model															
GARCH (1,1)_N	-8.96%	-6.34%	-4.94%	-41.18%	-29.12%	-22.70%	-4.88%	-3.45%	-2.69%	1.14%	3.80%	6.27%	1.33%	4.37%	7.03%
GARCH (1,1)_T	-338.98%	-239.57%	-186.59%	-2535.35%	-1791.84%	-1395.59%	-131.88%	-93.21%	-72.59%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
GARCH (1,1)_GED	-6.90%	-6.30%	-5.60%	-45.09%	-41.21%	-36.63%	-2.87%	-2.62%	-2.33%	3.42%	3.99%	5.89%	3.61%	3.99%	5.51%
IGARCH (1,1)_N	-8.02%	-5.67%	-4.42%	-15.53%	-10.98%	-8.56%	-3.72%	-2.63%	-2.05%	2.09%	3.99%	6.84%	2.66%	5.89%	8.75%
IGARCH (1,1)_T	-7.60%	-5.37%	-4.18%	-22.54%	-15.93%	-12.41%	-2.08%	-1.47%	-1.14%	2.28%	5.32%	7.41%	3.42%	7.41%	10.27%
IGARCH (1,1)_GED	-5.67%	-5.18%	-4.61%	-14.93%	-13.62%	-12.10%	-1.95%	-1.78%	-1.58%	4.18%	5.13%	6.27%	6.08%	7.79%	9.70%
(GJR)TGARCH (1,1)_N	-8.99%	-6.36%	-4.95%	-42.44%	-30.02%	-23.39%	-4.86%	-3.43%	-2.68%	1.14%	4.18%	6.46%	1.33%	4.18%	7.03%
(GJR)TGARCH (1,1)_T	-324.49%	-229.33%	-178.62%	-2376.37%	-1679.48%	-1308.07%	-126.09%	-89.11%	-69.41%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
(GJR)TGARCH (1,1)_GED	-6.88%	-6.29%	-5.59%	-44.25%	-40.44%	-35.95%	-2.88%	-2.63%	-2.34%	3.42%	3.99%	5.70%	3.61%	4.18%	5.70%
EGARCH (1,1)_N	-8.93%	-6.31%	-4.92%	-59.01%	-41.73%	-32.52%	-4.04%	-2.86%	-2.23%	0.95%	3.99%	6.27%	1.90%	3.99%	6.84%
EGARCH (1,1)_T	-21.57%	-15.24%	-11.87%	-332.53%	-235.01%	-183.04%	-8.61%	-6.08%	-4.74%	0.00%	0.00%	0.19%	0.19%	0.57%	0.95%
EGARCH (1,1)_GED	-6.46%	-5.90%	-5.24%	-76.98%	-70.36%	-62.54%	-2.72%	-2.47%	-2.20%	3.61%	4.37%	6.08%	3.99%	5.32%	6.08%
APARCH (1,1)_N	-8.95%	-6.33%	-4.93%	-37.13%	-26.26%	-20.46%	-4.51%	-3.19%	-2.49%	0.76%	3.80%	6.27%	1.52%	3.99%	7.41%
APARCH (1,1)_T	-48.87%	-34.54%	-26.90%	-264.53%	-186.95%	-145.61%	-14.77%	-10.44%	-8.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
APARCH (1,1)_GED	-6.69%	-6.11%	-5.43%	-32.82%	-29.97%	-26.64%	-2.28%	-2.09%	-1.85%	3.23%	3.80%	5.51%	4.37%	4.94%	5.13%
TARCH (1,1)_X_N	-9.21%	-6.52%	-5.08%	-47.23%	-33.40%	-26.03%	-4.15%	-2.93%	-2.29%	0.95%	3.99%	6.46%	1.33%	3.80%	6.84%
TARCH (1,1)_X_T	-301.49%	-213.08%	-165.96%	-2210.88%	-1562.52%	-1216.98%	-103.54%	-73.18%	-56.99%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
TARCH (1,1)_X_GED	-6.90%	-6.30%	-5.60%	-44.59%	-40.75%	-36.22%	-2.58%	-2.35%	-2.09%	3.42%	4.56%	5.32%	3.23%	4.18%	5.89%
RISK METRICS	-7.87%	-5.57%	-4.34%	-18.33%	-12.97%	-10.11%	-2.81%	-1.99%	-1.55%	2.28%	4.18%	7.22%	3.04%	6.84%	9.89%
HS(100) Long	-9.74%	-5.51%	-3.48%	-17.17%	-8.55%	-5.42%	-2.98%	-1.03%	-0.77%	1.90%	5.89%	11.22%	-	-	-
HS(250) Long	-9.53%	-5.05%	-3.31%	-10.00%	-6.53%	-4.11%	-7.48%	-3.51%	-2.42%	1.33%	5.51%	10.84%	-	-	-
HS(FS) Long	-11.02%	-6.01%	-3.68%	-11.16%	-6.16%	-3.82%	-10.84%	-5.90%	-3.59%	0.19%	4.37%	9.32%	-	-	-
HS(100) Short	15.24%	6.42%	3.88%	7.58%	2.90%	1.82%	23.92%	11.09%	6.29%	-	-	-	1.33%	5.13%	10.46%
HS(250) Short	11.14%	5.63%	3.31%	8.52%	3.84%	2.17%	12.98%	6.95%	4.72%	-	-	-	1.71%	5.13%	11.60%
HS(FS) Short	13.88%	6.77%	3.86%	13.48%	6.56%	3.78%	14.02%	7.01%	3.99%	-	-	-	0.57%	3.80%	10.27%

Table 25: Represents Value at Risk results for TD3 route spot price returns. The first column presents the different model types that used to measure Value at Risk. The next nine columns present average, minimum and maximum VaR estimates at 1%, 5% and 10%, confidence levels, respectively. The last six columns present the HIT sequence as a percentage of the out-of-sample observations. HIT sequences are reported for both long and short positions.

6.2.3.1.2 Backtesting

TD3_S LONG												
Out of Sample Obs		PoF			LRind			LRcc			QLF	
526	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model												
GARCH (1,1)_N	0.101	1.726	9.231***	-	-	1.655	-	-	10.886***	6.733	3.819	2.653
GARCH (1,1)_T	-	-	-	-	-	-	-	-	-	10632.244	5315.220	3227.091
GARCH (1,1)_GED	19.123***	1.204	11.390***	-	-	-	-	-	-	5.194	4.466	3.716
IGARCH (1,1)_N	4.814**	1.204	6.473**	11.439***	11.402***	25.106***	16.253***	12.606***	31.579***	4.530	2.634	1.885
IGARCH (1,1)_T	6.402**	0.113	4.253**	10.295***	6.069**	5.152**	16.697***	6.182**	9.405***	4.908	2.850	2.021
IGARCH (1,1)_GED	30.024***	0.019	9.231***	10.477***	10.154***	8.889***	40.501***	10.174***	18.120***	2.985	2.570	2.184
(GJR)TGARCH (1,1)_N	0.101	0.782	8.249***	-	-	3.130*	-	-	11.379***	6.865	3.894	2.704
(GJR)TGARCH (1,1)_T	-	-	-	-	-	-	-	-	-	9674.296	4836.135	2936.113
(GJR)TGARCH (1,1)_GED	19.123***	1.204	12.571***	-	-	0.387	-	-	12.958***	5.116	4.400	3.662
EGARCH (1,1)_N	0.013	1.204	9.231***	-	-	8.889***	-	-	18.120***	6.511	3.713	2.592
EGARCH (1,1)_T	-	-	100.705***	-	-		-	-		44.741	22.997	14.407
EGARCH (1,1)_GED	21.689***	0.454	10.277***	-	-	0.001	-	-	10.278***	4.476	3.857	3.236
APARCH (1,1)_N	0.332	1.726	9.231***	-	-	3.537*	-	-	12.768***	6.512	3.710	2.587
APARCH (1,1)_T	-	-	-	-			-	-		191.026	96.193	58.885
APARCH (1,1)_GED	16.671***	1.726	13.823***	-	-	0.288	-	-	14.112***	4.358	3.758	3.149
TARCH (1,1)_X_N	0.013	1.204	8.249***	-	-	3.130*	-	-	11.379***	7.369	4.163	2.876
TARCH (1,1)_X_T	-	-	-	-	-		-	-		8251.111	4125.059	2504.631
TARCH (1,1)_X_GED	19.123***	0.218	15.148***	-	0.010	0.175	-	0.228	15.323***	5.108	4.396	3.658
RISK METRICS	6.402**	0.782	4.936**	10.295***	6.551**	22.389***	16.697***	7.332**	27.325***	4.656	2.700	1.933
HS(100) Long	3.412*	0.838	0.836	12.727***	38.817***	54.499***	16.140***	39.655***	55.335***	6.749	2.581	1.446
HS(250) Long	0.527	0.283	0.399	9.618***	20.802***	44.456***	10.145***	21.084***	44.856***	5.685	2.163	1.310
HS(FS) Long	5.234**	0.454	0.280	-	24.277***	45.787***	-	24.731***	46.067***	7.298	2.716	1.455

Table 26: Represents statistical tests of unconditional, independent and conditional coverage of the interval forecasts under each approach and Loss Function scores for the TD3 spot prices for long positions, denoted by LRuc, LRind and LRcc, respectively. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The tests for LRuc and LRind are $x_1^{1\%}$, $x_1^{5\%}$ and $x_1^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. The tests for LRcc are $x_2^{1\%}$, $x_2^{5\%}$ and $x_2^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. Critical values for $x_1^{1\%}$, $x_1^{5\%}$, $x1^{10\%}$, $x_2^{1\%}$, $x_2^{5\%}$, $x_{21}^{0\%}$ are 6.63, 3.84, 2.7, 9.21, 5.99 and 4.6, respectively. If value of the likelihood ratio is larger than the critical value the Value at Risk model is rejected at the significance level.

TD3_S SHORT												
Out of Sample Obs		PoF			LRind			LRcc			QLF	
526	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model												
GARCH (1,1)_N	0.527	0.454	5.675**	-	9.613***	6.255**	-	10.067***	11.931***	6.431	3.019	1.834
GARCH (1,1)_T	-	-	-	-	-	-	-	-	-	10632.244	5315.220	3227.091
GARCH (1,1)_GED	21.689***	1.204	13.823***	-	0.031	8.586***	-	1.235	22.409***	4.827	3.936	2.923
IGARCH (1,1)_N	10.077***	0.838	0.957	13.875***	10.448***	24.070***	23.952***	11.287***	25.027***	3.992	1.830	1.098
IGARCH (1,1)_T	19.123***	5.657**	0.041	14.618***	10.470***	15.072***	33.741***	16.127***	15.113***	4.279	2.143	1.213
IGARCH (1,1)_GED	63.476***	7.445***	0.055	13.180***	11.890***	14.998***	76.655***	19.335***	15.052***	2.375	1.740	1.343
(GJR)TGARCH (1,1)_N	0.527	0.782	5.675**	-	10.477***	6.255**	-	11.258***	11.931***	6.561	3.117	1.878
(GJR)TGARCH (1,1)_T	6.561**	3.117*	1.878	-	-	-	-	-	-	9674.296	4836.135	2936.113
(GJR)TGARCH (1,1)_GED	21.689***	0.782	12.571***	-	0.007	7.871***	-	0.789	20.442***	4.753	3.863	2.860
EGARCH (1,1)_N	3.412*	1.204	6.473**	6.506**	11.402***	6.858***	9.918***	12.606***	13.331***	5.800	2.966	1.776
EGARCH (1,1)_T	5.234**	34.644***	76.301***	-	-	-	-	-	-	44.548	22.774	14.135
EGARCH (1,1)_GED	27.145***	0.113	10.277***	11.402***	9.346***	6.565**	38.547***	9.460***	16.842***	3.697	3.037	2.457
APARCH (1,1)_N	1.243	1.204	4.253**	2.658	11.402***	7.619***	3.901	12.606***	11.872***	6.037	2.955	1.706
APARCH (1,1)_T	-	-	-	-	-	-	-	-	-	191.026	96.193	58.885
APARCH (1,1)_GED	32.998***	0.004	16.549***	9.613***	11.013***	10.154***	42.611***	11.017***	26.703***	3.547	2.960	2.416
TARCH (1,1)_X_N	0.527	1.726	6.473**	-	12.396***	4.393**	-	14.122***	10.867***	7.069	3.381	2.081
TARCH (1,1)_X_T	-	-	-	-	-	-	-	-	-	8251.111	4125.059	2504.631
TARCH (1,1)_X_GED	16.671***	0.782	11.390***	-	0.007	7.198***	-	0.789	18.587***	4.747	3.868	2.849
RISK METRICS	14.342***	3.394*	0.008	17.218***	13.043***	20.312***	31.559***	16.437***	20.320***	4.076	1.928	1.105
HS(100) Short	0.527	0.019	0.120	9.618***	18.640***	39.224***	10.145***	18.659***	39.344***	6.226	1.865	0.763
HS(250) Short	2.215	0.019	1.425	7.394***	18.640***	50.305***	9.608***	18.659***	51.730***	5.121	1.498	0.612
HS(FS) Short	1.161	1.726	0.041	-	12.396***	50.423***	-	14.122***	50.464***	6.970	2.057	0.729

Table 27: Represents statistical tests of unconditional, independent and conditional coverage of the interval forecasts under each approach and Loss Function scores for the TD3 spot prices for short positions, denoted by LRuc, LRind and LRcc, respectively. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The tests for LRuc and LRind are $x_1^{1\%}$, $x_1^{5\%}$ and $x_1^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. The tests for LRcc are $x_2^{1\%}$, $x_2^{5\%}$ and $x_2^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. Critical values for $x_1^{1\%}$, $x_1^{5\%}$, $x1^{10\%}$, $x_2^{1\%}$, $x_2^{5\%}$, $x_{21}^{0\%}$ are 6.63, 3.84, 2.7, 9.21, 5.99 and 4.6, respectively. If value of the likelihood ratio is larger than the critical value the Value at Risk model is rejected at the significance level.

6.2.3.2 FFA 1 Month

As per Table 6 TD3 1 Month's historical distribution is leptokurtic and slightly skewed on the left side (Fischer Skewness Statistic equals -0.30). However, as per Figure 16 this skewness cannot be clearly illustrated on the QQ plots due to its insignificancy. Figure 20 that includes the autocorrelations rejects any suspicion of serious autocorrelation between the returns with all p-values equal to zero. The JB test supports the non-normality of the distribution.

From Tables 29 and 30 it can be seen that the parametric models that passed most statistical tests are the GARCH(1, 1)_N, IGARCH(1, 1)_N, TGARCH(1, 1)_N, TGARCH(1, 1)_T and Risk Metrics for both long and short positions. All mentioned GARCH-family models presented statistically significant coefficients. On the other hand all non-parametric models passed almost all statistical tests.

Comparing now the models with each other in terms of economic accuracy, the models that are suggested for TD3_1M' risk management for both long and short positions are GARCH(1, 1)_N, HS(100), HS(250) and HS(FS).

6.2.3.2.1 Value at Risk Statistics

TD3_1M															
Out of Sample Obs	Average VaR			Minimum VaR			Maximum VaR			Hit Sequence Long %			Hit Sequence Short %		
526	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model															
GARCH (1,1)_N	-11.28%	-7.97%	-6.21%	-67.15%	-47.49%	-37.01%	-6.52%	-4.61%	-3.60%	1.33%	3.04%	5.70%	1.90%	4.56%	6.08%
GARCH (1,1)_T	-16.93%	-11.97%	-9.32%	-74.67%	-52.77%	-41.10%	-9.47%	-6.70%	-5.21%	0.57%	0.95%	1.71%	0.76%	1.90%	2.28%
GARCH (1,1)_GED	-7.21%	-6.59%	-5.85%	-53.63%	-49.07%	-43.62%	-5.13%	-4.68%	-4.15%	3.80%	4.37%	5.70%	4.37%	5.51%	6.65%
IGARCH (1,1)_N	-10.14%	-7.17%	-5.59%	-51.07%	-36.12%	-28.15%	-4.13%	-2.92%	-2.28%	1.71%	4.56%	7.98%	2.66%	5.51%	8.17%
IGARCH (1,1)_T	-10.84%	-7.66%	-5.97%	-34.89%	-24.66%	-19.21%	-5.13%	-3.62%	-2.82%	1.52%	3.42%	6.08%	2.28%	4.37%	7.03%
IGARCH (1,1)_GED	-8.08%	-7.38%	-6.56%	-22.07%	-20.19%	-17.95%	-3.98%	-3.63%	-3.23%	2.85%	3.61%	4.94%	3.42%	4.37%	5.70%
(GJR)TGARCH (1,1)_N	-11.20%	-7.92%	-6.18%	-69.11%	-48.87%	-38.09%	-6.46%	-4.57%	-3.56%	1.14%	3.04%	5.70%	1.71%	4.18%	6.27%
(GJR)TGARCH (1,1)_T	-17.00%	-12.01%	-9.36%	-71.83%	-50.76%	-39.54%	-9.37%	-6.62%	-5.16%	0.57%	1.14%	2.09%	0.76%	1.90%	2.66%
(GJR)TGARCH (1,1)_GED	-7.34%	-6.71%	-5.96%	-54.15%	-49.54%	-44.04%	-4.54%	-4.14%	-3.68%	3.99%	4.18%	6.27%	4.75%	5.70%	6.46%
EGARCH (1,1)_N	-10.68%	-7.56%	-5.89%	-57.05%	-40.34%	-31.44%	-5.84%	-4.13%	-3.22%	1.14%	3.04%	5.32%	1.71%	4.37%	6.08%
EGARCH (1,1)_T	-13.74%	-9.71%	-7.56%	-41.16%	-29.09%	-22.66%	-7.25%	-5.12%	-3.99%	0.57%	1.52%	3.80%	1.33%	2.47%	3.61%
EGARCH (1,1)_GED	-7.01%	-6.40%	-5.69%	-8.17%	-7.48%	-6.65%	-4.28%	-3.92%	-3.48%	2.85%	3.42%	4.94%	3.23%	3.42%	5.13%
APARCH (1,1)_N	-10.90%	-7.71%	-6.01%	-61.20%	-43.28%	-33.73%	-6.28%	-4.44%	-3.46%	0.95%	3.23%	5.70%	1.90%	4.56%	6.46%
APARCH (1,1)_T	-13.23%	-9.35%	-7.28%	-28.55%	-20.18%	-15.72%	-7.10%	-5.02%	-3.91%	0.57%	1.90%	3.61%	1.33%	2.66%	3.99%
APARCH (1,1)_GED	-6.63%	-6.05%	-5.38%	-21.50%	-19.68%	-17.49%	-3.37%	-3.07%	-2.72%	4.56%	4.94%	6.65%	5.32%	6.27%	7.22%
TARCH (1,1)_X_N	-11.30%	-7.99%	-6.23%	-71.31%	-50.43%	-39.30%	-5.99%	-4.23%	-3.30%	1.14%	3.04%	5.70%	1.71%	3.42%	6.08%
TARCH (1,1)_X_T	-17.14%	-12.11%	-9.43%	-69.88%	-49.39%	-38.46%	-9.79%	-6.92%	-5.39%	0.57%	1.14%	2.28%	0.76%	1.71%	2.66%
TARCH (1,1)_X_GED	-6.92%	-6.32%	-5.62%	-44.84%	-41.03%	-36.47%	-5.31%	-4.83%	-4.30%	3.23%	4.18%	5.70%	3.80%	4.37%	7.03%
RISK METRICS	-10.20%	-7.22%	-5.62%	-49.24%	-34.82%	-27.14%	-4.22%	-2.98%	-2.33%	1.71%	4.37%	7.79%	2.66%	5.51%	7.79%
HS(100) Long	-22.36%	-5.78%	-3.91%	-61.12%	-9.53%	-5.30%	-4.76%	-2.84%	-2.07%	1.14%	6.46%	9.89%	-	-	-
HS(250) Long	-14.60%	-5.22%	-3.43%	-25.24%	-6.22%	-4.55%	-8.66%	-3.92%	-2.25%	0.95%	5.51%	12.17%	-	-	-
HS(FS) Long	-17.69%	-7.03%	-4.56%	-18.10%	-7.41%	-4.68%	-17.17%	-6.78%	-4.47%	0.38%	3.04%	7.41%	-	-	-
HS(100) Short	22.07%	6.07%	4.03%	7.23%	4.94%	2.47%	61.12%	8.89%	5.51%	-	-	-	1.33%	5.32%	11.03%
HS(250) Short	11.71%	5.37%	3.92%	8.11%	4.32%	2.60%	15.59%	6.06%	4.80%	-	-	-	1.71%	6.08%	11.41%
HS(FS) Short	14.41%	7.27%	5.06%	14.02%	7.08%	4.98%	14.54%	7.41%	5.24%	-	-	-	0.95%	3.23%	7.22%

Table 28: Represents Value at Risk results for TD3 route 1 month price returns. The first column presents the different model types that used to measure Value at Risk. The next nine columns present average, minimum and maximum VaR estimates at 1%, 5% and 10%, confidence levels, respectively. The last six columns present the HIT sequence as a percentage of the out-of-sample observations. HIT sequences are reported for both long and short positions.

6.2.3.2.2 Backtesting

TD3_1M LONG												
Out of Sample Obs		PoF			LRind			LRcc			QLF	
526	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model												
GARCH (1,1)_N	0.527	4.907**	12.571***	-	0.446	0.051	-	5.354*	12.622***	4.569	1.522	1.126
GARCH (1,1)_T	1.161	26.894***	59.319***	-	-	-	-	-	-	5.251	4.052	2.899
GARCH (1,1)_GED	24.365***	0.454	12.571***	0.074	0.000	0.051	24.439***	0.454	12.622***	5.979	0.804	0.777
IGARCH (1,1)_N	2.215	0.218	2.532	-	0.670	0.047	-	0.888	2.579	5.378	1.536	1.120
IGARCH (1,1)_T	1.243	3.086*	10.277***	-	0.217	0.561	-	3.303	10.838***	4.093	1.204	0.950
IGARCH (1,1)_GED	12.141***	2.351	18.027***	0.598	0.135	0.379	12.739***	2.486	18.406***	5.276	0.975	1.037
(GJR)TGARCH (1,1)_N	0.101	4.907**	12.571***	-	0.446	0.387	-	5.354*	12.958***	4.721	1.586	1.174
(GJR)TGARCH (1,1)_T	1.161	23.680***	52.327***	-	-	1.510	-	-	53.837***	5.097	3.988	2.849
(GJR)TGARCH (1,1)_GED	27.145***	0.782	9.231***	0.031	0.007	1.655	27.176***	0.789	10.886***	6.116	1.026	0.962
EGARCH (1,1)_N	0.101	4.907**	15.148***	-	0.446	0.203	-	5.354*	15.352***	3.571	0.805	0.690
EGARCH (1,1)_T	1.161	18.220***	28.716***	-	2.658	0.074	-	20.878***	28.789***	2.268	1.369	1.150
EGARCH (1,1)_GED	12.141***	3.086*	18.027***	0.598	0.217	0.076	12.739***	3.303	18.104***	5.668	0.412	0.488
APARCH (1,1)_N	0.013	3.936**	12.571***	-	0.320	0.387	-	4.256	12.958***	4.083	1.157	0.919
APARCH (1,1)_T	1.161	13.786***	30.836***	-	1.836	0.135	-	15.622***	30.971***	1.770	0.951	0.908
APARCH (1,1)_GED	36.063***	0.004	7.331***	0.010	0.076	1.083	36.073***	0.080	8.414**	6.144	0.551	0.537
TARCH (1,1)_X_N	0.101	4.907**	12.571***	-	0.446	0.051	-	5.354*	12.622***	4.586	1.538	1.155
TARCH (1,1)_X_T	1.161	23.680***	49.119***	-	-	1.229	-	-	50.348***	5.207	4.107	2.933
TARCH (1,1)_X_GED	16.671***	0.782	12.571***	0.320	0.007	0.909	16.992***	0.789	13.480***	5.665	0.265	0.311
RISK METRICS	2.215	0.454	3.052*	-	0.850	0.015	-	1.305	3.067	5.262	1.507	1.107
HS(100) Long	0.101	2.181	0.008	-	1.394	3.033*	-	3.575	3.040	22.368	0.649	0.527
HS(250) Long	0.013	0.283	2.586	4.578**	1.118	1.558	4.592	1.400	4.144	1.117	0.553	0.551
HS(FS) Long	2.672	4.907**	4.253**	-	0.446	1.511	-	5.354*	5.764*	0.218	0.362	0.432

Table 29: Represents statistical tests of unconditional, independent and conditional coverage of the interval forecasts under each approach and Loss Function scores for the TD3 1-Month front FFA prices for long positions, denoted by LRuc, LRind and LRcc, respectively. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The tests for LRuc and LRind are $x_1^{1\%}$, $x_1^{5\%}$ and $x_1^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. The tests for LRcc are $x_2^{1\%}$, $x_2^{5\%}$ and $x_2^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. Critical values for $x_1^{1\%}$, $x_1^{5\%}$, $x1^{10\%}$, $x_2^{1\%}$, $x_2^{5\%}$, $x_{21}^{0\%}$ are 6.63, 3.84, 2.7, 9.21, 5.99 and 4.6, respectively. If value of the likelihood ratio is larger than the critical value the Value at Risk model is rejected at the significance level.

TD3_1M SHORT												
Out of Sample Obs		PoF			LRind			LRcc			QLF	
526	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model												
GARCH (1,1)_N	3.412*	0.218	10.277***	1.836	2.563	1.942	5.249*	2.780	12.219***	3.639	1.772	1.303
GARCH (1,1)_T	0.332	13.786***	49.119***	-	1.836	1.229	-	15.622***	50.348***	5.893	4.201	2.915
GARCH (1,1)_GED	32.998***	0.283	7.331***	0.850	1.118	1.158	33.848***	1.400	8.488**	3.947	1.119	1.008
IGARCH (1,1)_N	10.077***	0.283	2.063	3.871**	2.969*	3.319*	13.948***	3.252	5.382*	4.044	1.751	1.270
IGARCH (1,1)_T	6.402**	0.454	5.675**	1.229	5.917**	6.255**	7.631**	6.372**	11.931***	2.864	1.327	1.036
IGARCH (1,1)_GED	19.123***	0.454	12.571***	5.419**	5.917**	11.296***	24.542***	6.372**	23.868***	3.259	1.076	1.081
(GJR)TGARCH (1,1)_N	2.215	0.782	9.231***	2.085	1.159	11.908***	4.299	1.940	21.139***	3.695	1.785	1.302
(GJR)TGARCH (1,1)_T	0.332	13.786***	43.203***	-	1.836	3.871**	-	15.622***	47.073***	5.798	4.175	2.892
(GJR)TGARCH (1,1)_GED	39.215***	0.525	8.249***	0.513	2.598	1.394	39.728***	3.123	9.643***	4.153	1.403	1.241
EGARCH (1,1)_N	2.215	0.454	10.277***	2.215	2.942*	0.561	4.430	3.396	10.838***	2.408	1.021	0.830
EGARCH (1,1)_T	0.527	8.631***	30.836***	-	4.421**	4.835**	-	13.052***	35.671***	1.846	1.448	1.167
EGARCH (1,1)_GED	16.671***	3.086*	16.549***	2.529	2.167	0.267	19.201***	5.254*	16.815***	3.256	0.406	0.426
APARCH (1,1)_N	3.412*	0.218	8.249***	1.836	2.563	1.394	5.249*	2.780	9.643***	2.928	1.330	1.019
APARCH (1,1)_T	0.527	7.246***	26.700***	-	3.871**	3.808*	-	11.116***	30.508***	1.104	0.951	0.844
APARCH (1,1)_GED	49.164***	1.668	4.936**	1.352	1.655	3.503*	50.516***	3.323	8.438**	3.722	0.644	0.580
TARCH (1,1)_X_N	2.215	3.086*	10.277***	2.215	2.167	1.942	4.430	5.254*	12.219***	3.584	1.755	1.285
TARCH (1,1)_X_T	0.332	15.890***	43.203***	-	2.215	3.871**	-	18.105***	47.073***	5.932	4.274	2.957
TARCH (1,1)_X_GED	24.365***	0.454	5.675**	1.550	0.850	0.757	25.915***	1.305	6.432**	3.601	0.653	0.612
RISK METRICS	10.077***	0.283	3.052*	3.871**	2.969*	4.177**	13.948***	3.252	7.229**	3.935	1.712	1.249
HS(100) Short	0.527	0.113	0.598	9.618***	1.352	1.212	10.145***	1.465	1.810	22.717	0.522	0.546
HS(250) Short	2.215	1.220	1.112	7.394***	0.001	2.817*	9.608***	1.221	3.928	0.855	0.571	0.543
HS(FS) Short	0.013	3.936**	4.936**	-	2.529	0.026	-	6.465**	4.961*	0.234	0.362	0.427

Table 30: Represents statistical tests of unconditional, independent and conditional coverage of the interval forecasts under each approach and Loss Function scores for the TD3 1-Month front FFA prices for short positions, denoted by LRuc, LRind and LRcc, respectively. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The tests for LRuc and LRind are $x_1^{1\%}$, $x_1^{5\%}$ and $x_1^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. The tests for LRcc are $x_2^{1\%}$, $x_2^{5\%}$ and $x_2^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. Critical values for $x_1^{1\%}$, $x_1^{5\%}$, $x1^{10\%}$, $x_2^{1\%}$, $x_2^{5\%}$, $x_{21}^{0\%}$ are 6.63, 3.84, 2.7, 9.21, 5.99 and 4.6, respectively. If value of the likelihood ratio is larger than the critical value the Value at Risk model is rejected at the significance level.

6.2.3.3 FFA 3 Months

As per Table 6 TD3 3 Months' historical distribution is leptokurtic and slightly skewed at the left side (Fischer Skewness Statistic equals -0.43). Figure 20 that includes the autocorrelations rejects any suspicion of serious autocorrelation between the returns with all p-values equal to zero. The JB test supports the non-normality of the distribution.

The augmented TGARCH that incorporates the spot-3 months slop of returns with t-distribution assumption could not be estimated for the TD3 3 months price returns.

As per Tables 32 and 33 it can be seen that no parametric model performed well at the statistical tests for long positions at VaR1%, where zero hypothesis of the uncondional test has been rejected for all models. Same results are presented also for short positions, with only a few parametric models passing the statistical tests at VaR5% and VaR10%. On the other hand, both HS(100) and HS(250) passed all the tests at all levels for both long and short positions.

By comparing the models in terms of economic accuracy, the non-parametric ones should be preferred for TD3_3M's risk management purposes.

6.2.3.3.1 Value at Risk Statistics

TD3_3M															
Out of Sample Obs	Average VaR			Minimum VaR			Maximum VaR			Hit Sequence Long %			Hit Sequence Short %		
526	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model															
GARCH (1,1)_N	-5.48%	-3.87%	-3.02%	-15.74%	-11.13%	-8.67%	-3.11%	-2.20%	-1.72%	2.28%	3.23%	6.46%	1.90%	4.56%	6.65%
GARCH (1,1)_T	-5.84%	-4.12%	-3.21%	-15.19%	-10.74%	-8.36%	-2.61%	-1.85%	-1.44%	1.90%	3.04%	5.32%	1.90%	3.99%	6.08%
GARCH (1,1)_GED	-4.02%	-3.68%	-3.27%	-13.45%	-12.32%	-10.95%	-3.04%	-2.77%	-2.46%	3.42%	4.56%	5.70%	3.80%	4.56%	5.70%
IGARCH (1,1)_N	-4.60%	-3.25%	-2.53%	-8.14%	-5.76%	-4.49%	-2.86%	-2.02%	-1.58%	2.85%	3.99%	7.41%	2.66%	6.46%	8.94%
IGARCH (1,1)_T	-4.65%	-3.29%	-2.56%	-8.83%	-6.24%	-4.86%	-2.71%	-1.92%	-1.49%	2.85%	3.80%	7.79%	2.66%	6.65%	8.94%
IGARCH (1,1)_GED	-3.33%	-3.04%	-2.71%	-5.54%	-5.08%	-4.51%	-2.18%	-1.99%	-1.77%	3.99%	4.94%	6.84%	6.08%	7.79%	8.56%
(GJR)TGARCH (1,1)_N	-5.44%	-3.85%	-3.00%	-14.73%	-10.42%	-8.12%	-3.04%	-2.15%	-1.68%	2.09%	3.42%	6.65%	1.90%	4.56%	6.84%
(GJR)TGARCH (1,1)_T	-17.59%	-12.43%	-9.68%	-41.75%	-29.51%	-22.98%	-7.61%	-5.38%	-4.19%	0.00%	0.19%	0.19%	0.00%	0.19%	0.57%
(GJR)TGARCH (1,1)_GED	-4.05%	-3.70%	-3.29%	-13.64%	-12.49%	-11.11%	-3.02%	-2.76%	-2.45%	3.42%	4.56%	5.70%	3.99%	4.75%	5.70%
EGARCH (1,1)_N	-5.37%	-3.79%	-2.96%	-11.68%	-8.26%	-6.44%	-2.55%	-1.80%	-1.40%	2.28%	3.23%	6.08%	1.90%	4.18%	7.03%
EGARCH (1,1)_T	-14.68%	-10.37%	-8.08%	-37.53%	-26.52%	-20.66%	-5.98%	-4.22%	-3.29%	0.00%	0.19%	0.19%	0.00%	0.38%	0.95%
EGARCH (1,1)_GED	-4.17%	-3.81%	-3.39%	-12.53%	-11.48%	-10.20%	-3.18%	-2.90%	-2.58%	3.04%	3.80%	4.94%	3.42%	4.37%	5.51%
APARCH (1,1)_N	-5.36%	-3.79%	-2.95%	-11.84%	-8.37%	-6.53%	-2.65%	-1.87%	-1.46%	2.28%	3.23%	6.46%	1.90%	4.37%	7.03%
APARCH (1,1)_T	-13.85%	-9.79%	-7.62%	-34.77%	-24.57%	-19.14%	-5.69%	-4.02%	-3.13%	0.00%	0.19%	0.76%	0.19%	0.38%	0.95%
APARCH (1,1)_GED	-3.77%	-3.44%	-3.06%	-13.84%	-12.68%	-11.27%	-2.59%	-2.36%	-2.10%	4.18%	5.13%	6.65%	4.75%	5.13%	6.84%
TARCH (1,1)_X_N	-5.45%	-3.86%	-3.01%	-14.72%	-10.41%	-8.11%	-3.01%	-2.13%	-1.66%	2.09%	3.42%	6.65%	1.90%	4.56%	6.84%
TARCH (1,1)_X_T															
TARCH (1,1)_X_GED	-3.87%	-3.54%	-3.15%	-9.91%	-9.08%	-8.07%	-2.55%	-2.33%	-2.07%	3.42%	4.37%	5.70%	4.18%	5.13%	6.27%
RISK METRICS	-4.72%	-3.33%	-2.60%	-13.05%	-9.23%	-7.20%	-1.71%	-1.21%	-0.94%	2.85%	4.75%	7.79%	3.04%	5.70%	8.75%
HS(100) Long	-6.45%	-3.26%	-2.16%	-9.91%	-5.65%	-3.08%	-3.08%	-1.36%	-1.22%	1.33%	6.08%	10.27%	-	-	-
HS(250) Long	-6.47%	-2.96%	-1.93%	-7.67%	-4.08%	-2.82%	-4.88%	-2.53%	-1.32%	1.14%	6.27%	12.17%	-	-	-
HS(FS) Long	-9.03%	-4.51%	-2.92%	-9.36%	-4.88%	-3.06%	-8.43%	-4.31%	-2.82%	0.19%	2.66%	6.65%	-	-	-
HS(100) Short	7.96%	3.47%	2.38%	3.67%	2.38%	1.32%	16.99%	7.20%	3.45%	-	-	-	1.33%	5.70%	10.27%
HS(250) Short	5.94%	3.17%	2.07%	4.83%	2.47%	1.36%	8.62%	3.67%	2.74%	-	-	-	1.33%	6.27%	11.41%
HS(FS) Short	9.02%	4.50%	2.83%	8.59%	4.34%	2.72%	9.18%	4.65%	2.93%	-	-	-	0.57%	3.04%	7.98%

Table 31: Represents Value at Risk results for TD3 route 3 months price returns. The first column presents the different model types that used to measure Value at Risk. The next nine columns present average, minimum and maximum VaR estimates at 1%, 5% and 10%, confidence levels, respectively. The last six columns present the HIT sequence as a percentage of the out-of-sample observations. HIT sequences are reported for both long and short positions.

6.2.3.3.2 Backtesting

TD3_3M LONG												
Out of Sample Obs		PoF			LRind			LRcc			QLF	
526	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model												
GARCH (1,1)_N	6.402**	3.936**	8.249***	-	0.320	0.022	-	4.256	8.271**	0.722	0.114	0.074
GARCH (1,1)_T	3.412*	4.907**	15.148***	-	0.446	0.175	-	5.354*	15.323***	0.642	0.119	0.087
GARCH (1,1)_GED	19.123***	0.218	12.571***	0.217	0.010	0.387	19.340***	0.228	12.958***	1.188	0.094	0.070
IGARCH (1,1)_N	12.141***	1.204	4.253**	0.598	1.289	0.004	12.739***	2.493	4.257	0.910	0.102	0.043
IGARCH (1,1)_T	12.141***	1.726	3.052*	0.598	0.074	0.015	12.739***	1.799	3.067	0.901	0.104	0.046
IGARCH (1,1)_GED	27.145***	0.004	6.473**	1.289	0.379	0.125	28.434***	0.383	6.598**	1.488	0.122	0.036
(GJR)TGARCH (1,1)_N	4.814**	3.086*	7.331***	-	0.217	0.057	-	3.303	7.388**	0.724	0.109	0.070
(GJR)TGARCH (1,1)_T	-	45.321***	100.705***	-	-	-	-	-	-	6.000	4.340	3.012
(GJR)TGARCH (1,1)_GED	19.123***	0.218	12.571***	0.217	0.010	0.387	19.340***	0.228	12.958***	1.180	0.095	0.074
EGARCH (1,1)_N	6.402**	3.936**	10.277***	-	0.320	0.001	-	4.256	10.278***	0.697	0.088	0.055
EGARCH (1,1)_T	-	45.321***	100.705***	-	-	-	-	-	-	3.337	2.625	1.879
EGARCH (1,1)_GED	14.342***	1.726	18.027***	-	0.074	0.076	-	1.799	18.104***	1.092	0.058	0.054
APARCH (1,1)_N	6.402**	3.936**	8.249***	-	0.320	0.022	-	4.256	8.271**	0.702	0.088	0.055
APARCH (1,1)_T	-	45.321***	81.415***	-	-	-	-	-	-	2.675	2.185	1.583
APARCH (1,1)_GED	30.024***	0.019	7.331***	0.007	0.133	0.057	30.031***	0.152	7.388**	1.316	0.126	0.076
TARCH (1,1)_X_N	4.814**	3.086*	7.331***	-	0.217	0.057	-	3.303	7.388**	0.721	0.109	0.070
TARCH (1,1)_X_T	-	-	-	-	-	-	-	-	-	2.857	0.801	0.404
TARCH (1,1)_X_GED	19.123***	0.454	12.571***	0.217	0.000	0.051	19.340***	0.454	12.622***	1.254	0.099	0.062
RISK METRICS	12.141***	0.069	3.052*	0.598	0.513	0.600	12.739***	0.582	3.652	0.985	0.152	0.076
HS(100) Long	0.527	1.220	0.041	-	0.561	0.044	-	1.781	0.085	0.417	0.123	0.071
HS(250) Long	0.101	1.668	2.586	-	0.003	0.110	-	1.671	2.696	0.310	0.121	0.081
HS(FS) Long	5.234**	7.246***	7.331***	-	-	0.057	-	-	7.388**	0.010	0.010	0.020

Table 32: Represents statistical tests of unconditional, independent and conditional coverage of the interval forecasts under each approach and Loss Function scores for the TD3 3-Months front FFA prices for long positions, denoted by LRuc, LRind and LRcc, respectively. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The tests for LRuc and LRind are $x_1^{1\%}$, $x_1^{5\%}$ and $x_1^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. The tests for LRcc are $x_2^{1\%}$, $x_2^{5\%}$ and $x_2^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. Critical values for $x_1^{1\%}$, $x_1^{5\%}$, $x1^{10\%}$, $x_2^{1\%}$, $x_2^{5\%}$, $x_{21}^{0\%}$ are 6.63, 3.84, 2.7, 9.21, 5.99 and 4.6, respectively. If value of the likelihood ratio is larger than the critical value the Value at Risk model is rejected at the significance level.

TD3_3M SHORT												
Out of Sample Obs		PoF			LRind			LRcc			QLF	
526	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model												
GARCH (1,1)_N	3.412*	0.218	7.331***	-	0.010	0.203	-	0.228	7.534**	0.822	0.130	0.092
GARCH (1,1)_T	3.412*	1.204	10.277***	-	0.031	0.561	-	1.235	10.838***	0.729	0.134	0.106
GARCH (1,1)_GED	24.365***	0.218	12.571***	0.074	0.010	0.387	24.439***	0.228	12.958***	1.328	0.115	0.089
IGARCH (1,1)_N	10.077***	2.181	0.685	0.777	0.301	0.172	10.854***	2.482	0.856	1.044	0.131	0.069
IGARCH (1,1)_T	10.077***	2.757*	0.685	0.777	1.158	0.172	10.854***	3.915	0.856	1.033	0.132	0.071
IGARCH (1,1)_GED	63.476***	7.445***	1.277	0.561	1.042	0.376	64.037***	8.487**	1.653	1.621	0.153	0.061
(GJR)TGARCH (1,1)_N	3.412*	0.218	6.473**	-	0.670	0.125	-	0.888	6.598**	0.821	0.125	0.087
(GJR)TGARCH (1,1)_T	-	45.321***	87.040***	-	-	-	-	-	-	5.760	4.269	3.016
(GJR)TGARCH (1,1)_GED	27.145***	0.069	12.571***	0.031	0.035	0.387	27.176***	0.104	12.958***	1.316	0.116	0.092
EGARCH (1,1)_N	3.412*	0.782	5.675**	-	0.007	0.757	-	0.789	6.432**	0.803	0.108	0.076
EGARCH (1,1)_T	-	39.457***	76.301***				-	39.457***	76.301***	3.177	2.574	1.883
EGARCH (1,1)_GED	19.123***	0.454	13.823***	0.217	0.000	0.104	19.340***	0.454	13.927***	1.230	0.082	0.076
APARCH (1,1)_N	3.412*	0.454	5.675**	-	0.000	0.757	-	0.454	6.432**	0.807	0.109	0.077
APARCH (1,1)_T	5.234**	39.457***	76.301***				5.234*	39.457***	76.301***	2.536	2.140	1.592
APARCH (1,1)_GED	39.215***	0.019	6.473**	0.035	0.133	1.261	39.251***	0.152	7.735**	1.459	0.150	0.094
TARCH (1,1)_X_N	3.412*	0.218	6.473**	-	0.670	0.125	-	0.888	6.598**	0.818	0.125	0.088
TARCH (1,1)_X_T	-	-	-	-	-	-	-	-	-	1.473	0.486	0.293
TARCH (1,1)_X_GED	30.024***	0.019	9.231***	0.007	0.267	0.420	30.031***	0.286	9.651***	1.392	0.121	0.081
RISK METRICS	14.342***	0.525	0.957	-	0.051	0.342	-	0.576	1.299	1.101	0.176	0.096
HS(100) Short	0.527	0.525	0.041	-	2.598	1.212	-	3.123	1.253	0.572	0.108	0.077
HS(250) Short	0.527	1.668	1.112	-	1.655	0.795	-	3.323	1.907	0.579	0.131	0.097
HS(FS) Short	1.161	4.907**	2.532	-	2.930*	0.842	-	7.838**	3.374	0.009	0.031	0.051

Table 33: Represents statistical tests of unconditional, independent and conditional coverage of the interval forecasts under each approach and Loss Function scores for the TD3 3-Months front FFA prices for short positions, denoted by LRuc, LRind and LRcc, respectively. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The tests for LRuc and LRind are $x_1^{1\%}$, $x_1^{5\%}$ and $x_1^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. The tests for LRcc are $x_2^{1\%}$, $x_2^{5\%}$ and $x_2^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. Critical values for $x_1^{1\%}$, $x_1^{5\%}$, $x1^{10\%}$, $x_2^{1\%}$, $x_2^{5\%}$, $x_{21}^{0\%}$ are 6.63, 3.84, 2.7, 9.21, 5.99 and 4.6, respectively. If value of the likelihood ratio is larger than the critical value the Value at Risk model is rejected at the significance level.

6.2.4 TD7

6.2.4.1 Spot

As per Table 6, TD7 spot's historical distribution is leptokurtic and skewed at the right side (Fischer Skewness Statistic equals 0.66). Figure 16 that includes the QQ plots, gives an illustration of the positive skewness, since it presents some extreme returns on the right side of normal distribution's diagram. Figure 20 that includes the autocorrelations rejects any suspicion of serious autocorrelation between the returns with all p-values equal to zero. The JB test supports the non-normality of the distribution. These results are congruent with findings from earlier period by Abouarghoub (2008).

Tables 35 and 36, clearly depicts the parametric models' incapacity of capturing risk at VaR5% and VaR10% for both long and short positions, since they resulted over conservative results. However, their performance is satisfying at VaR1% for both long and short positions. Both HS(250) and HS(FS) presented good results for both long and short positions.

Comparing the models by their resulted QLF scores, it is clear that the non-parametric models performed better overall for both long and short positions, at all confidence levels.

6.2.4.1.1 Value at Risk Statistics

TD7_S															
Out of Sample Obs	Average VaR			Minimum VaR			Maximum VaR			Hit Sequence Long %			Hit Sequence Short %		
465	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model															
GARCH (1,1)_N	-16.57%	-11.72%	-9.13%	-163.99%	-115.97%	-90.38%	-1.44%	-1.02%	-0.80%	1.51%	2.37%	3.44%	1.51%	2.37%	3.01%
GARCH (1,1)_T	-20.40%	-14.42%	-11.23%	-206.84%	-146.18%	-113.86%	-0.18%	-0.13%	-0.10%	1.51%	2.15%	2.37%	1.51%	2.15%	2.58%
GARCH (1,1)_GED	-7.57%	-6.95%	-6.17%	-63.24%	-58.08%	-51.62%	-1.10%	-1.01%	-0.90%	3.01%	3.44%	4.09%	2.80%	3.23%	3.66%
IGARCH (1,1)_N	-11.18%	-7.91%	-6.16%	-24.59%	-17.39%	-13.55%	-3.00%	-2.12%	-1.65%	1.08%	1.72%	2.58%	1.08%	2.15%	2.58%
IGARCH (1,1)_T	-8.73%	-6.17%	-4.81%	-57.37%	-40.55%	-31.58%	-0.39%	-0.28%	-0.22%	2.58%	3.66%	4.30%	2.80%	3.44%	4.73%
IGARCH (1,1)_GED	-8.31%	-7.62%	-6.78%	-16.62%	-15.25%	-13.55%	-2.43%	-2.23%	-1.98%	1.51%	1.94%	2.37%	1.94%	1.94%	2.37%
(GJR)TGARCH (1,1)_N	-13.34%	-9.44%	-7.35%	-87.54%	-61.91%	-48.25%	-2.19%	-1.55%	-1.21%	1.29%	2.37%	3.87%	0.86%	1.29%	2.37%
(GJR)TGARCH (1,1)_T	-17.11%	-12.09%	-9.42%	-172.31%	-121.78%	-94.85%	-0.33%	-0.23%	-0.18%	1.51%	2.15%	2.58%	1.51%	2.37%	2.58%
(GJR)TGARCH (1,1)_G	-8.70%	-7.98%	-7.10%	-95.15%	-87.38%	-77.67%	-1.34%	-1.23%	-1.09%	3.44%	3.87%	3.87%	2.80%	3.01%	3.44%
EGARCH (1,1)_N	-12.07%	-8.53%	-6.65%	-54.26%	-38.37%	-29.91%	-2.47%	-1.75%	-1.36%	1.51%	2.58%	3.44%	1.08%	1.51%	1.94%
EGARCH (1,1)_T	-124.49%	-87.98%	-68.53%	-27978.17%	-19773.32%	-15400.61%	-3.79%	-2.68%	-2.08%	0.22%	1.08%	1.94%	0.22%	0.86%	1.29%
EGARCH (1,1)_GED	-10.01%	-9.19%	-8.17%	-478.59%	-439.31%	-390.50%	-1.31%	-1.20%	-1.07%	3.23%	3.44%	4.09%	2.37%	2.80%	3.66%
APARCH (1,1)_N	-11.43%	-8.08%	-6.30%	-46.64%	-32.99%	-25.71%	-2.10%	-1.48%	-1.16%	1.51%	2.37%	3.87%	1.08%	1.51%	2.15%
APARCH (1,1)_T	-33.60%	-23.75%	-18.50%	-320.68%	-226.64%	-176.52%	-0.62%	-0.44%	-0.34%	0.65%	0.86%	1.72%	0.43%	0.86%	1.29%
APARCH (1,1)_GED	-8.17%	-7.50%	-6.67%	-65.35%	-60.01%	-53.34%	-0.36%	-0.33%	-0.29%	3.23%	3.66%	3.87%	2.80%	2.80%	3.23%
TARCH (1,1)_X_N	-12.00%	-8.48%	-6.61%	-43.35%	-30.66%	-23.89%	-3.71%	-2.63%	-2.05%	0.86%	1.51%	2.58%	0.43%	1.08%	1.72%
TARCH (1,1)_X_T	-11.13%	-7.87%	-6.13%	-38.94%	-27.52%	-21.43%	-3.54%	-2.50%	-1.95%	1.08%	2.15%	2.80%	0.43%	1.08%	1.94%
TARCH (1,1)_X_GED	-7.41%	-6.80%	-6.05%	-50.29%	-46.18%	-41.05%	-1.95%	-1.79%	-1.59%	2.15%	2.37%	3.23%	1.08%	1.08%	1.72%
RISK METRICS	-6.36%	-4.50%	-3.51%	-28.83%	-20.39%	-15.89%	-2.11%	-1.50%	-1.17%	2.80%	3.87%	4.52%	2.37%	4.09%	4.95%
HS(100) Long	-15.84%	-2.88%	-0.62%	-36.10%	-7.41%	-2.18%	-2.82%	-0.86%	0.00%	1.08%	4.95%	8.39%	-	-	-
HS(250) Long	-10.01%	-2.59%	-0.71%	-12.52%	-3.54%	-1.10%	-4.26%	-0.93%	0.00%	1.51%	4.73%	8.60%	-	-	-
HS(FS) Long	-9.24%	-3.76%	-2.16%	-9.65%	-3.82%	-2.29%	-8.79%	-3.64%	-2.06%	1.72%	3.87%	4.95%	-	-	-
HS(100) Short	20.73%	7.88%	4.35%	14.31%	2.99%	0.95%	36.10%	10.79%	7.47%	-	-	-	0.00%	1.72%	3.01%
HS(250) Short	9.35%	2.45%	0.97%	3.18%	1.71%	0.00%	10.92%	3.35%	1.37%	-	-	-	1.51%	5.59%	9.68%
HS(FS) Short	9.10%	3.81%	2.24%	8.75%	3.70%	2.17%	9.61%	4.04%	2.50%	-	-	-	1.29%	3.44%	6.02%

Table 34: Represents Value at Risk results for TD7 route spot price returns. The first column presents the different model types that used to measure Value at Risk. The next nine columns present average, minimum and maximum VaR estimates at 1%, 5% and 10%, confidence levels, respectively. The last six columns present the HIT sequence as a percentage of the out-of-sample observations. HIT sequences are reported for both long and short positions.

6.2.4.1.2 Backtesting

TD7_S LONG												
Out of Sample Obs	PoF			LRind			LRcc			QLF		
465	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model												
GARCH (1,1)_N	1.039	8.372***	29.031***	2.952*	1.315	0.320	3.991	9.687***	29.351***	20.637	12.215	7.825
GARCH (1,1)_T	1.039	10.019***	42.215***	2.952*	1.631	1.315	3.991	11.650***	43.531***	34.692	19.994	12.759
GARCH (1,1)_GED	12.353***	2.659	22.758***	0.619	0.320	0.064	12.972***	2.979	22.822***	3.208	3.091	2.829
IGARCH (1,1)_N	0.026	13.951***	39.260***	-	-	-	-	-	-	1.417	1.528	1.225
IGARCH (1,1)_T	8.171***	1.943	20.895***	-	-	1.232	-	-	22.126***	3.321	1.974	1.406
IGARCH (1,1)_GED	1.039	11.871***	42.215***	-	-	-	-	-	-	0.670	1.250	1.450
(GJR)TGARCH (1,1)_N	0.363	8.372***	24.731***	-	-	-	-	-	-	8.797	5.642	3.681
(GJR)TGARCH (1,1)_T	1.039	10.019***	39.260***	2.952*	1.631	1.045	3.991	11.650***	40.305***	22.455	13.208	8.521
(GJR)TGARCH (1,1)_GED	17.125***	1.349	24.731***	0.320	0.126	0.126	17.445***	1.474	24.857***	5.240	5.298	4.681
EGARCH (1,1)_N	1.039	6.911***	29.031***	-	-	-	-	-	-	4.506	3.213	2.276
EGARCH (1,1)_T	4.255**	21.875***	48.704***	-	-	-	-	-		90475.756	45214.960	27433.010
EGARCH (1,1)_GED	14.670***	2.659	22.758***	-	-	0.064	-	-	22.822***	49.568	43.202	34.742
APARCH (1,1)_N	1.039	8.372***	24.731***	-	-	-	-	-	-	3.386	2.553	1.851
APARCH (1,1)_T	0.676	25.247***	52.278***	-	5.319**	2.436	-	30.566***	54.714***	93.797	52.211	32.805
APARCH (1,1)_GED	14.670***	1.943	24.731***	0.455	0.210	0.126	15.125***	2.153	24.857***	3.172	3.340	3.091
TARCH (1,1)_X_N	0.096	16.285***	39.260***	-	-	-	-	-	-	1.253	1.604	1.296
TARCH (1,1)_X_T	0.026	10.019***	36.476***	-	-	-	-	-	-	0.901	1.249	1.055
TARCH (1,1)_X_GED	4.677**	8.372***	31.372***	-	-	-	-	-	-	1.430	1.519	1.586
RISK METRICS	10.183***	1.349	19.136***	-	-	-	-	-	-	1.513	0.662	0.542
HS(100) Long	0.026	0.003	1.414	-	-	0.179	-	-	1.593	8.029	0.261	0.351
HS(250) Long	1.039	0.072	1.055	-	-	5.599**	-	-	6.653**	0.316	0.245	0.322
HS(FS) Long	2.006	1.349	15.913***	-	-	-	-	-	-	0.091	0.158	0.195

Table 35: Represents statistical tests of unconditional, independent and conditional coverage of the interval forecasts under each approach and Loss Function scores for the TD7 spot prices for long positions, denoted by LRuc, LRind and LRcc, respectively. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The tests for LRuc and LRind are $x_1^{1\%}$, $x_1^{5\%}$ and $x_1^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. The tests for LRcc are $x_2^{1\%}$, $x_2^{5\%}$ and $x_2^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. Critical values for $x_1^{1\%}$, $x_1^{5\%}$, $x1^{10\%}$, $x_2^{1\%}$, $x_2^{5\%}$, $x_{21}^{0\%}$ are 6.63, 3.84, 2.7, 9.21, 5.99 and 4.6, respectively. If value of the likelihood ratio is larger than the critical value the Value at Risk model is rejected at the significance level.

TD7_S SHORT												
Out of Sample Obs	PoF			LRind			LRcc			QLF		
465	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model												
GARCH (1,1)_N	1.039	8.372***	33.850***	2.952*	5.274**	3.452*	3.991	13.645***	37.302***	21.137	12.134	7.831
GARCH (1,1)_T	1.039	10.019***	39.260***	2.952*	6.044**	4.594**	3.991	16.063***	43.854***	35.440	19.860	12.639
GARCH (1,1)_GED	10.183***	3.505*	26.820***	3.990**	2.971*	2.155	14.173***	6.476**	28.975***	3.143	3.116	2.837
IGARCH (1,1)_N	0.026	10.019***	39.260***	-	-	-	-	-	-	1.551	1.498	1.187
IGARCH (1,1)_T	10.183***	2.659	17.477***	-	2.540	0.781	-	5.200*	18.258***	3.324	1.985	1.390
IGARCH (1,1)_GED	3.228*	11.871***	42.215***	-	-	-	-	-	-	0.611	1.230	1.411
(GJR)TGARCH (1,1)_N	0.096	18.910***	42.215***	-	-	-	-	-	-	9.077	5.508	3.668
(GJR)TGARCH (1,1)_T	1.039	8.372***	39.260***	-	5.274**	4.594**	-	13.645***	43.854***	22.987	13.070	8.396
(GJR)TGARCH (1,1)_GED	10.183***	4.489**	29.031***	3.990**	3.452*	2.540	14.173***	7.941**	31.571***	5.276	5.334	4.683
EGARCH (1,1)_N	0.026	16.285***	48.704***	-	-	-	-	-	-	4.715	3.214	2.247
EGARCH (1,1)_T	4.255**	25.247***	60.226***	-	-	3.573*	-	-	63.800***	90483.282	45214.431	27432.322
EGARCH (1,1)_GED	6.331**	5.621**	26.820***	5.274**	3.990**	2.155	11.604***	9.611***	28.975***	49.690	43.242	34.744
APARCH (1,1)_N	0.026	16.285***	45.357***	-	-	-	-	-	-	3.558	2.545	1.829
APARCH (1,1)_T	1.940	25.247***	60.226***	-	-	-	-	-	-	95.395	52.078	32.565
APARCH (1,1)_GED	10.183***	5.621**	31.372***	3.990**	3.990**	2.971*	14.173***	9.611***	34.342***	3.147	3.348	3.078
TARCH (1,1)_X_N	1.940	21.875***	52.278***	-	-	-	-	-	-	1.454	1.586	1.256
TARCH (1,1)_X_T	1.940	21.875***	48.704***	-	-	-	-	-	-	1.040	1.237	1.003
TARCH (1,1)_X_GED	0.026	21.875***	52.278***	-	-	-	-	-	-	1.321	1.500	1.539
RISK METRICS	6.331**	0.870	15.913***	-	-	-	-	-	-	1.245	0.576	0.472
HS(100) Short	-	13.951***	33.850***	-	-	-	-	-	-	11.175	1.178	0.514
HS(250) Short	1.039	0.330	0.054	-	1.452	3.130*	-	1.782	3.185	0.330	0.252	0.284
HS(FS) Short	0.363	2.659	9.400***	-	2.540	2.705	-	5.200*	12.105***	0.085	0.144	0.178

Table 36: Represents statistical tests of unconditional, independent and conditional coverage of the interval forecasts under each approach and Loss Function scores for the TD7 spot prices for short positions, denoted by LRuc, LRind and LRcc, respectively. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The tests for LRuc and LRind are $x_1^{1\%}$, $x_1^{5\%}$ and $x_1^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. The tests for LRcc are $x_2^{1\%}$, $x_2^{5\%}$ and $x_2^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. Critical values for $x_1^{1\%}$, $x_1^{5\%}$, $x1^{10\%}$, $x_2^{1\%}$, $x_2^{5\%}$, $x_{21}^{0\%}$ are 6.63, 3.84, 2.7, 9.21, 5.99 and 4.6, respectively. If value of the likelihood ratio is larger than the critical value the Value at Risk model is rejected at the significance level.

6.2.4.2 FFA 1 Month

As per Table 6, TD7 1 Month's historical distribution is leptokurtic and slightly skewed at the left side (Fischer Skewness Statistic equals -0.48). Figure 16 which includes the QQ plots, clearly depicts the distribution's non-normality. Same is supported by the JB test. Figure 20 that includes the autocorrelations rejects any suspicion of serious autocorrelation between the returns with all p-values equal to zero.

The IGARCH with t-distribution assumption could not be estimated for the TD7 1 month price returns.

As per Tables 38 and 39, the best parametric models in terms of statistical accuracy for both long and short positions are GARCH(1, 1)_N, IGARCH(1, 1)_N and TGARCH(1, 1)_N. However, not all TGARCH(1, 1)_N's coefficients were statistically significant. Non-parametric models passed most of the statistical test at the respective confidence levels.

Testing now for economic accuracy, by examining the QLF scores, the models that should be used for TD7_1M's risk management are the non-parametric ones. The results are in place for both long and short positions.

6.2.4.2.1 Value at Risk Statistics

TD7_1M															
Out of Sample Obs	Average VaR			Minimum VaR			Maximum VaR			Hit Sequence Long %			Hit Sequence Short %		
465	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model															
GARCH (1,1)_N	-6.51%	-4.61%	-3.59%	-26.05%	-18.42%	-14.36%	-4.54%	-3.21%	-2.50%	1.72%	3.23%	4.30%	1.72%	2.37%	3.44%
GARCH (1,1)_T	-8.98%	-6.35%	-4.94%	-132.25%	-93.47%	-72.80%	-0.18%	-0.12%	-0.10%	3.01%	3.87%	4.52%	3.01%	3.44%	3.87%
GARCH (1,1)_GED	-2.79%	-2.56%	-2.28%	-34.46%	-31.62%	-28.10%	-0.88%	-0.81%	-0.72%	5.38%	5.38%	5.59%	5.38%	6.02%	6.24%
IGARCH (1,1)_N	-7.04%	-4.98%	-3.88%	-20.09%	-14.21%	-11.07%	-2.86%	-2.02%	-1.58%	2.15%	3.01%	4.52%	1.72%	3.44%	4.09%
IGARCH (1,1)_T	-6.77%	-4.78%	-3.72%	-8.29%	-5.86%	-4.56%	-4.10%	-2.90%	-2.26%	2.37%	3.23%	3.87%	1.94%	2.80%	4.09%
IGARCH (1,1)_GED	-5.02%	-4.61%	-4.10%	-6.79%	-6.23%	-5.54%	-2.35%	-2.16%	-1.92%	3.01%	3.23%	3.44%	3.23%	3.44%	4.09%
(GJR)TGARCH (1,1)_N	-6.51%	-4.60%	-3.59%	-26.46%	-18.71%	-14.58%	-4.52%	-3.19%	-2.49%	1.72%	3.44%	4.30%	1.72%	2.37%	3.44%
(GJR)TGARCH (1,1)_T															
(GJR)TGARCH (1,1)_G	-3.32%	-3.05%	-2.71%	-36.46%	-33.46%	-29.74%	-2.04%	-1.87%	-1.66%	4.73%	4.73%	5.38%	4.52%	4.52%	5.16%
EGARCH (1,1)_N	-5.79%	-4.09%	-3.19%	-22.64%	-16.01%	-12.48%	-3.38%	-2.39%	-1.86%	2.58%	3.87%	5.16%	2.15%	3.23%	4.09%
EGARCH (1,1)_T	-35.69%	-25.23%	-19.65%	-133.73%	-94.51%	-73.61%	-8.80%	-6.22%	-4.85%	0.22%	0.43%	0.65%	0.22%	0.22%	0.86%
EGARCH (1,1)_GED	-3.98%	-3.65%	-3.24%	-108.30%	-99.38%	-88.34%	-1.24%	-1.14%	-1.01%	4.09%	4.09%	4.52%	3.01%	4.09%	4.52%
APARCH (1,1)_N	-5.59%	-3.96%	-3.08%	-24.66%	-17.44%	-13.59%	-1.38%	-0.97%	-0.76%	2.58%	4.30%	4.73%	1.94%	3.23%	4.73%
APARCH (1,1)_T	-2.21%	-1.56%	-1.22%	-21.65%	-15.30%	-11.92%	-0.01%	-0.01%	0.00%	6.02%	6.88%	7.31%	7.10%	8.39%	9.03%
APARCH (1,1)_GED	-2.53%	-2.33%	-2.07%	-19.64%	-18.02%	-16.02%	-0.94%	-0.91%	-0.86%	5.38%	5.59%	5.59%	4.52%	5.38%	6.24%
TARCH (1,1)_X_N	-7.01%	-4.96%	-3.87%	-84.08%	-59.46%	-46.34%	-0.03%	-0.02%	-0.02%	3.01%	4.52%	4.73%	2.80%	3.23%	4.09%
TARCH (1,1)_X_T	-8.00%	-5.65%	-4.40%	-98.19%	-69.40%	-54.05%	-0.10%	-0.07%	-0.06%	3.01%	4.09%	4.52%	2.58%	3.01%	3.66%
TARCH (1,1)_X_GED	-3.51%	-3.22%	-2.86%	-30.63%	-28.11%	-24.99%	-1.59%	-1.52%	-1.44%	4.30%	4.73%	4.95%	4.09%	4.30%	4.73%
RISK METRICS	-6.36%	-4.50%	-3.51%	-28.83%	-20.39%	-15.89%	-2.11%	-1.50%	-1.17%	2.80%	3.87%	4.52%	2.37%	4.09%	4.95%
HS(100) Long	-15.84%	-2.88%	-0.62%	-36.10%	-7.41%	-2.18%	-2.82%	-0.86%	0.00%	1.08%	4.95%	8.39%	-	-	-
HS(250) Long	-10.01%	-2.59%	-0.71%	-12.52%	-3.54%	-1.10%	-4.26%	-0.93%	0.00%	1.51%	4.73%	8.60%	-	-	-
HS(FS) Long	-9.24%	-3.76%	-2.16%	-9.65%	-3.82%	-2.29%	-8.79%	-3.64%	-2.06%	1.72%	3.87%	4.95%	-	-	-
HS(100) Short	20.73%	7.88%	4.35%	14.31%	2.99%	0.95%	36.10%	10.79%	7.47%	-	-	-	0.43%	1.94%	4.52%
HS(250) Short	9.35%	2.45%	0.97%	3.18%	1.71%	0.00%	10.92%	3.35%	1.37%	-	-	-	1.51%	5.59%	9.89%
HS(FS) Short	9.10%	3.81%	2.24%	8.75%	3.70%	2.17%	9.61%	4.04%	2.50%	-	-	-	1.29%	3.44%	6.02%

Table 37: Represents Value at Risk results for TD7 route 1 month price returns. The first column presents the different model types that used to measure Value at Risk. The next nine columns present average, minimum and maximum VaR estimates at 1%, 5% and 10%, confidence levels, respectively. The last six columns present the HIT sequence as a percentage of the out-of-sample observations. HIT sequences are reported for both long and short positions.

6.2.4.2.2 Backtesting

TD7_1M LONG												
Out of Sample Obs	PoF			LRind			LRcc			QLF		
465	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model												
GARCH (1,1)_N	2.006	3.505*	20.895***	-	-	-	-	-	-	0.961	0.397	0.394
GARCH (1,1)_T	12.353***	1.349	19.136***	-	-	-	-	-	-	7.974	4.434	2.947
GARCH (1,1)_GED	44.314***	0.135	11.758***	-	-	0.179	-	-	-	2.680	0.683	0.554
IGARCH (1,1)_N	4.677**	4.489**	19.136***	-	-	-	-	-	-	0.965	0.518	0.480
IGARCH (1,1)_T	6.331**	3.505*	24.731***	-	-	-	-	-	-	0.507	0.228	0.303
IGARCH (1,1)_GED	12.353***	3.505*	29.031***	-	-	-	-	-	-	1.101	0.236	0.381
(GJR)TGARCH (1,1)_N	2.006	2.659	20.895***	-	-	-	-	-	-	0.973	0.402	0.396
(GJR)TGARCH (1,1)_T	-	-	-	-	-	-	-	-	-	3.947	0.804	0.440
(GJR)TGARCH (1,1)_GED	34.346***	0.072	13.057***	-	-	-	-	-	-	2.334	0.592	0.524
EGARCH (1,1)_N	8.171***	1.349	14.441***	-	-	-	-	-	-	1.062	0.309	0.315
EGARCH (1,1)_T	4.255**	33.694***	74.927***	-	-	-	-	-	-	71.262	41.395	26.373
EGARCH (1,1)_GED	25.240***	0.870	19.136***	-	-	-	-	-	-	2.710	1.161	1.024
APARCH (1,1)_N	8.171***	0.501	17.477***	-	-	-	-	-	-	1.179	0.322	0.313
APARCH (1,1)_T	55.044***	3.118*	4.079**	-	0.023	0.120	-	3.141	4.199	2.967	0.619	0.389
APARCH (1,1)_GED	44.314***	0.330	11.758***	-	-	-	-	-	-	2.511	0.419	0.321
TARCH (1,1)_X_N	12.353***	0.237	17.477***	-	-	-	-	-	-	3.838	1.969	1.373
TARCH (1,1)_X_T	12.353***	0.870	19.136***	-	-	-	-	-	-	4.853	2.669	1.836
TARCH (1,1)_X_GED	28.172***	0.072	15.913***	-	-	-	-	-	-	2.067	0.433	0.412
RISK METRICS	10.183***	1.349	19.136***	-	-	-	-	-	-	1.513	0.662	0.542
HS(100) Long	0.026	0.003	1.414	-	-	-	-	-	-	8.029	0.261	0.351
HS(250) Long	1.039	0.072	1.055	-	-	5.599**	-	-	6.653**	0.316	0.245	0.322
HS(FS) Long	2.006	1.349	15.913***	-	-	-	-	-	-	0.091	0.158	0.195

Table 38: Represents statistical tests of unconditional, independent and conditional coverage of the interval forecasts under each approach and Loss Function scores for the TD7 1-Month front FFA prices for long positions, denoted by LRuc, LRind and LRcc, respectively. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The tests for LRuc and LRind are $x_1^{1\%}$, $x_1^{5\%}$ and $x_1^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. The tests for LRcc are $x_2^{1\%}$, $x_2^{5\%}$ and $x_2^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. Critical values for $x_1^{1\%}$, $x_1^{5\%}$, $x1^{10\%}$, $x_2^{1\%}$, $x_2^{5\%}$, $x_{21}^{0\%}$ are 6.63, 3.84, 2.7, 9.21, 5.99 and 4.6, respectively. If value of the likelihood ratio is larger than the critical value the Value at Risk model is rejected at the significance level.

TD7_1M SHORT												
Out of Sample Obs	PoF			LRind			LRcc			QLF		
465	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model												
GARCH (1,1)_N	2.006	8.372***	29.031***	-	-	-	-	-	-	0.710	0.326	0.322
GARCH (1,1)_T	12.353***	2.659	24.731***	0.619	0.320	0.126	12.972***	2.979	24.857***	7.851	4.305	2.801
GARCH (1,1)_GED	44.314***	0.962	8.337***	-	0.367	0.021	-	1.329	8.358**	2.123	0.513	0.387
IGARCH (1,1)_N	2.006	2.659	22.758***	-	-	-	-	-	-	0.775	0.457	0.427
IGARCH (1,1)_T	3.228*	5.621**	22.758***	-	-	1.504	-	-	24.262***	0.336	0.199	0.264
IGARCH (1,1)_GED	14.670***	2.659	22.758***	-	-	1.504	-	-	24.262***	0.814	0.202	0.331
(GJR)TGARCH (1,1)_N	2.006	8.372***	29.031***	-	-	-	-	-	-	0.726	0.334	0.328
(GJR)TGARCH (1,1)_T	-	-	-	-	-	-	-	-	-	0.723	0.338	0.284
(GJR)TGARCH (1,1)_GED	31.209***	0.237	14.441***	-	-	-	-	-	-	1.781	0.379	0.310
EGARCH (1,1)_N	4.677**	3.505*	22.758***	-	-	-	-	-	-	0.803	0.270	0.265
EGARCH (1,1)_T	4.255**	39.310***	69.552***	-	-	-	-	-	-	72.975	41.227	26.060
EGARCH (1,1)_GED	12.353***	0.870	19.136***	-	1.504	0.991	-	2.374	20.127***	2.400	1.159	1.008
APARCH (1,1)_N	3.228*	3.505*	17.477***	-	-	-	-	-	-	0.951	0.315	0.290
APARCH (1,1)_T	74.419***	9.414***	0.498	0.062	0.029	0.217	74.481***	9.443***	0.716	2.424	0.565	0.340
APARCH (1,1)_GED	31.209***	0.135	8.337***	-	-	-	-	-	-	2.042	0.349	0.246
TARCH (1,1)_X_N	10.183***	3.505*	22.758***	-	-	-	-	-	-	3.598	1.846	1.234
TARCH (1,1)_X_T	8.171***	4.489**	26.820***	-	-	-	-	-	-	4.687	2.548	1.691
TARCH (1,1)_X_GED	25.240***	0.501	17.477***	-	-	-	-	-	-	1.549	0.245	0.224
RISK METRICS	6.331**	0.870	15.913***	-	-	-	-	-	-	1.245	0.576	0.472
HS(100) Short	1.940	11.871***	19.136***	-	-	0.003	-	-	19.139***	11.098	1.178	0.511
HS(250) Short	1.039	0.330	0.006	-	1.452	4.397**	-	1.782	4.403	0.330	0.252	0.283
HS(FS) Short	0.363	2.659	9.400***	-	2.540	2.705	-	5.200*	12.105***	0.085	0.144	0.178

Table 39: Represents statistical tests of unconditional, independent and conditional coverage of the interval forecasts under each approach and Loss Function scores for the TD7 1-Month front FFA prices for short positions, denoted by LRuc, LRind and LRcc, respectively. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The tests for LRuc and LRind are $x_1^{1\%}$, $x_1^{5\%}$ and $x_1^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. The tests for LRcc are $x_2^{1\%}$, $x_2^{5\%}$ and $x_2^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. Critical values for $x_1^{1\%}$, $x_1^{5\%}$, $x1^{10\%}$, $x_2^{1\%}$, $x_2^{5\%}$, $x_{21}^{0\%}$ are 6.63, 3.84, 2.7, 9.21, 5.99 and 4.6, respectively. If value of the likelihood ratio is larger than the critical value the Value at Risk model is rejected at the significance level.

6.2.4.3 FFA 3 Months

As per Table 6 TD7 3 Months' historical distribution is leptokurtic and highly skewed at the left side (Fischer Skewness Statistic equals -3.65). In fact, TD7_3M presents the highest skewness between all returns time series under investigation. Figure 20 that includes the autocorrelations rejects the presence of any serious autocorrelation between the returns with all p-values equal to zero.

The IGARCH with t-distribution assumption could not be estimated for the TD7 3 months price returns.

Tables 41 and 42, suggest that all models fail to pass the statistical tests at VaR10% with the parametric ones failing also at VaR1%. Same confirmed for both long and short positions. This models' incapacity to capture the risk is depicted also from Table 40 that presents the HIT sequences. Combining this finding with the high negative skewness, the models incapacity to adapt to highly non-normal distributions can be justified.

For long positions, all HS(100), HS(250) and HS(FS) captured the risk, while for short ones only the HS(FS). The parametric models performed well only at VaR5%.

6.2.4.3.1 Value at Risk Statistics

TD7_3M															
Out of Sample Obs	Average VaR			Minimum VaR			Maximum VaR			Hit Sequence Long %			Hit Sequence Short %		
465	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model															
GARCH (1,1)_N	-3.18%	-2.25%	-1.75%	-4.92%	-3.48%	-2.71%	-2.21%	-1.56%	-1.22%	2.15%	3.01%	3.66%	2.80%	4.09%	5.16%
GARCH (1,1)_T	-1.42%	-1.00%	-0.78%	-10.96%	-7.74%	-6.03%	-0.03%	-0.02%	-0.02%	4.95%	5.81%	5.81%	6.45%	7.10%	7.74%
GARCH (1,1)_GED	-1.55%	-1.43%	-1.27%	-7.81%	-7.17%	-6.37%	-1.13%	-1.04%	-0.92%	4.52%	4.52%	4.73%	5.38%	5.38%	5.81%
IGARCH (1,1)_N	-3.04%	-2.15%	-1.67%	-4.77%	-3.38%	-2.63%	-1.84%	-1.30%	-1.02%	2.37%	3.23%	3.87%	3.01%	3.87%	5.59%
IGARCH (1,1)_T	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
IGARCH (1,1)_GED	-2.24%	-2.06%	-1.83%	-3.97%	-3.64%	-3.24%	-1.14%	-1.05%	-0.93%	3.01%	3.23%	3.87%	4.30%	4.73%	5.59%
(GJR)TGARCH (1,1)_N	-3.28%	-2.32%	-1.81%	-4.90%	-3.47%	-2.70%	-2.24%	-1.58%	-1.23%	2.15%	3.01%	3.66%	2.80%	4.09%	4.95%
(GJR)TGARCH (1,1)_T	-1.94%	-1.37%	-1.07%	-14.90%	-10.53%	-8.20%	-0.12%	-0.08%	-0.06%	3.87%	4.95%	5.81%	4.95%	6.67%	6.88%
(GJR)TGARCH (1,1)_G	-1.85%	-1.70%	-1.51%	-10.12%	-9.28%	-8.25%	-1.46%	-1.34%	-1.19%	4.09%	4.52%	4.52%	4.52%	4.95%	5.38%
EGARCH (1,1)_N	-3.04%	-2.15%	-1.67%	-4.27%	-3.02%	-2.35%	-2.37%	-1.67%	-1.30%	2.37%	3.23%	3.87%	3.01%	3.87%	4.95%
EGARCH (1,1)_T	-19.04%	-13.45%	-10.48%	-4128.76%	-2917.97%	-2272.68%	-0.96%	-0.68%	-0.53%	4.09%	4.52%	4.52%	4.95%	6.02%	6.45%
EGARCH (1,1)_GED	-1.85%	-1.70%	-1.51%	-10.12%	-9.28%	-8.25%	-1.46%	-1.34%	-1.19%	4.09%	4.52%	4.52%	4.52%	4.95%	5.38%
APARCH (1,1)_N	-2.94%	-2.08%	-1.62%	-4.31%	-3.05%	-2.37%	-2.14%	-1.51%	-1.18%	2.15%	3.44%	3.66%	3.23%	4.52%	4.95%
APARCH (1,1)_T	-0.70%	-0.49%	-0.38%	-7.98%	-5.64%	-4.39%	-0.01%	0.00%	0.00%	5.38%	5.38%	6.02%	7.31%	7.96%	8.39%
APARCH (1,1)_GED	-1.86%	-1.71%	-1.52%	-10.75%	-9.86%	-8.76%	-1.45%	-1.33%	-1.18%	3.66%	4.30%	4.52%	4.30%	4.95%	5.38%
TARCH (1,1)_X_N	-3.22%	-2.28%	-1.77%	-4.96%	-3.51%	-2.73%	-2.13%	-1.50%	-1.17%	2.15%	3.01%	3.66%	2.80%	4.09%	5.16%
TARCH (1,1)_X_T	-1.24%	-0.88%	-0.68%	-10.38%	-7.34%	-5.71%	-0.01%	-0.01%	-0.01%	4.95%	5.81%	6.02%	6.67%	7.31%	7.74%
TARCH (1,1)_X_GED	-2.33%	-2.14%	-1.90%	-6.10%	-5.59%	-4.97%	-1.69%	-1.55%	-1.38%	3.01%	3.01%	3.66%	3.01%	3.87%	4.73%
RISK METRICS	-2.87%	-1.49%	-1.16%	-8.08%	-5.71%	-4.45%	-0.51%	0.00%	0.00%	2.37%	4.52%	4.73%	3.87%	36.99%	37.63%
HS(100) Long	-5.68%	-1.89%	-0.19%	-8.10%	-4.31%	-0.75%	-2.02%	0.00%	0.00%	1.08%	4.09%	7.74%	-	-	-
HS(250) Long	-5.62%	-1.50%	-0.17%	-8.00%	-2.11%	-0.60%	-3.47%	-1.08%	0.00%	1.08%	4.09%	7.10%	-	-	-
HS(FS) Long	-5.19%	-2.30%	-1.18%	-5.23%	-2.38%	-1.32%	-5.13%	-2.22%	-1.12%	0.86%	3.01%	4.52%	-	-	-
HS(100) Short	7.65%	4.74%	2.69%	5.51%	1.94%	0.00%	8.00%	5.61%	4.82%	-	-	-	0.65%	1.72%	16.77%
HS(250) Short	5.61%	1.47%	0.46%	3.64%	0.00%	0.00%	7.26%	2.35%	1.13%	-	-	-	1.29%	5.59%	30.11%
HS(FS) Short	5.11%	2.29%	1.21%	4.88%	2.26%	1.13%	5.23%	2.30%	1.33%	-	-	-	1.51%	3.87%	6.02%

Table 40: Represents Value at Risk results for TD7 route 3 months price returns. The first column presents the different model types that used to measure Value at Risk. The next nine columns present average, minimum and maximum VaR estimates at 1%, 5% and 10%, confidence levels, respectively. The last six columns present the HIT sequence as a percentage of the out-of-sample observations. HIT sequences are reported for both long and short positions.

6.2.4.3.2 Backtesting

TD7_3M LONG												
Out of Sample Obs		PoF			LRind			LRcc			QLF	
465	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model												
GARCH (1,1)_N	4.677**	4.489**	26.820***	-	-	-	-	-	-	0.204	0.019	0.038
GARCH (1,1)_T	37.578***	0.607	10.540***	-	-	-	-	-	-	0.777	0.154	0.070
GARCH (1,1)_GED	31.209***	0.237	17.477***	-	-	-	-	-	-	0.639	0.076	0.043
IGARCH (1,1)_N	6.331**	3.505*	24.731***	-	-	-	-	-	-	0.237	0.023	0.036
IGARCH (1,1)_T	-	-	-	-	-	-	-	-	-			
IGARCH (1,1)_GED	12.353***	3.505*	24.731***	-	-	-	-	-	-	0.419	0.027	0.047
(GJR)TGARCH (1,1)_N	4.677**	4.489**	26.820***	-	-	-	-	-	-	0.187	0.019	0.041
(GJR)TGARCH (1,1)_T	22.417***	0.003	10.540***	-	-	-	-	-	-	0.736	0.181	0.097
(GJR)TGARCH (1,1)_GED	25.240***	0.237	19.136***	-	-	-	-	-	-	0.561	0.068	0.055
EGARCH (1,1)_N	6.331**	3.505*	24.731***	-	-	-	-	-	-	0.227	0.018	0.033
EGARCH (1,1)_T	25.240***	0.237	19.136***	-	-	-	-	-	-	2157.106	1078.868	654.991
EGARCH (1,1)_GED	25.240***	0.237	19.136***	-	-	-	-	-	-	0.561	0.068	0.055
APARCH (1,1)_N	4.677**	2.659	26.820***	-	-	-	-	-	-	0.251	0.021	0.032
APARCH (1,1)_T	44.314***	0.135	9.400***	-	-	-	-	-	-	0.967	0.189	0.072
APARCH (1,1)_GED	19.710***	0.501	19.136***	-	-	-	-	-	-	0.570	0.078	0.063
TARCH (1,1)_X_N	4.677**	4.489**	26.820***	-	-	-	-	-	-	0.202	0.021	0.040
TARCH (1,1)_X_T	37.578***	0.607	9.400***	-	-	-	-	-	-	0.822	0.161	0.069
TARCH (1,1)_X_GED	12.353***	4.489**	26.820***	-	-	-	-	-	-	0.389	0.021	0.048
RISK METRICS	6.331**	2.659	20.895***	-	-	-	-	-	-	0.338	0.057	0.052
HS(100) Long	0.026	0.870	2.834*	-	-	0.289	-	-	3.123	0.178	0.100	0.074
HS(250) Long	0.026	0.870	4.797**	-	-	0.062	-	-	4.859	0.188	0.047	0.074
HS(FS) Long	0.096	4.489**	19.136***	-	-	-	-	-	-	0.002	0.013	0.022

Table 41: Represents statistical tests of unconditional, independent and conditional coverage of the interval forecasts under each approach and Loss Function scores for the TD7 3-Months front FFA prices for long positions, denoted by LRuc, LRind and LRcc, respectively. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The tests for LRuc and LRind are $x_1^{1\%}$, $x_1^{5\%}$ and $x_1^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. The tests for LRcc are $x_2^{1\%}$, $x_2^{5\%}$ and $x_2^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. Critical values for $x_1^{1\%}$, $x_1^{5\%,}$ $x1^{10\%,,}$ $x_2^{1\%}$,$x_2^{5\%,}$ $x_{21}^{0\%}$ are 6.63, 3.84, 2.7, 9.21, 5.99 and 4.6, respectively. If value of the likelihood ratio is larger than the critical value the Value at Risk model is rejected at the significance level.

TD7_3M SHORT												
Out of Sample Obs		PoF			LRind			LRcc			QLF	
465	1%	5%	10%	1%	5%	10%	1%	5%	10%	1%	5%	10%
Model												
GARCH (1,1)_N	10.183***	0.870	14.441***	0.814	1.504	0.443	10.997***	2.374	14.884***	0.205	0.023	0.043
GARCH (1,1)_T	62.582***	3.830*	2.834*	0.002	0.062	0.018	62.584***	3.892	2.852	0.769	0.163	0.077
GARCH (1,1)_GED	44.314***	0.135	10.540***	0.109	0.109	0.265	44.422***	0.244	10.804***	0.639	0.087	0.052
IGARCH (1,1)_N	12.353***	1.349	11.758***	0.619	1.811	0.206	12.972***	3.159	11.964***	0.237	0.028	0.041
IGARCH (1,1)_T	-	-	-	-	-	-	-	-	-	-	-	-
IGARCH (1,1)_GED	28.172***	0.072	11.758***	1.232	0.781	0.206	29.404***	0.853	11.964***	0.416	0.033	0.053
(GJR)TGARCH (1,1)_N	10.183***	0.870	15.913***	-	1.504	0.599	-	2.374	16.512***	0.189	0.025	0.046
(GJR)TGARCH (1,1)_T	37.578***	2.473	5.579**	0.020	0.003	0.023	37.598***	2.476	5.602*	0.733	0.184	0.104
(GJR)TGARCH (1,1)_GED	31.209***	0.003	13.057***	0.003	0.020	0.109	31.212***	0.023	13.166***	0.564	0.080	0.065
EGARCH (1,1)_N	12.353***	1.349	15.913***	-	0.126	0.599	-	1.474	16.512***	0.228	0.023	0.039
EGARCH (1,1)_T	37.578***	0.962	7.347***	-	-	-	-	-	-	2157.110	1078.836	654.993
EGARCH (1,1)_GED	31.209***	0.003	13.057***	0.003	0.020	0.109	31.212***	0.023	13.166***	0.564	0.080	0.065
APARCH (1,1)_N	14.670***	0.237	15.913***	-	0.991	0.599	-	1.228	16.512***	0.250	0.026	0.037
APARCH (1,1)_T	78.498***	7.314***	1.414	0.115	1.438	2.255		8.752**	3.669	0.954	0.199	0.080
APARCH (1,1)_GED	28.172***	0.003	13.057***	-	-	0.109	-	-	13.166***	0.575	0.092	0.076
TARCH (1,1)_X_N	10.183***	0.870	14.441***	0.814	1.504	0.443		2.374	14.884***	0.203	0.027	0.046
TARCH (1,1)_X_T	66.459***	4.608**	2.834*	0.003	0.120	0.018	66.462***	4.727*	2.852	0.814	0.172	0.077
TARCH (1,1)_X_GED	12.353***	1.349	17.477***	-	-	0.781	-	-	18.258***	0.394	0.027	0.053
RISK METRICS	22.417***	0.025	9.400***	0.126	2.064	0.961	22.543***	2.088778367	10.361***	0.327	0.060	0.055
HS(100) Short	0.676	13.951***	20.125***	-	-	250.113***	-	-	270.238***	0.316	0.363	0.216
HS(250) Short	0.363	0.330	144.260***	-	0.206	275.669***	-	0.536	419.929***	0.082	0.058	0.051
HS(FS) Short	1.039	1.349	9.400***	-	0.126	0.061	-	1.474	9.462***	0.003	0.016	0.028

Table 42: Represents statistical tests of unconditional, independent and conditional coverage of the interval forecasts under each approach and Loss Function scores for the TD7 3-Months front FFA prices for short positions, denoted by LRuc, LRind and LRcc, respectively. *, ** and *** denote significance at 10%, 5% and 1% level, respectively. The tests for LRuc and LRind are $x_1^{1\%}$, $x_1^{5\%}$ and $x_1^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. The tests for LRcc are $x_2^{1\%}$, $x_2^{5\%}$ and $x_2^{10\%}$ for 1% 5% and 10% Value at Risk, respectively. Critical values for $x_1^{1\%}$, $x_1^{5\%,}$ $x1^{10\%,,}$ $x_2^{1\%}$,$x_2^{5\%,}$ $x_{21}^{0\%}$ are 6.63, 3.84, 2.7, 9.21, 5.99 and 4.6, respectively. If value of the likelihood ratio is larger than the critical value the Value at Risk model is rejected at the significance level.

Chapter 7: Conclusion

The study reveals that all routes' spot, 1 month and 3 months front historical distributions of returns are leptokurtic and skewed compared to the theoretical Normal distribution. This characteristic may reflect a degree of the tanker markets inefficiency due to the observed mysticopathy regarding the concluded transactions. This finding should be taken into consideration from market participants, when establishing a risk management framework, since assumptions regarding the distributions may have a considerable impact on Value at Risk estimates, valuations of financial instrument and hedging practices. Research between spot and future contact prices revealed that not one type of skewness is maintained along spot and future contract returns of the same route. This finding observed at TC2, TD3 and TD7. Additionally, sample period future contracts price returns presented less volatility than spot's, with only exemption the future contract price returns of route TC5.

Values at Risk results justify the importance of the selection of the method for calculating the conditional volatility, since in many cases the several Value at Risk methods presented significantly different values with each other. According to the Value at Risk backtesting results, neither the extra complexity nor the extended distribution assumptions managed to improve the performance of the simple GARCH model. It is remarkable that there was no Value at Risk method, assuming a Generalized Error Distributions of returns, which managed to capture the risk at 1% confidence level. This is explained from the fact that generalized error distributions assumption weighs heavily the excess peak characteristic but not the fat tails, in comparison with Normal and Student distributions. The results also suggest that neither the augmented TGARCH model that incorporated the spot-3 months front returns slop, managed to improve simplest GARCH model's ability to capture the risk.

Findings support that freight rate risk quantification favors simpler specifications, such as the GARCH and the historical simulation models. The results are congruent with findings from earlier periods by Kavussanos and

Dimitrakopoulos (2011) and Angelidis and Skiadopoulos (2008), who applied similar methodologies on freight indexes and spot price returns. This study extends this verification to also shipping freight futures contracts and short positions in both spot and futures markets.

To the best of author's knowledge, it is the first time that a study measures the performance between several parametric and non-parametric models in the tanker freight futures markets. Also, there are hardly any studies comparing the results between long and short positions. It will be of high research interest for further studies to examine if hybrid models, like semi-parametric or GARCH-EVT could present better results in capturing the risk of shipping freight futures contracts. It would be also interesting, to examine if different approaches, such as the Chaos Theory, could contribute to the methodology of modelling volatility and establishing risk management frameworks for the tanker freight markets.

Chapter 8: List of References

Abouarghoub, W. M., & Mariscal, I. B. F. (2011). Measuring level of risk exposure in tanker Shipping freight markets. *International Journal of Business and Social Research*, 1(1), pp. 20-44.

Abouarghoub, Wessam. "Measuring Shipping Tanker Freight Risk."

Alizadeh, A., & Nomikos, N. (2007b). The Slope of Forward Curve and Volatility of Shipping Freight Rates', mimeo, Cass Business School, City University, London, UK.

Alizadeh, A., & Nomikos, N. (2009). Shipping derivatives and risk management. Palgrave Macmillan.

Andreou, E. & E. Ghysels (2002). Rolling-Sample Volatility Estimators. *Journal of Business & Economic Statistics*, 20, pp. 363-376.

Angelidis, T., Benos, A., & Degiannakis, S. (2004). The use of GARCH models in VaR estimation. Statistical methodology, 1(1), pp. 105-128.

Angelidis, T., & Skiadopoulos, G. (2008). Measuring the market risk of freight rates: a value-at-risk approach. *International Journal of Theoretical and Applied Finance*, pp. 447-469.

Bodie, Z., A. Kane & A. J. Marcus. (2009). Investments. New York: Mc Graw Hill.

Bollerslev, T. (1986). Generalized Autoregressive Conditional Heteroskedasticity, *Journal of Econometrics*, 31. pp. 307-327.

Bonett, D. G. & E. Seier (2002). A test of normality with high uniform power. Computational Statistics & Data Analysis, pp. 435 – 445.

Bookstaber, R. M. & S. Pomerantz (1989). An Information-Based Model of Market Volatility. *Financial Analysts Journal*, 45, pp. 37-46.

Bowman, K. O. & L. R. Shenton (1975). Omnibus test contours for departures from normality based on b1 and b2. *Biometrika*, 62, pp. 243-250.

Brooks, C. (2008). Introductory Econometrics for Finance. Cambridge: *Cambridge University Press*.

D'Agostino, R. B., A. Belanger & R. B. D'Agostino, Jr. (1990). A Suggestion for Using Powerful and Informative Tests of Normality. *The American Statistician*, Vol. 44, pp. 316-321.

Danielsson, J. (2011). Financial Risk Forecasting. WILEY, London.

Ding, Z., Granger, C. W., & Engle, R. F. (1993). A long memory property of stock market returns and a new model. *Journal of empirical finance*, 1(1), pp. 83-106.

Engle, R. (1982). Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation. *Econometrica*, 50(4): pp. 987-1007.

Fama, E. F. & J. D. MacBeth (1973). Risk, return, and equilibrium: Empirical tests. *The Journal of Political Economy*, 81, pp. 607-636.

French, K. R., G. W. Schwert & R. F. Stambaugh (1987). Expected stock returns and volatility. *Journal of Financial Economics*, 19, pp. 3-29.

Gel, Y. R. & J. L. Gastwirth (2008). A robust modification of the Jarque–Bera test of normality. *Economics Letters*, 99, pp. 30-32.

Gel, Y. R., W. Miao & J. L. Gastwirth (2007). Robust directed tests of normality against heavy-tailed alternatives. Computational Statistics Camp; Data Analysis, 51, pp. 2734-2746.

Glosten, L., Jagannathan, R. and Runkle, D. (1993). On the Relation between the Expected Value and the Volatility of the Nominal Excess Return on Stocks, *Journal of Finance*, XLVIII. Pp. 1779-1801.

Hagan, P. S., D. Kumar, A. S. Lesniewski & D. E. Woodward (2002). Managing Smile Risk. *WILMOTT Magazine*, pp. 84-108.

Haug, E. G. (2007). The Complete Guide to Option Pricing Formulas. New York: The Mcgraw-Hill Companies, Inc.

Heston, S. (1993). A closed-form solution for options with stochastic volatility with applications to bond and currency options. *Review of Financial Studies*, 6, pp. 327-343.

Hull, J. C. (2012). Options, Futures And Other Derivatives. Harlow: *Pearson Education Limited.*

Jarque, C. M. & A. K. Bera (1980). Efficient tests for normality, homoscedasticity and serial independence of regression residuals. *Economics Letters*, 6, pp. 255-259.

Jensen, A. and Lange, T. (2007). Addressing the IGARCH puzzle, *Department of Natural Sciences & Department of Mathematical Sciences,* University of Copenhagen.

Kavussanos, M. G. & D. N. Dimitrakopoulos (2011). Market risk model selection and medium-term risk with limited data: Application to ocean tanker freight markets. *International Review of Financial Analysis*, 20, pp. 258-268.

Klein, B. (1977) The Demand for Quality-adjusted Cash Balances: Price Uncertainty in the US Demand for Money Function. *Journal of Political Economy*, Vol. 85, pp. 692-715.

Kupiec, P.H. (1995). Techniques for verifying the accuracy of risk measurement models. *The Journal of Derivatives*, 3, pp. 73-84.

Lopez, J.A. (1998). Methods for evaluating Value-at-Risk Estimates. Federal Reserve. Bank of New York. Economic Policy Review.

Mandelbrot, B. (1963). The Variation of Certain Speculative Prices. The Journal of Business, 36, pp. 394-419.

Mantalos, P. (2010a). Robust Critical Values For The Jarque-Bera Test For Normality. *Jönköping International Business School.*

Mantalos, P. (2010b). Three Different Measures of Sample Skewness and Kurtosis and their Effects on the Jarque- Bera Test for Normality. *Jönköping International Business School.*

Mills, F. C. (1927). The Behaviour of Prices. *National Bureau of Economic Research.*

Nelson, D. (1991). Conditional Heteroskedasticity in Asset Returns: A New Approach, *Econometrica*, 59(2): pp. 347-370.

Oliver, M. (1926). Les Nombres indices de la variation des prix. *Paris doctoral dissertation.*

Pearson, K. (1895). Contributions to the Mathematical Theory of Evolution. II. Skew Variation in Homogeneous Material. Philosophical Transactions of the Royal Society of London. 186, pp. 343-414.

Pearson, K. (1905). Das Fehlergesetz und Seine Verallgemeinerungen Durch Fechner und Pearson. A Rejoinder. *Biometrika*, 4, No. 1/2, pp. 169-212.

Ruppert, D. (1987). What Is Kurtosis?: An Influence Function Approach. *The American Statistician*, 41, pp. 1-5.

Stopford, M. (2009). Maritime Economics 3e. Routledge.

Taylor. S. (1986). Modeling financial time series. Chichester, Wiley.

Terasvirta, T. (2006). An Introduction to Univariate GARCH Models, *SSE/EFI Working papers in Economics and Finance*, 646.

Thadewald, T. & H. Böning (2007). Jarque–Bera Test and its Competitors for Testing Normality – A Power Comparison. *Journal of Applied Statistics*, 34, pp. 87-105.

Urzúa, C. M. (1996). On the correct use of omnibus tests for normality. *Economics Letters*, 53, pp. 247-251.

Appendix A

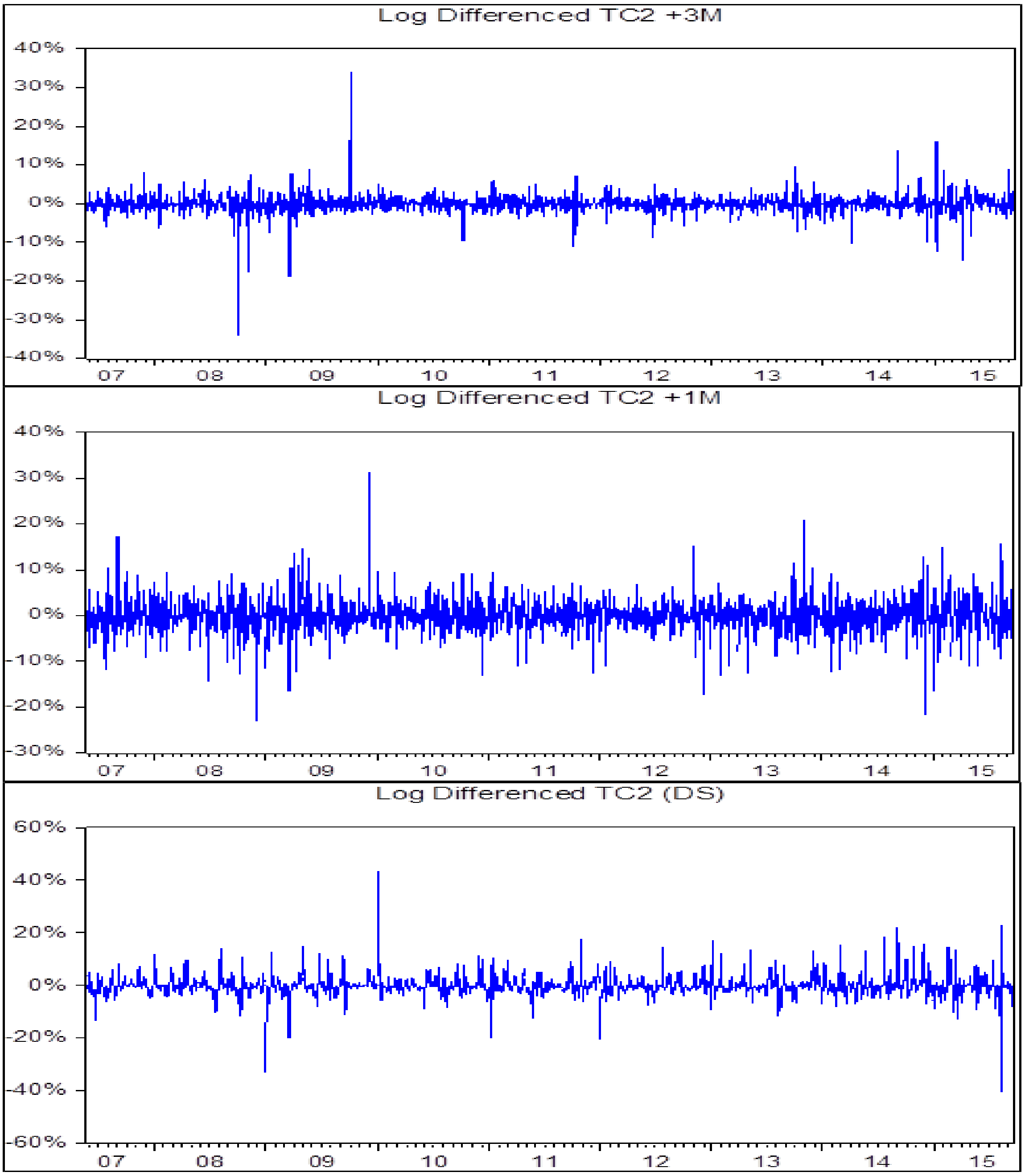


Figure 12: Log Differenced returns of spot, 1 Month front and 3 Months front of the TC2 route

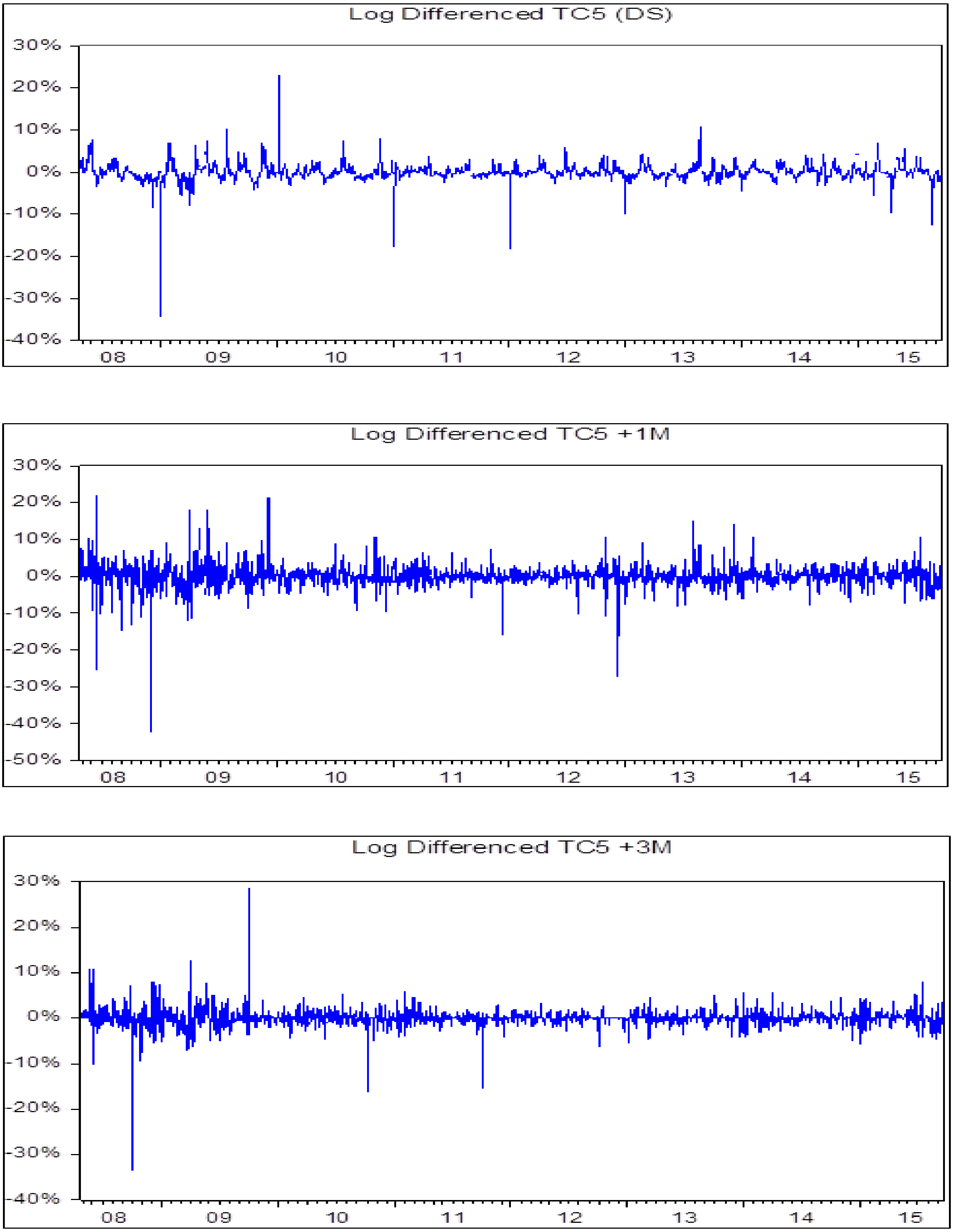


Figure 13: Log Differenced returns of spot, 1 Month front and 3 Months front of the TC5 route

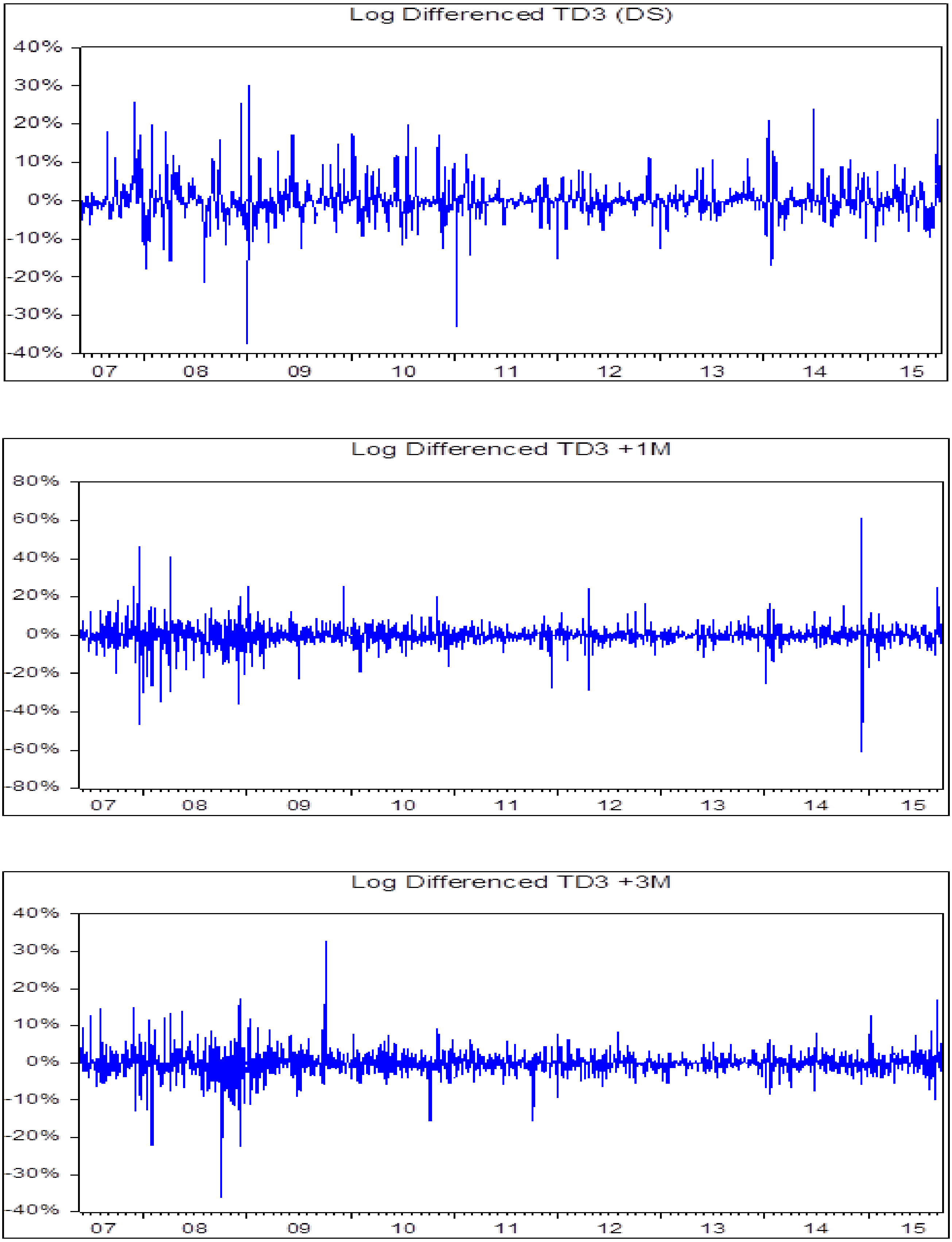


Figure 14: Log Differenced returns of spot, 1 Month front and 3 Months front of the TD3 route

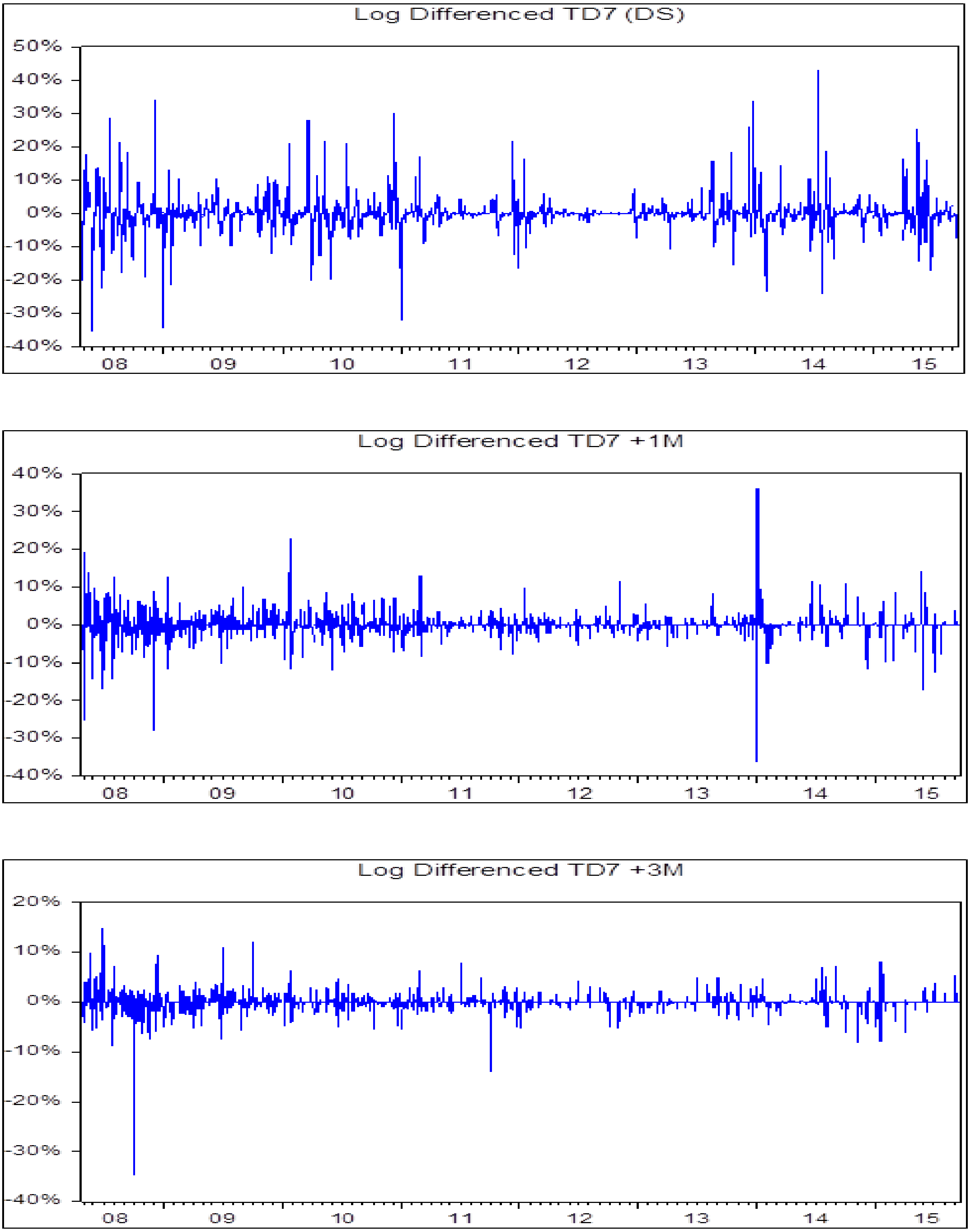


Figure 15: Log Differenced returns of spot, 1 Month front and 3 Months front of the TD7 route

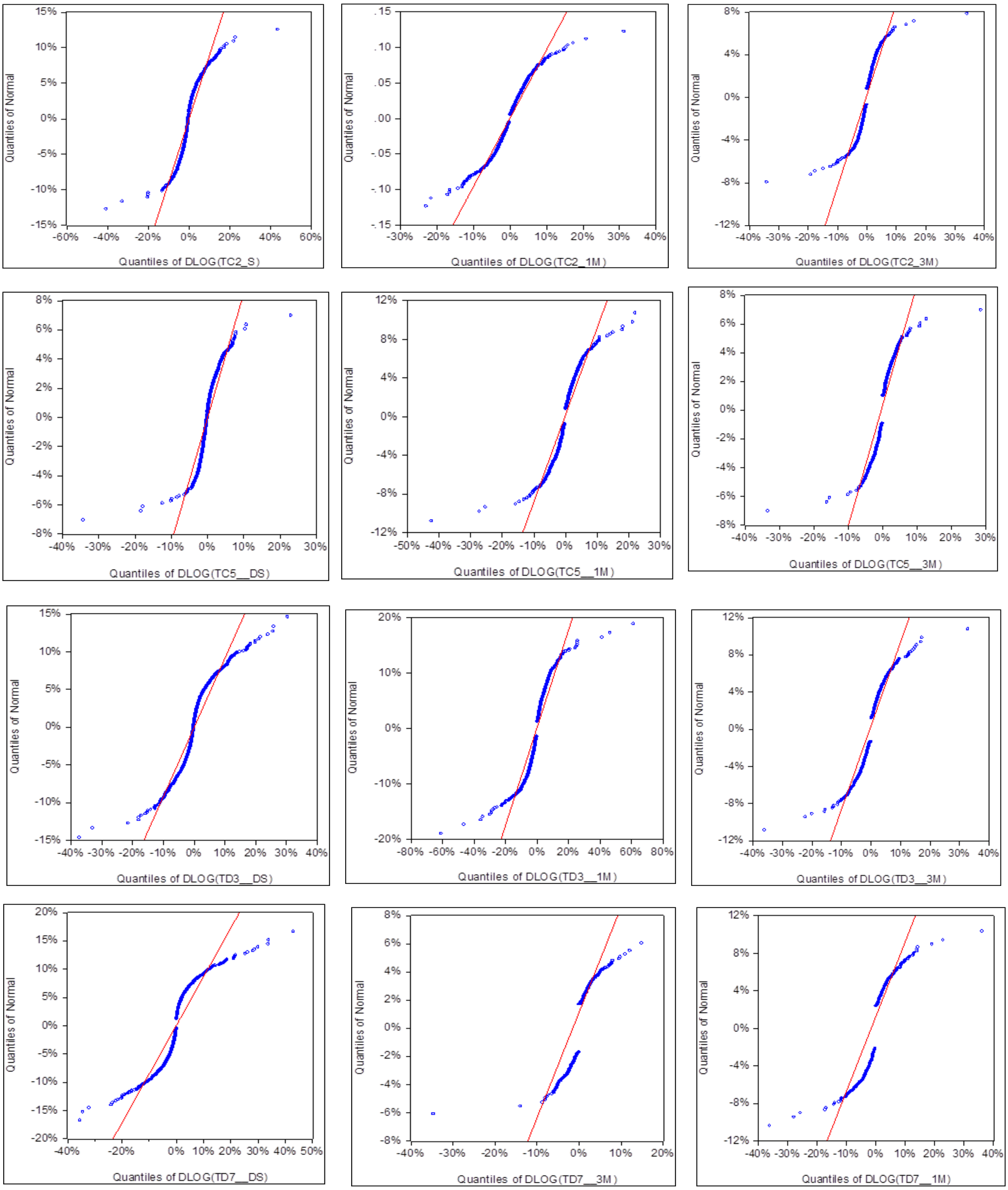


Figure 16: QQ plots for spot, 1 Month front and 3 Months front of TC2, TC5, TD3 and TD7 routes

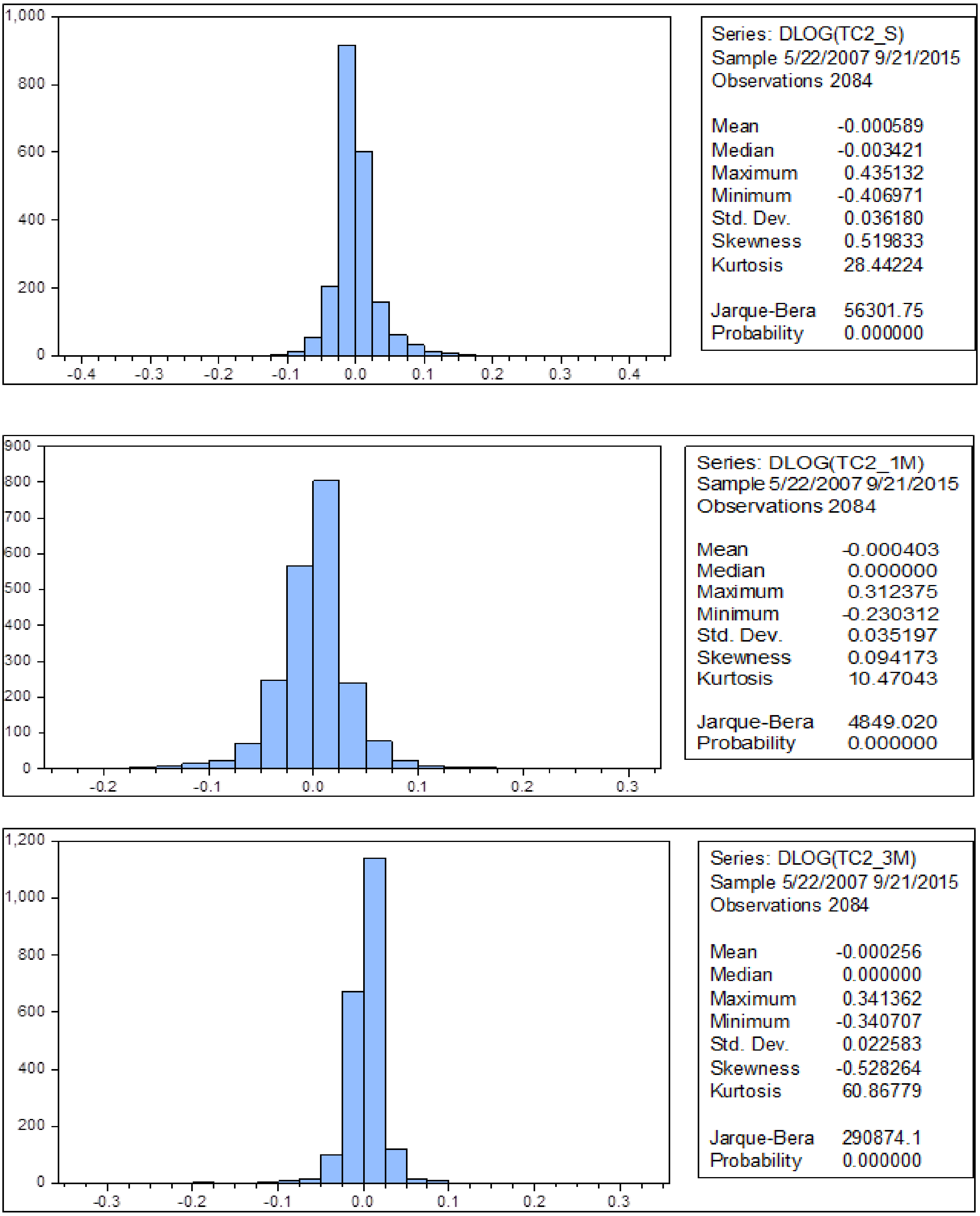
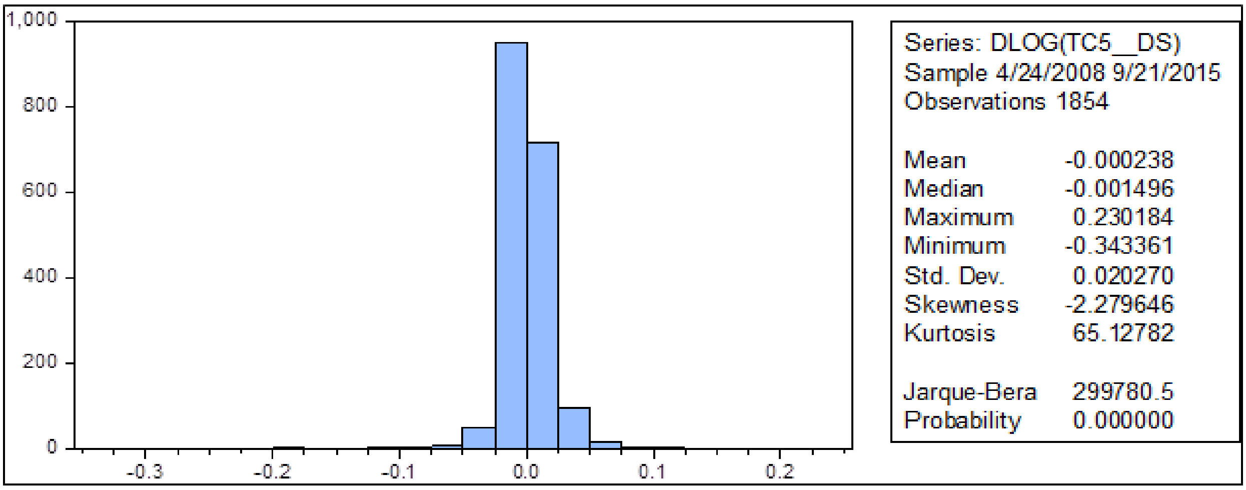
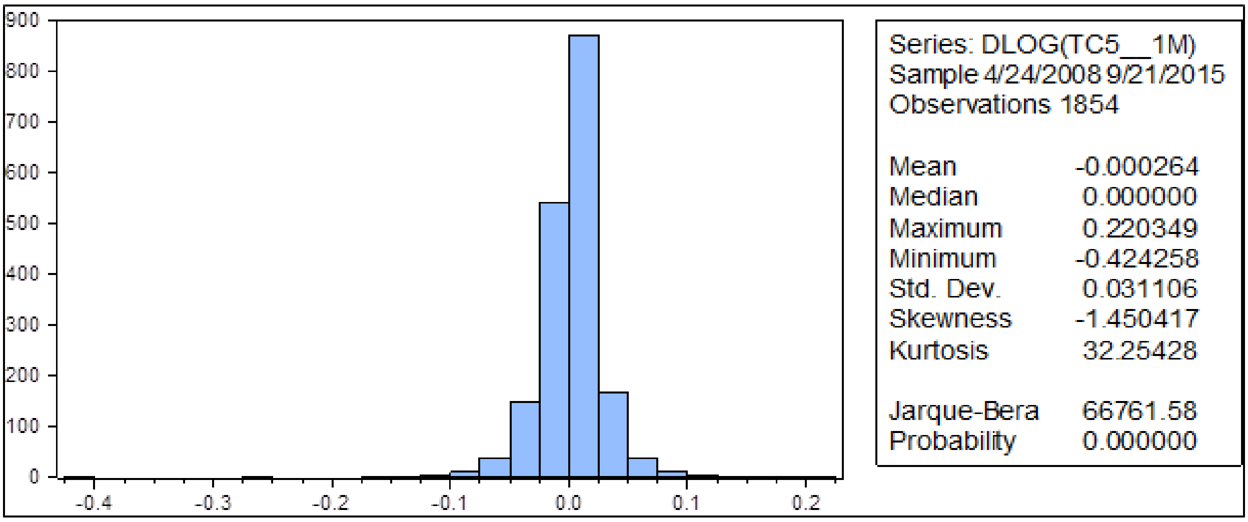


Figure 17: Histograms along with descriptive statistics of the returns of spot, 1 Month front and 3 Months front for TC2 route





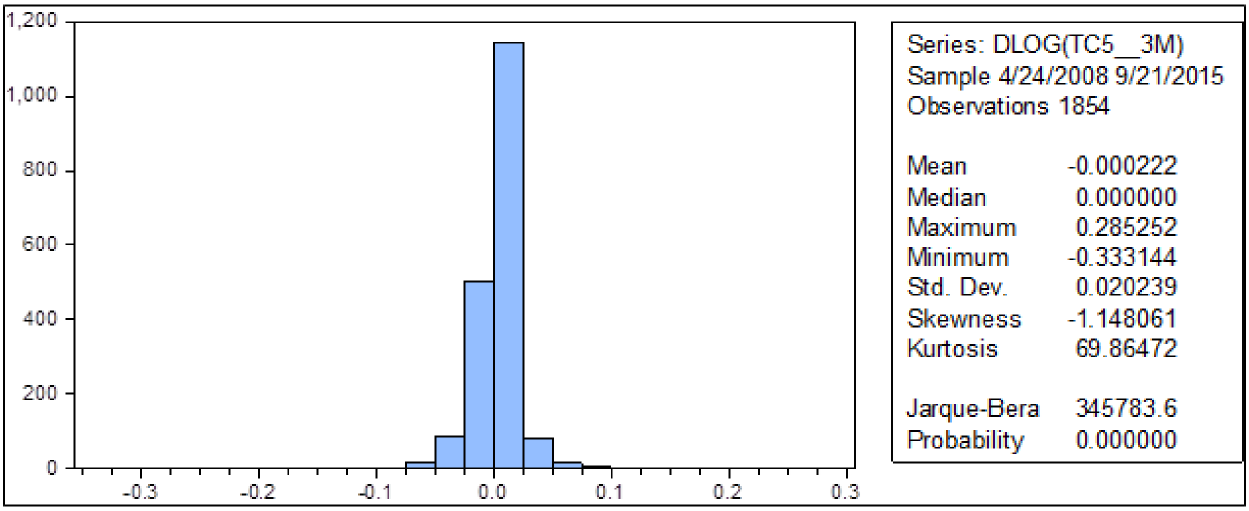


Figure 18: Histograms along with descriptive statistics of the returns of spot, 1 Month front and 3 Months front for TC5 route

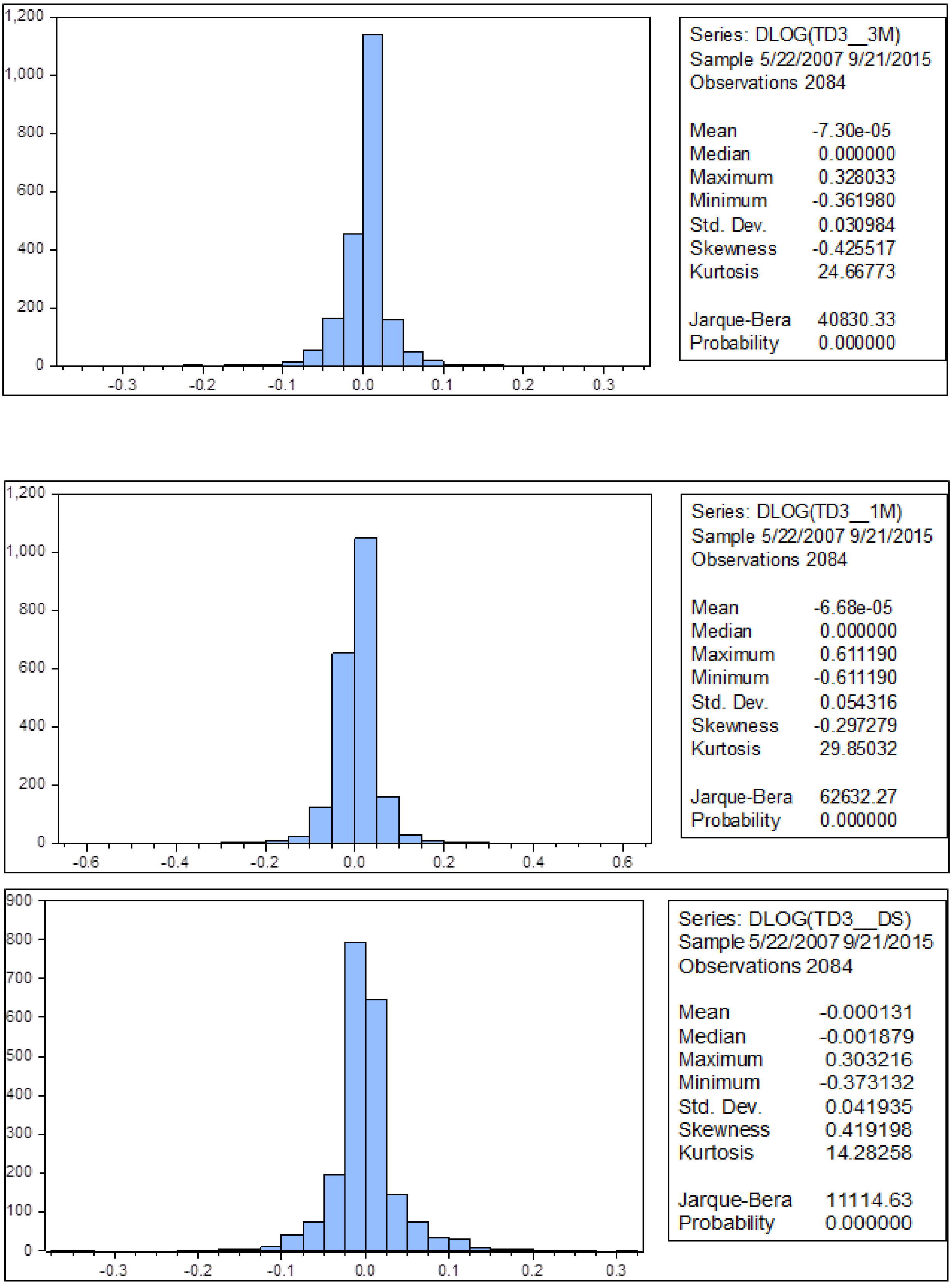


Figure 19: Histograms along with descriptive statistics of the returns of spot, 1 Month front and 3 Months front for TD3 route

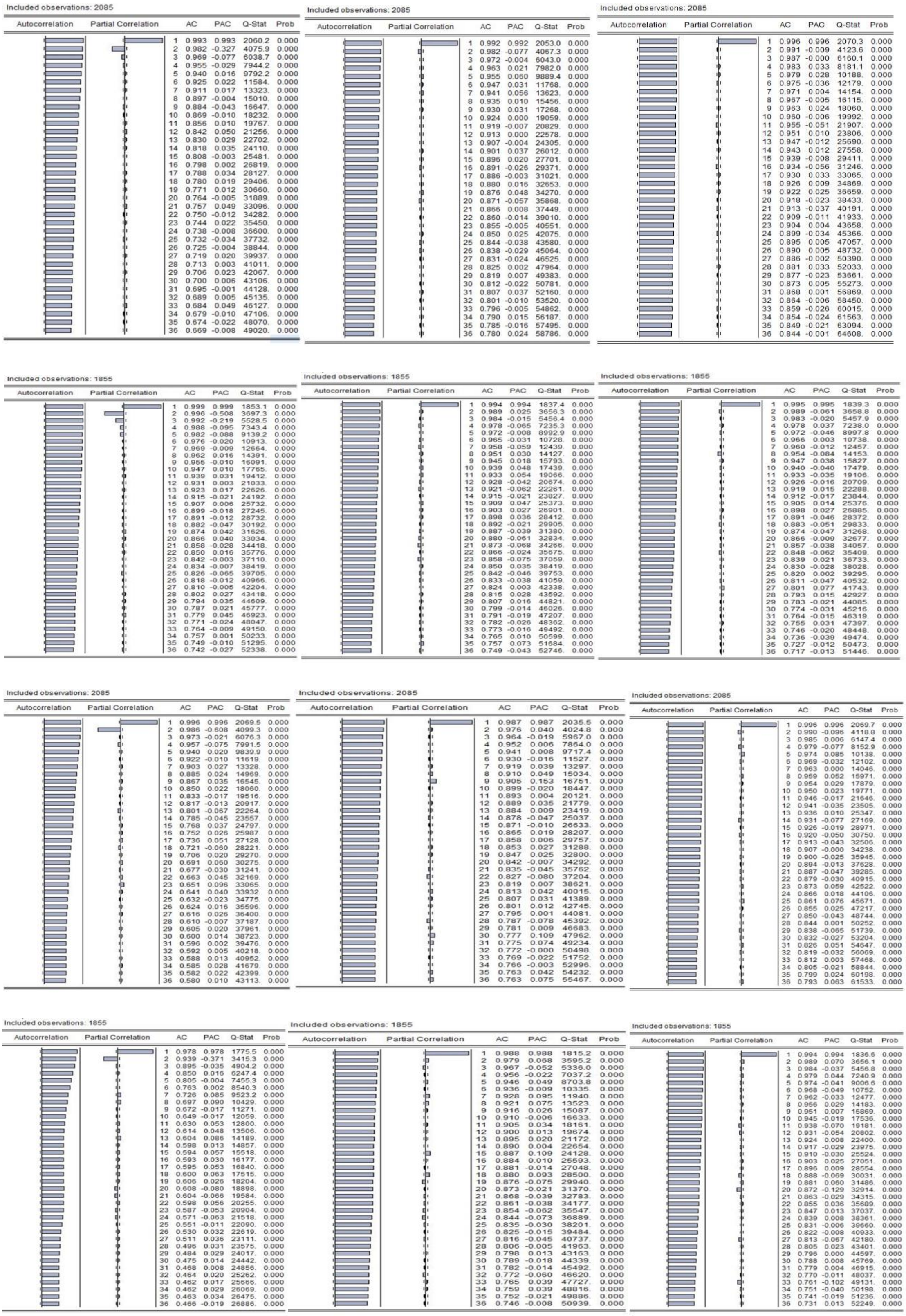


Figure 20: Autocorrelations of the spot, 1 Month front and 3 Months front prices of TC2, TC5, TD3 and TD7 routes. The first row includes TC2, the second TC5, the third TD3 and the fourth TD7. All rows include spot, 1 month and 3 months analysis in the order that have been mentioned.

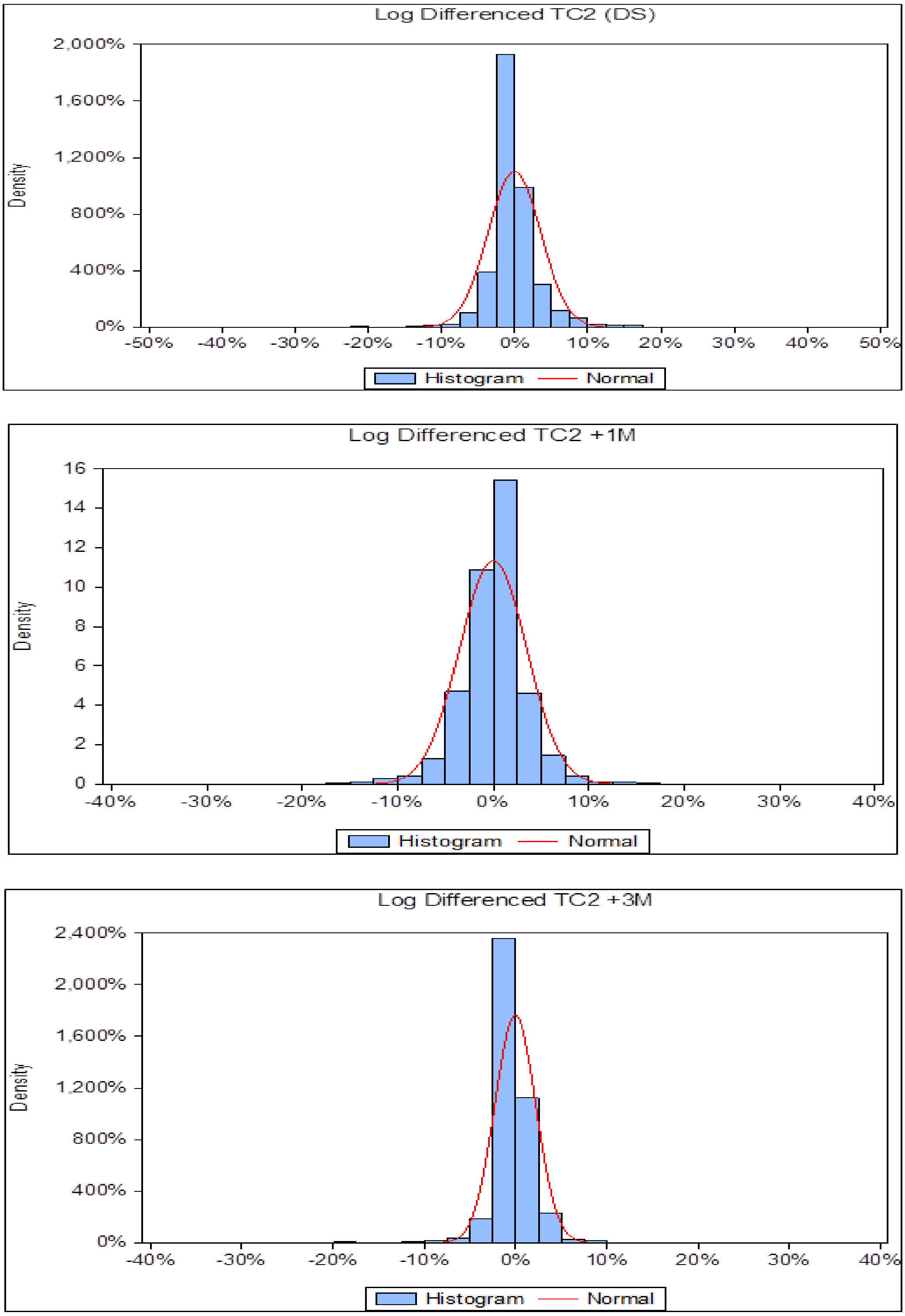


Figure 21: Histograms against the theoretical normal distribution of the returns of spot, 1 Month front and 3 Months front for TC2 route

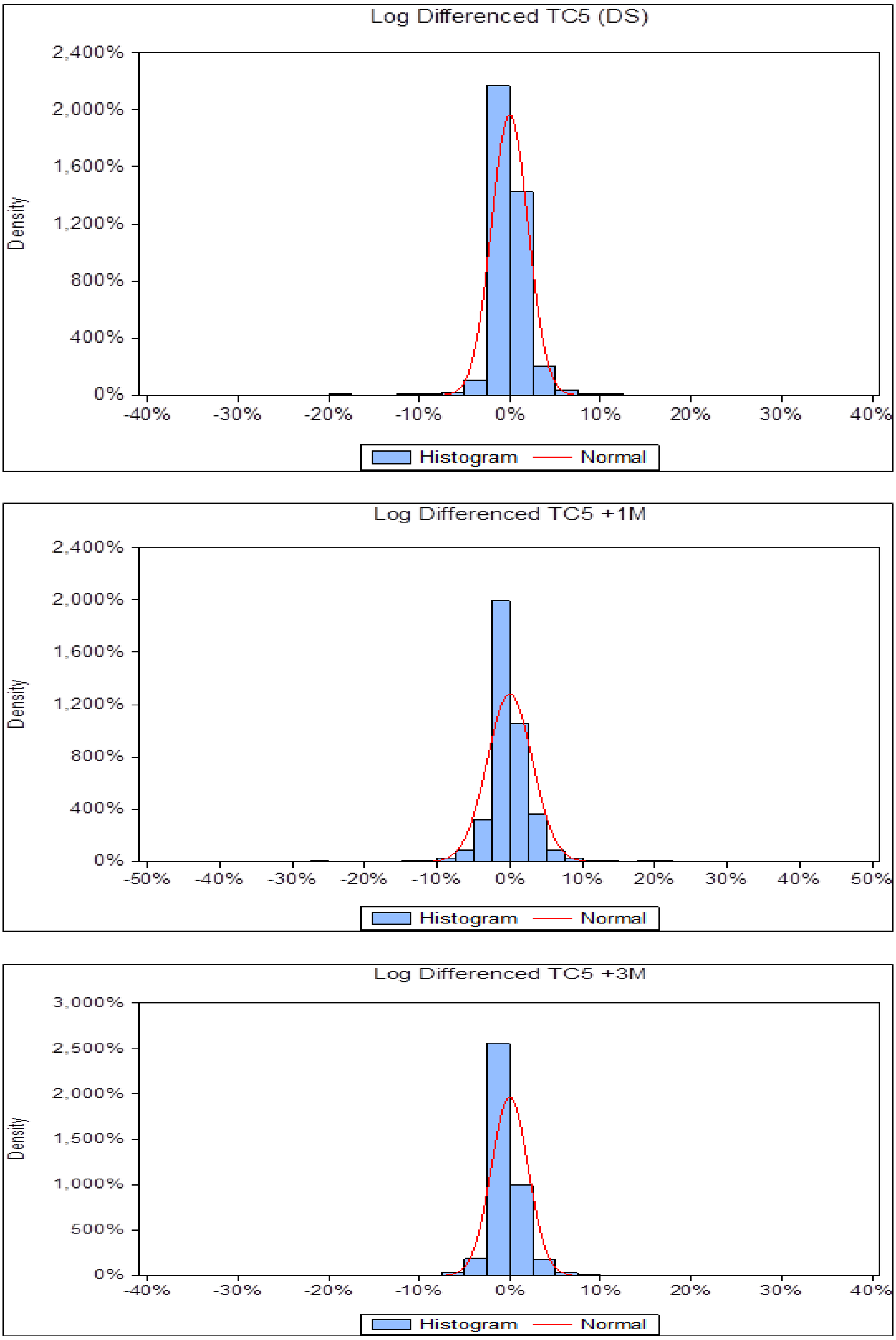


Figure 22: Histograms against the theoretical normal distribution of the returns of spot, 1 Month front and 3 Months front for TC5 route

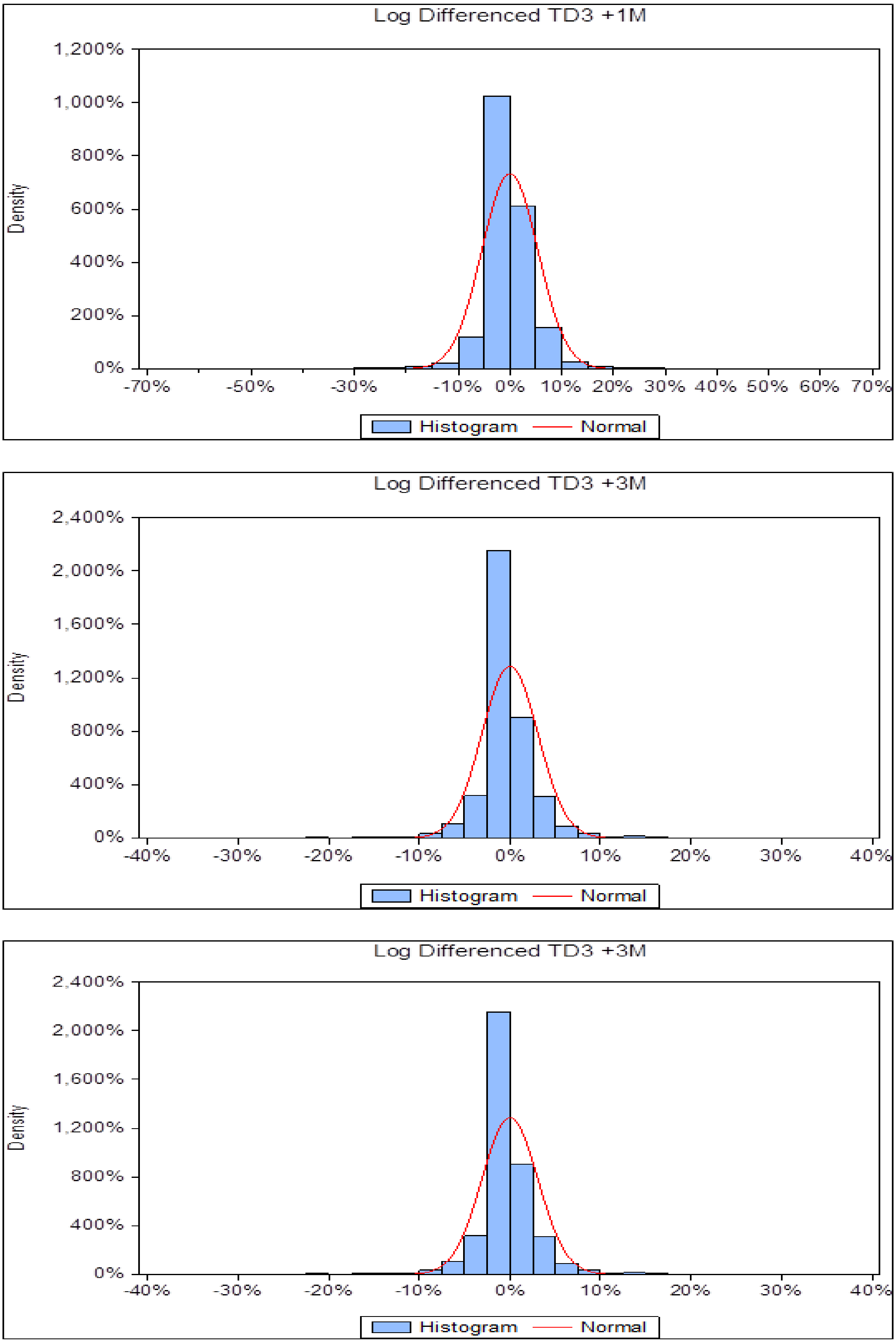


Figure 23: Histograms against the theoretical normal distribution of the returns of spot, 1 Month front and 3 Months front for TD3 route

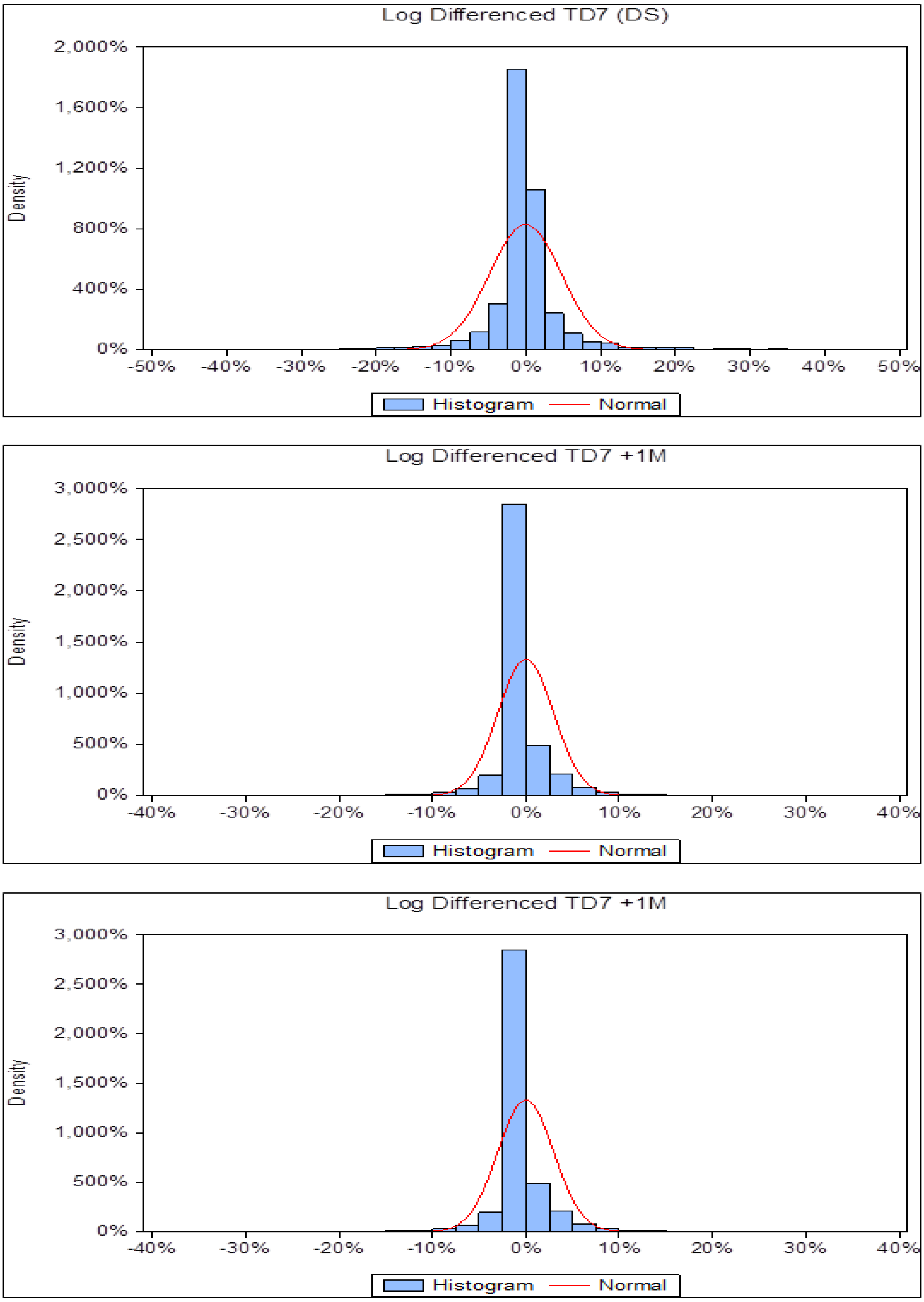


Figure 24: Histograms against the theoretical normal distribution of the returns of spot, 1 Month front and 3 Months front for TD7 route

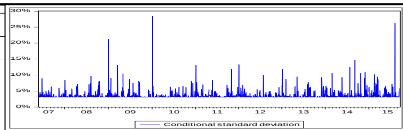
Appendix B (Eviews)

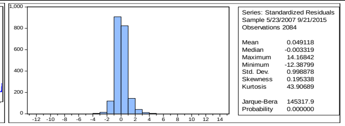
TC2 Spot

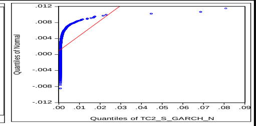
GARCH (1,1)_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.003318	0.000767	-4.326211	0
	Variance Equation			
C	0.000955	0.000019	50.27088	0
RESID(-1)^2	4.16E-01	3.38E-02	1.23E+01	0.00E+00
GARCH(-1)	-0.002128	0.017006	-0.125123	0.9004
R-squared	-0.005692	Mean dependent var		-0.000589
Adjusted R-squared	-0.005692	S.D. dependent var		0.03618
S.E. of regression	0.036283	Akaike info criterion		-3.867804
Sum squared resid	2.742155	Schwarz criterion		-3.856975
Log likelihood	4034.252	Hannan-Quinn criter.		-3.863836
Durbin-Watson stat	1.23646			



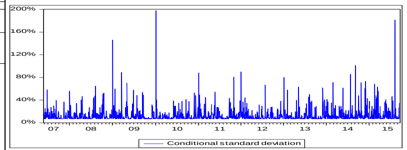


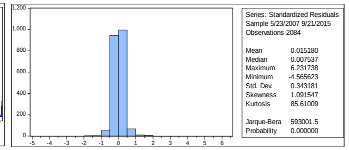


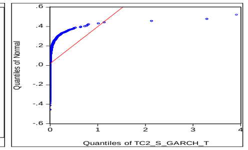
GARCH (1,1)_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.00411	0.000364	-11.30432	0
	Variance Equation			
C	0.004555	0.014813	0.307508	0.7585
RESID(-1)^2	2.03E+01	6.63E+01	3.06E-01	7.60E-01
GARCH(-1)	0.01415	0.013176	1.073983	0.2828
T-DIST. DOF	2.0377	0.126552	16.10167	0
R-squared	-0.009471	Mean dependent var		-0.000589
Adjusted R-squared	-0.009471	S.D. dependent var		0.03618
S.E. of regression	0.036351	Akaike info criterion		-4.527493
Sum squared resid	2.752459	Schwarz criterion		-4.513956
Log likelihood	4722.647	Hannan-Quinn criter.		-4.522533
Durbin-Watson stat	1.231831			



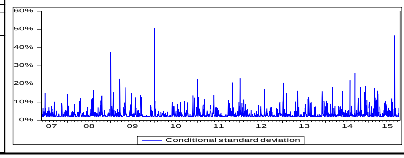


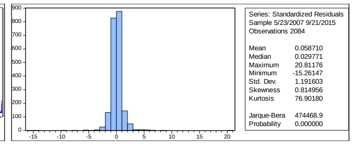


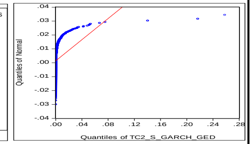
GARCH (1,1)_GED

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.004192	0.000215	-19.48188	0
	Variance Equation			
C	0.000415	0.0000336	12.37277	0
RESID(-1)^2	1.335661	0.178395	7.487101	0
GARCH(-1)	0.015375	0.020134	0.763611	0.4451
GED PARAMETER	0.719554	0.018096	39.76276	0
R-squared	-0.00992	Mean dependent var		-0.000589
Adjusted R-squared	-9.92E-03	S.D. dependent var		3.62E-02
S.E. of regression	0.036359	Akaike info criterion		-4.500907
Sum squared resid	2.753684	Schwarz criterion		-4.48737
Log likelihood	4694.945	Hannan-Quinn criter.		-4.495947
Durbin-Watson stat	1.231283			



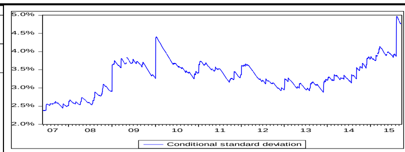


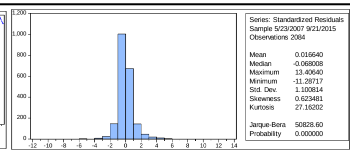


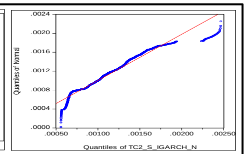
IGARCH (1,1)_N

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.001097	0.000618	-1.775933	0.0757
	Variance Equation			
RESID(-1)^2	0.004546	0.000293	15.50858	0
GARCH(-1)	0.995454	0.000293	3396.046	0
R-squared	-0.000197	Mean dependent var		-0.000589
Adjusted R-squared	-0.000197	S.D. dependent var		0.03618
S.E. of regression	0.036184	Akaike info criterion		-3.772538
Sum squared resid	2.727173	Schwarz criterion		-3.767124
Log likelihood	3932.985	Hannan-Quinn criter.		-3.770554
Durbin-Watson stat	1.243252			



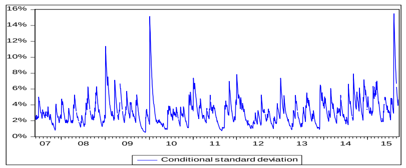


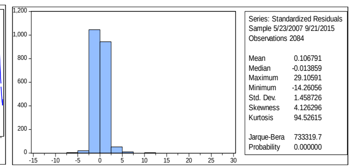


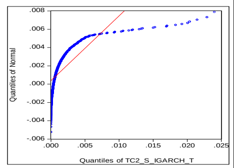
IGARCH (1,1)_T

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.003016	0.000341	-8.853867	0
	Variance Equation			
RESID(-1)^2	0.118406	0.006807	17.39483	0
GARCH(-1)	0.881594	0.006807	129.5138	0
T-DIST. DOF	2.941021	0.076237	38.5771	0
R-squared	-0.004502	Mean dependent var		-0.000589
Adjusted R-squared	-0.004502	S.D. dependent var		0.03618
S.E. of regression	0.036261	Akaike info criterion		-4.358392
Sum squared resid	2.73891	Schwarz criterion		-4.35027
Log likelihood	4544.444	Hannan-Quinn criter.		-4.355416
Durbin-Watson stat	1.237924			



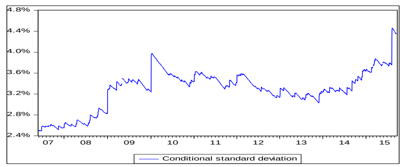


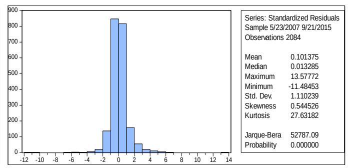


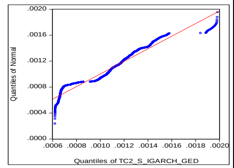
IGARCH (1,1)_GED

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.003872	0.000211	-18.34906	0
	Variance Equation			
RESID(-1)^2	0.002689	0.000883	3.043139	0.0023
GARCH(-1)	0.997311	0.000883	1128.848	0
GED PARAMETER	0.679297	0.019897	34.14029	0
R-squared	-0.008238	Mean dependent var		-0.000589
Adjusted R-squared	-0.008238	S.D. dependent var		0.03618
S.E. of regression	0.036329	Akaike info criterion		-4.382544
Sum squared resid	2.749097	Schwarz criterion		-4.374422
Log likelihood	4569.611	Hannan-Quinn criter.		-4.379568
Durbin-Watson stat	1.233337			



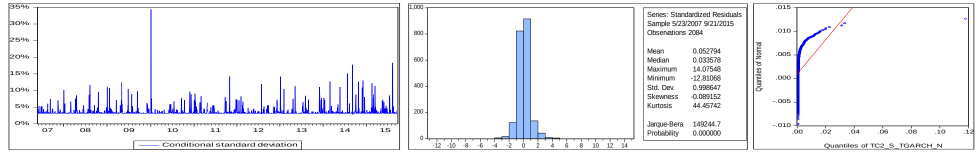




(GJR)TGARCH (1,1)_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1)

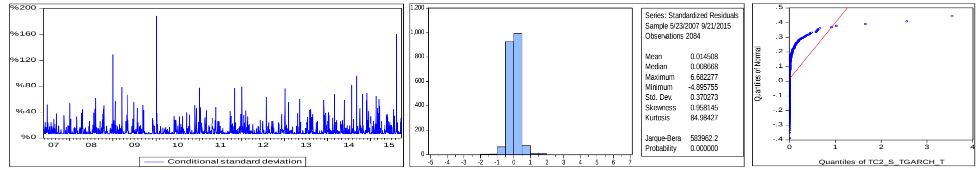
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.00453	0.000846	-5.352187	0
	Variance Equation			
C	9.69E-04	1.28E-05	7.57E+01	0.00E+00
RESID(-1)^2	0.605934	0.056608	10.7041	0
RESID(-1)^2*(RESID(-1)<0)	-0.499143	0.063778	-7.826284	0
GARCH(-1)	-0.006103	0.009966	-0.612342	0.5403
R-squared	-0.01187	Mean dependent var		-0.000589
Adjusted R-squared	-0.01187	S.D. dependent var		0.03618
S.E. of regression	0.036394	Akaike info criterion		-3.877475
Sum squared resid	2.758999	Schwarz criterion		-3.863938
Log likelihood	4045.329	Hannan-Quinn criter.		-3.872515
Durbin-Watson stat	1.228911			



(GJR)TGARCH (1,1)_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1)

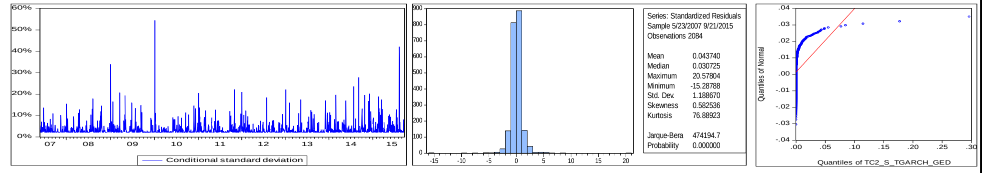
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.00417	0.000368	-11.32991	0
	Variance Equation			
C	0.003946	0.010919	0.361425	0.7178
RESID(-1)^2	18.39587	51.13713	0.359736	0.719
RESID(-1)^2*(RESID(-1)<0)	-2.607909	7.79574	-0.33453	0.738
GARCH(-1)	0.01286	0.012434	1.034269	0.301
T-DIST. DOF	2.044344	0.127346	16.05342	0
R-squared	-0.009799	Mean dependent var		-0.000589
Adjusted R-squared	-0.009799	S.D. dependent var		0.03618
S.E. of regression	0.036357	Akaike info criterion		-4.526834
Sum squared resid	2.753352	Schwarz criterion		-4.51059
Log likelihood	4722.961	Hannan-Quinn criter.		-4.520882
Durbin-Watson stat	1.231431			



(GJR)TGARCH (1,1)_ged

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1)

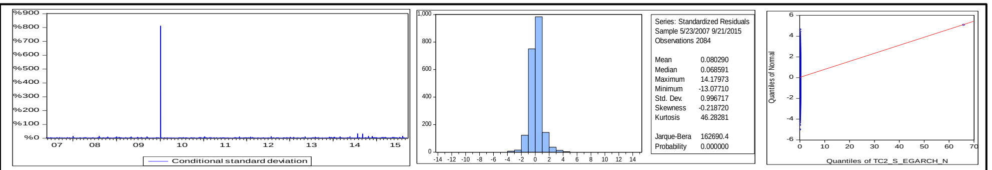
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.004242	0.000211	-20.10783	0
	Variance Equation			
C	0.000423	0.0000334	12.64594	0
RESID(-1)^2	1.534063	0.245509	6.248495	0
RESID(-1)^2*(RESID(-1)<0)	-0.441606	0.307692	-1.435222	0.1512
GARCH(-1)	0.012293	0.018098	0.679267	0.497
GED PARAMETER	0.721167	0.01808	39.88816	0
R-squared	-0.010199	Mean dependent var		-0.000589
Adjusted R-squared	-0.010199	S.D. dependent var		0.03618
S.E. of regression	0.036364	Akaike info criterion		-4.500833
Sum squared resid	2.754444	Schwarz criterion		-4.484589
Log likelihood	4695.868	Hannan-Quinn criter.		-4.494881
Durbin-Watson stat	1.230943			



EGARCH (1,1)_N

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

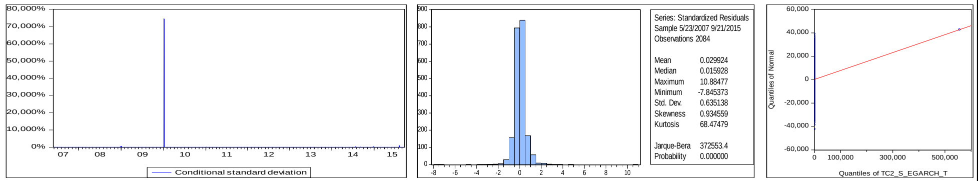
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.005734	0.000694	-8.258356	0
	Variance Equation			
C(2)	-6.358812	0.266881	-23.82636	0
C(3)	0.528865	0.03976	13.30141	0
C(4)	0.266434	0.024832	10.72954	0
C(5)	0.105094	0.038736	2.713086	0.0067
R-squared	-0.020231	Mean dependent var		-0.000589
Adjusted R-squared	-0.020231	S.D. dependent var		0.03618
S.E. of regression	0.036544	Akaike info criterion		-3.89385
Sum squared resid	2.781797	Schwarz criterion		-3.880313
Log likelihood	4062.392	Hannan-Quinn criter.		-3.88889
Durbin-Watson stat	1.218839			



EGARCH (1,1)_T

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

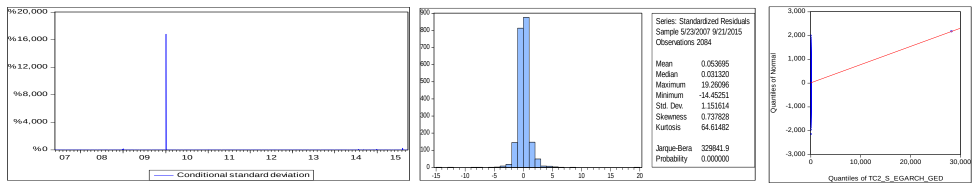
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.004209	0.000406	-10.37023	0
	Variance Equation			
C(2)	-3.89134	0.498057	-7.813049	0
C(3)	1.603584	0.592176	2.707954	0.0068
C(4)	0.219927	0.109583	2.006942	0.0448
C(5)	0.425009	0.045716	9.296689	0
T-DIST. DOF	2.163361	0.134498	16.08476	0
R-squared	-0.010013	Mean dependent var		-0.000589
Adjusted R-squared	-0.010013	S.D. dependent var		0.03618
S.E. of regression	0.036361	Akaike info criterion		-4.498661
Sum squared resid	2.753936	Schwarz criterion		-4.482417
Log likelihood	4693.605	Hannan-Quinn criter.		-4.492709
Durbin-Watson stat	1.23117			



EGARCH (1,1)_GED

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

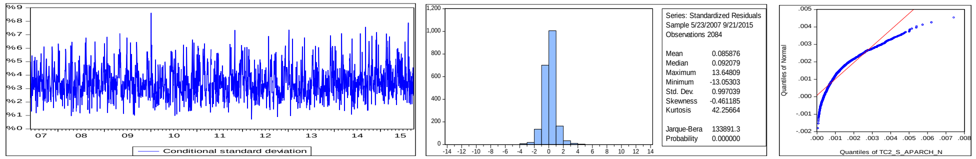
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-4.27E-03	2.31E-04	-1.85E+01	0.00E+00
	Variance Equation			
C(2)	-4.540194	0.446933	-10.15856	0
C(3)	0.793964	0.056498	14.05285	0
C(4)	0.140275	0.04836	2.900665	0.0037
C(5)	0.423884	0.06195	6.842394	0
GED PARAMETER	0.734045	0.018719	39.2146	0
R-squared	-0.010363	Mean dependent var		-0.000589
Adjusted R-squared	-0.010363	S.D. dependent var		0.03618
S.E. of regression	0.036367	Akaike info criterion		-4.486993
Sum squared resid	2.754892	Schwarz criterion		-4.470749
Log likelihood	4681.446	Hannan-Quinn criter.		-4.481041
Durbin-Watson stat	1.230743			



APARCH (1,1)_N

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

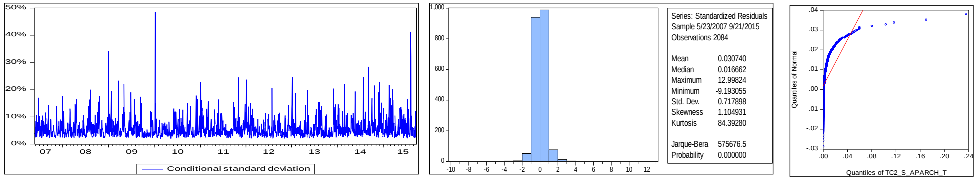
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-6.32E-03	2.15E-05	-2.94E+02	0.00E+00
	Variance Equation			
C(2)	0.668786	0.070676	9.462677	0
C(3)	0.230055	0.012229	18.81183	0
C(4)	-0.461683	0.012078	-38.22463	0
C(5)	0.082887	0.022541	3.677116	0.0002
C(6)	0.008941	0.028952	0.308825	0.7575
R-squared	-2.51E-02	Mean dependent var		-5.89E-04
Adjusted R-squared	-2.51E-02	S.D. dependent var		3.62E-02
S.E. of regression	0.036631	Akaike info criterion		-3.968672
Sum squared resid	2.794964	Schwarz criterion		-3.952428
Log likelihood	4141.356	Hannan-Quinn criter.		-3.96272
Durbin-Watson stat	1.213098			



APARCH (1,1)_T

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

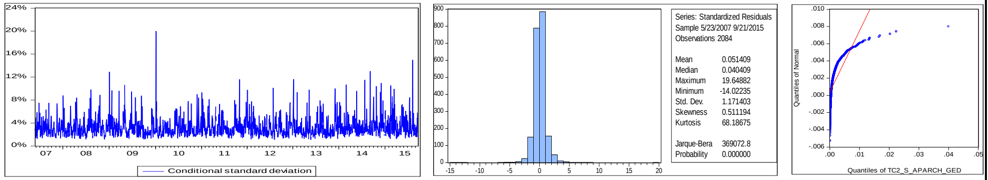
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-4.12E-03	2.32E-04	-1.78E+01	0.00E+00
	Variance Equation			
C(2)	0.087283	0.03662	2.3835	0.0171
C(3)	0.872821	0.23067	3.783854	0.0002
C(4)	-0.058834	0.059479	-0.989153	0.3226
C(5)	0.073987	0.04623	1.600411	0.1095
C(6)	0.602286	0.118745	5.072075	0
T-DIST. DOF	2.194643	0.135342	16.21558	0
R-squared	-0.00955	Mean dependent var		-0.000589
Adjusted R-squared	-0.00955	S.D. dependent var		0.03618
S.E. of regression	0.036352	Akaike info criterion		-4.545685
Sum squared resid	2.752674	Schwarz criterion		-4.526733
Log likelihood	4743.603	Hannan-Quinn criter.		-4.538741
Durbin-Watson stat	1.231734			



APARCH (1,1)_GED

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

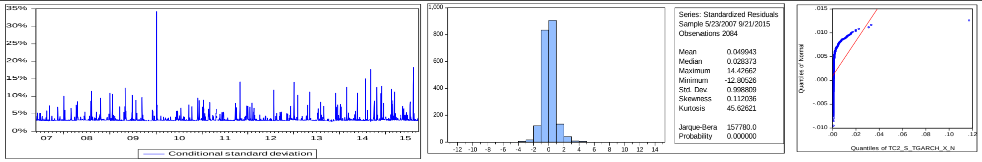
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-4.49E-03	1.30E-04	-3.45E+01	0.00E+00
	Variance Equation			
C(2)	0.142028	0.058477	2.42877	0.0152
C(3)	0.474114	0.069318	6.83967	0
C(4)	-0.173883	0.075051	-2.316857	0.0205
C(5)	0.065481	0.061582	1.063305	0.2876
C(6)	0.408996	0.110201	3.711374	0.0002
GED PARAMETER	0.747958	0.019173	39.01064	0
R-squared	-0.01165	Mean dependent var		-0.000589
Adjusted R-squared	-0.01165	S.D. dependent var		0.03618
S.E. of regression	0.03639	Akaike info criterion		-4.520621
Sum squared resid	2.7584	Schwarz criterion		-4.50167
Log likelihood	4717.487	Hannan-Quinn criter.		-4.513677
Durbin-Watson stat	1.229178			



TARCH (1,1)_X_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1) + C(6)*SPREAD_TC2_S_TC2_3M

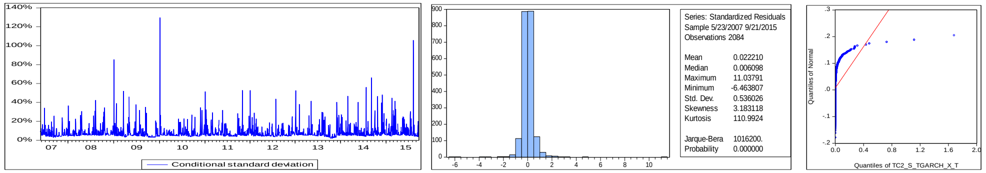
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-4.33E-03	9.75E-04	-4.44E+00	0.00E+00
	Variance Equation			
C	0.000973	0.0000143	67.85968	0
RESID(-1)^2	0.602229	0.056949	10.57496	0
RESID(-1)^2*(RESID(-1)<0)	-0.497369	0.064558	-7.704235	0
GARCH(-1)	-0.006196	0.010363	-0.597913	0.5499
SPREAD_TC2_S_TC2_3M	0.000197	0.0000375	5.263247	0
R-squared	-0.010713	Mean dependent var		-0.000589
Adjusted R-squared	-0.010713	S.D. dependent var		0.03618
S.E. of regression	0.036373	Akaike info criterion		-3.877222
Sum squared resid	2.755845	Schwarz criterion		-3.860978
Log likelihood	4046.065	Hannan-Quinn criter.		-3.87127
Durbin-Watson stat	1.230318			



TARCH (1,1)_X_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1) + C(6)*SPREAD_TC2_S_TC2_3M

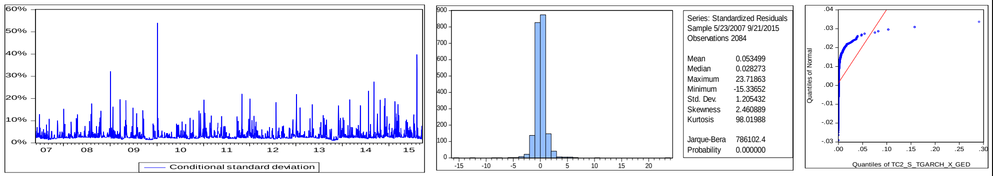
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-3.80E-03	3.60E-04	-1.05E+01	0.00E+00
	Variance Equation			
C	0.002109	0.002643	0.797988	0.4249
RESID(-1)^2	8.718267	11.04167	0.789579	0.4298
RESID(-1)^2*(RESID(-1)<0)	-1.814053	2.672763	-0.678718	0.4973
GARCH(-1)	0.012479	0.012998	0.960082	0.337
SPREAD_TC2_S_TC2_3M	0.00263	0.003323	0.791457	0.4287
T-DIST. DOF	2.095857	0.129898	16.13469	0
R-squared	-0.007856	Mean dependent var		-0.000589
Adjusted R-squared	-0.007856	S.D. dependent var		0.03618
S.E. of regression	0.036322	Akaike info criterion		-4.535063
Sum squared resid	2.748055	Schwarz criterion		-4.516112
Log likelihood	4732.536	Hannan-Quinn criter.		-4.528119
Durbin-Watson stat	1.233805			



TARCH (1,1)_X_GED

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1) + C(6)*SPREAD_TC2_S_TC2_3M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-4.14E-03	2.20E-04	-1.88E+01	0.00E+00
	Variance Equation			
C	0.000452	0.000036	12.55091	0
RESID(-1)^2	1.507153	0.238672	6.314743	0
RESID(-1)^2*(RESID(-1)<0)	-0.526535	0.295956	-1.779099	0.0752
GARCH(-1)	0.008889	0.016933	0.524957	0.5996
SPREAD_TC2_S_TC2_3M	0.000537	0.000107	5.024782	0
GED PARAMETER	0.729049	0.017768	41.03129	0
R-squared	-0.009622	Mean dependent var		-0.000589
Adjusted R-squared	-0.009622	S.D. dependent var		0.03618
S.E. of regression	0.036354	Akaike info criterion		-4.506696
Sum squared resid	2.752871	Schwarz criterion		-4.487745
Log likelihood	4702.978	Hannan-Quinn criter.		-4.499752
Durbin-Watson stat	1.231646			

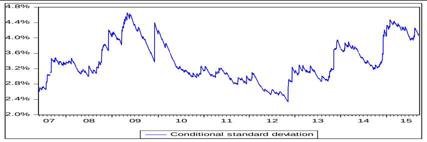


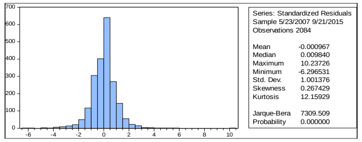
TC2 1 Month Front

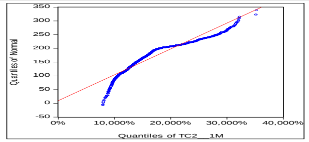
GARCH (1,1)_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000346	0.000744	-0.465044	0.6419
	Variance Equation			
C	2.66E-05	6.26E-06	4.245639	0
RESID(-1)^2	0.0137	0.001924	7.121601	0
GARCH(-1)	0.965057	0.006602	146.1671	0
R-squared	-0.000003	Mean dependent var		-0.000403
Adjusted R-squared	-0.000003	S.D. dependent var		0.035197
S.E. of regression	0.035197	Akaike info criterion		-3.870426
Sum squared resid	2.580539	Schwarz criterion		-3.859597
Log likelihood	4036.984	Hannan-Quinn criter.		-3.866458
Durbin-Watson stat	1.783754			



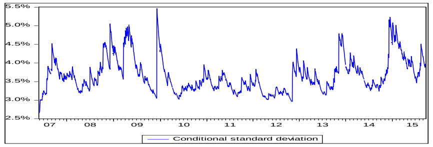


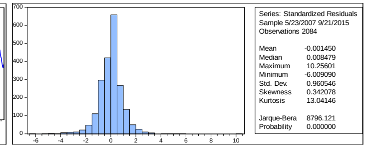


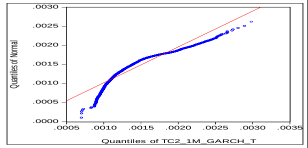
GARCH (1,1)_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000312	0.000593	-0.525965	0.5989
	Variance Equation			
C	2.88E-05	1.44E-05	1.997393	0.0458
RESID(-1)^2	0.021123	0.007447	2.836453	0.0046
GARCH(-1)	0.959961	0.014849	64.64918	0
T-DIST. DOF	3.244981	0.2676	12.12624	0
R-squared	-0.000007	Mean dependent var		-0.000403
Adjusted R-squared	-0.000007	S.D. dependent var		0.035197
S.E. of regression	0.035197	Akaike info criterion		-4.08411
Sum squared resid	2.58055	Schwarz criterion		-4.070574
Log likelihood	4260.643	Hannan-Quinn criter.		-4.07915
Durbin-Watson stat	1.783746			



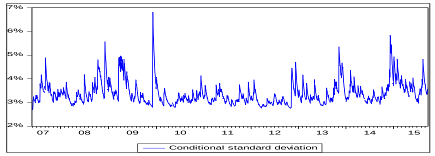


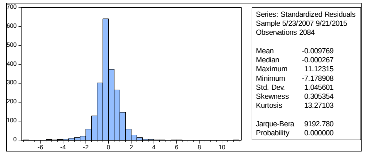


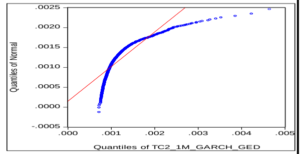
GARCH (1,1)_GED

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	8.58615E-06	0.000489027	0.017558	0.985991765
	Variance Equation			
C	7.43E-05	2.80E-05	2.658881	0.007840061
RESID(-1)^2	0.039631703	0.01357622	2.9192	0.003509309
GARCH(-1)	0.89446773	0.033630531	26.5969	7.37E-156
GED PARAMETER	0.961434081	0.028809982	33.37156	3.55E-244
R-squared	-0.000136775	Mean dependent var		-0.000402951
Adjusted R-squared	-0.000136775	S.D. dependent var		0.035197356
S.E. of regression	0.035199763	Akaike info criterion		-4.104100681
Sum squared resid	2.580885636	Schwarz criterion		-4.090564106
Log likelihood	4281.472909	Hannan-Quinn criter.		-4.099140675
Durbin-Watson stat	1.783514363			



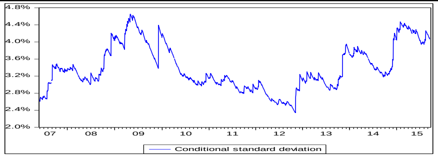


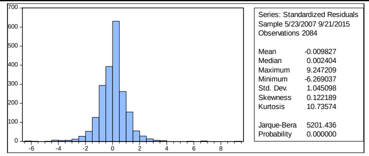


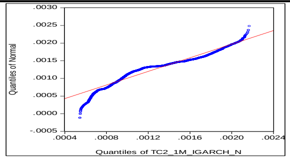
IGARCH (1,1)_N

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.0000833	0.000627	-0.132811	0.8943
	Variance Equation			
RESID(-1)^2	0.008192	0.000438	18.69328	0
GARCH(-1)	0.991808	0.000438	2263.182	0
R-squared	-0.000083	Mean dependent var		-0.000403
Adjusted R-squared	-0.000083	S.D. dependent var		0.035197
S.E. of regression	0.035199	Akaike info criterion		-3.85815
Sum squared resid	2.580746	Schwarz criterion		-3.852736
Log likelihood	4022.193	Hannan-Quinn criter.		-3.856166
Durbin-Watson stat	1.783611			



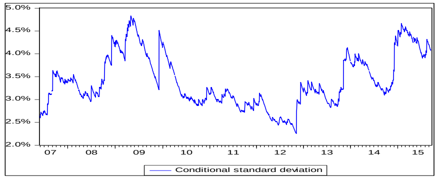


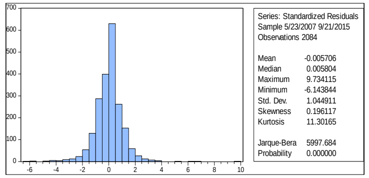


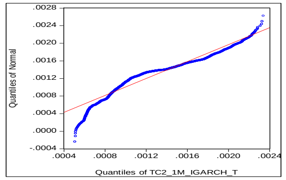
IGARCH (1,1)_T

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000201	0.000576	-0.348786	0.7272
	Variance Equation			
RESID(-1)^2	0.010408	0.002126	4.895134	0
GARCH(-1)	0.989592	0.002126	465.4393	0
T-DIST. DOF	3.669099	0.16215	22.62783	0
R-squared	-0.000033	Mean dependent var		-0.000403
Adjusted R-squared	-0.000033	S.D. dependent var		0.035197
S.E. of regression	0.035198	Akaike info criterion		-4.07661
Sum squared resid	2.580618	Schwarz criterion		-4.068488
Log likelihood	4250.828	Hannan-Quinn criter.		-4.073634
Durbin-Watson stat	1.783699			



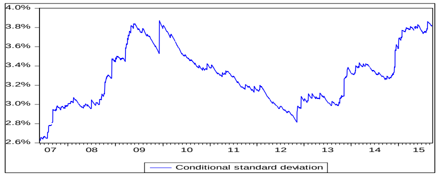


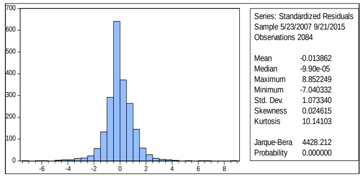


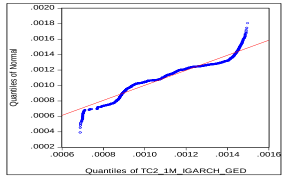
IGARCH (1,1)_GED

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.00000326	0.000469	0.006952	0.9945
	Variance Equation			
RESID(-1)^2	0.002634	0.000642	4.102574	0
GARCH(-1)	0.997366	0.000642	1553.187	0
GED PARAMETER	0.952581	0.02855	33.36522	0
R-squared	-0.000133	Mean dependent var		-0.000403
Adjusted R-squared	-0.000133	S.D. dependent var		0.035197
S.E. of regression	0.0352	Akaike info criterion		-4.096359
Sum squared resid	2.580877	Schwarz criterion		-4.088237
Log likelihood	4271.406	Hannan-Quinn criter.		-4.093383
Durbin-Watson stat	1.783521			



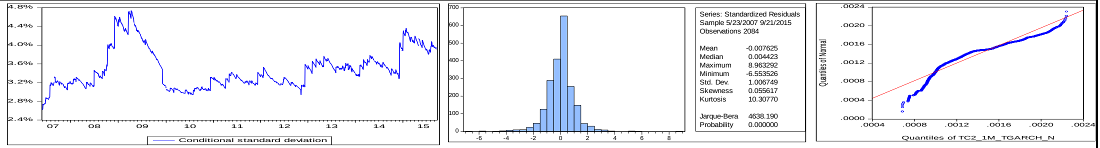




(GJR)TGARCH (1,1)_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1)

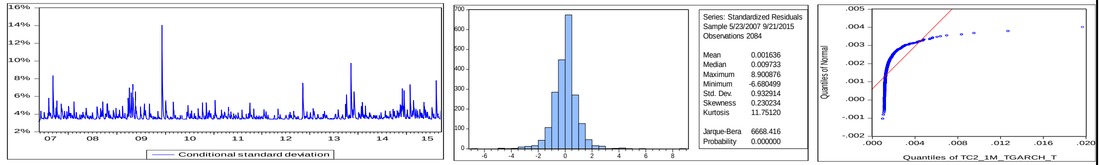
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000156	0.000742	-0.210757	0.8331
	Variance Equation			
C	5.25E-06	8.91E-07	5.892816	0
RESID(-1)^2	-0.002011	0.000962	-2.090213	0.0366
RESID(-1)^2*(RESID(-1)<0)	0.01318	0.001617	8.149658	0
GARCH(-1)	0.991375	0.000751	1319.69	0
R-squared	-0.000049	Mean dependent var		-0.000403
Adjusted R-squared	-0.000049	S.D. dependent var		0.035197
S.E. of regression	0.035198	Akaike info criterion		-3.87175
Sum squared resid	2.580659	Schwarz criterion		-3.858213
Log likelihood	4039.363	Hannan-Quinn criter.		-3.86679
Durbin-Watson stat	1.783671			



(GJR)TGARCH (1,1)_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1)

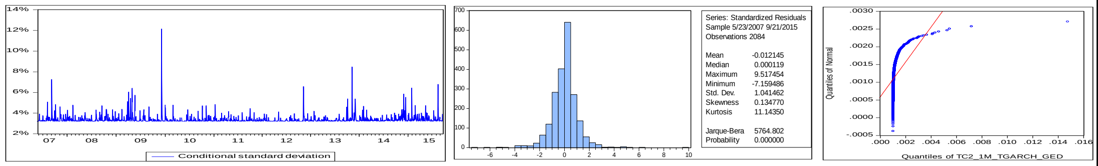
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000354	0.000592	-0.597654	0.5501
	Variance Equation			
C	0.000433	0.000143	3.024262	0.0025
RESID(-1)^2	0.189145	0.065901	2.870136	0.0041
RESID(-1)^2*(RESID(-1)<0)	-0.174281	0.065348	-2.666976	0.0077
GARCH(-1)	0.623546	0.104306	5.978027	0
T-DIST. DOF	3.051539	0.248156	12.29686	0
R-squared	-0.000002	Mean dependent var		-0.000403
Adjusted R-squared	-0.000002	S.D. dependent var		0.035197
S.E. of regression	0.035197	Akaike info criterion		-4.0831
Sum squared resid	2.580538	Schwarz criterion		-4.066856
Log likelihood	4260.59	Hannan-Quinn criter.		-4.077148
Durbin-Watson stat	1.783755			



(GJR)TGARCH (1,1)_GED

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1)

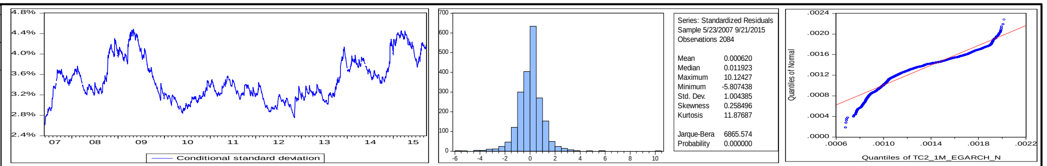
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.0000039	0.000491	-0.007942	0.9937
	Variance Equation			
C	0.000694	0.000221	3.141919	0.0017
RESID(-1)^2	0.140481	0.061126	2.298206	0.0216
RESID(-1)^2*(RESID(-1)<0)	-0.1244	0.061528	-2.021842	0.0432
GARCH(-1)	0.322601	0.200361	1.610093	0.1074
GED PARAMETER	0.95481	0.029146	32.75942	0
R-squared	-0.000129	Mean dependent var		-0.000403
Adjusted R-squared	-0.000129	S.D. dependent var		0.035197
S.E. of regression	0.0352	Akaike info criterion		-4.103084
Sum squared resid	2.580865	Schwarz criterion		-4.08684
Log likelihood	4281.413	Hannan-Quinn criter.		-4.097132
Durbin-Watson stat	1.783529			



EGARCH (1,1)_N

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

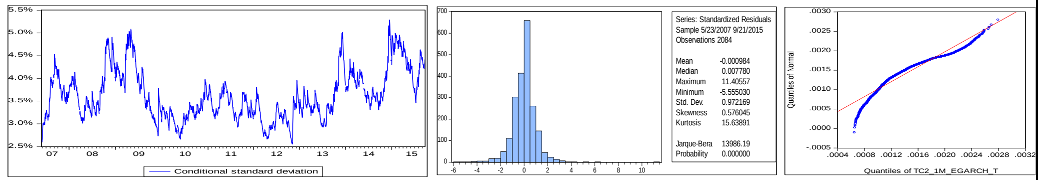
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000416	0.000763	-0.54553	0.5854
	Variance Equation			
C(2)	-0.053128	0.008068	-6.585347	0
C(3)	0.027147	0.001923	14.11921	0
C(4)	-0.005045	0.002753	-1.83261	0.0669
C(5)	0.994784	0.001222	814.1756	0
R-squared	0	Mean dependent var		-0.000403
Adjusted R-squared	0	S.D. dependent var		0.035197
S.E. of regression	0.035197	Akaike info criterion		-3.876249
Sum squared resid	2.580533	Schwarz criterion		-3.862712
Log likelihood	4044.051	Hannan-Quinn criter.		-3.871289
Durbin-Watson stat	1.783758			



EGARCH (1,1)_T

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

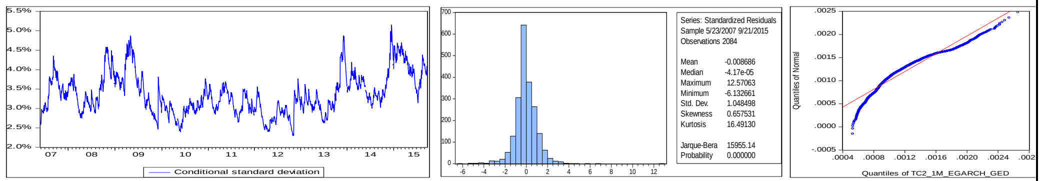
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000285	0.000586	-0.486956	0.6263
	Variance Equation			
C(2)	-0.115825	0.04719	-2.454447	0.0141
C(3)	0.064364	0.017544	3.668816	0.0002
C(4)	-0.004849	0.011541	-0.420159	0.6744
C(5)	0.988862	0.0062	159.4964	0
T-DIST. DOF	3.292909	0.269385	12.22381	0
R-squared	-0.000011	Mean dependent var		-0.000403
Adjusted R-squared	-0.000011	S.D. dependent var		0.035197
S.E. of regression	0.035198	Akaike info criterion		-4.092406
Sum squared resid	2.580561	Schwarz criterion		-4.076163
Log likelihood	4270.288	Hannan-Quinn criter.		-4.086454
Durbin-Watson stat	1.783738			



EGARCH (1,1)_GED

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

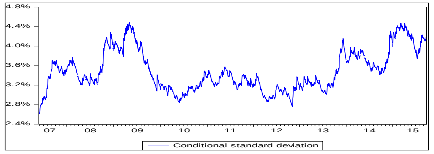
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.00000135	0.000496	0.00271	0.9978
	Variance Equation			
C(2)	-0.129897	0.053488	-2.428507	0.0152
C(3)	0.069114	0.016421	4.208851	0
C(4)	0.002303	0.010465	0.220113	0.8258
C(5)	0.988006	0.006838	144.4869	0
GED PARAMETER	0.982018	0.028628	34.30281	0
R-squared	-0.000132	Mean dependent var		-0.000403
Adjusted R-squared	-0.000132	S.D. dependent var		0.035197
S.E. of regression	0.0352	Akaike info criterion		-4.110849
Sum squared resid	2.580873	Schwarz criterion		-4.094605
Log likelihood	4289.505	Hannan-Quinn criter.		-4.104897
Durbin-Watson stat	1.783523			

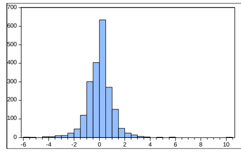


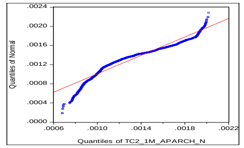
APARCH (1,1)_N

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000410979	0.000772026	-0.532338654	0.594491465
	Variance Equation			
C(2)	0.000197155	0.000135768	1.452138023	0.146463231
C(3)	0.014002113	0.001070116	13.08467153	4.03E-39
C(4)	0.155772618	0.111132753	1.401680548	0.161010662
C(5)	0.985210615	0.001523068	646.8591791	0
C(6)	0.990158583	0.208698646	4.744441813	2.09E-06
R-squared	-5.20E-08	Mean dependent var		-0.000402951
Adjusted R-squared	-5.20E-08	S.D. dependent var		0.035197356
S.E. of regression	0.035197357	Akaike info criterion		-3.875425978
Sum squared resid	2.580532817	Schwarz criterion		-3.859182088
Log likelihood	4044.193869	Hannan-Quinn criter.		-3.869473971
Durbin-Watson stat	1.783758211			



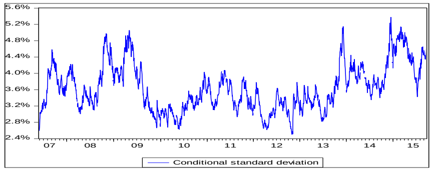


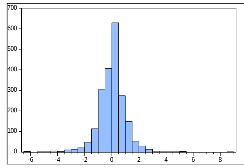


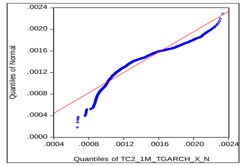
APARCH (1,1)_T

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000372	0.000582	-0.639314	0.5226
	Variance Equation			
C(2)	0.001051	0.000966	1.087871	0.2767
C(3)	0.034209	0.009503	3.600018	0.0003
C(4)	0.038532	0.198263	0.19435	0.8459
C(5)	0.966773	0.010129	95.45	0
C(6)	0.696813	0.233521	2.98394	0.0028
T-DIST. DOF	3.273825	0.267585	12.23469	0
R-squared	-0.000001	Mean dependent var		-0.000403
Adjusted R-squared	-0.000001	S.D. dependent var		0.035197
S.E. of regression	0.035197	Akaike info criterion		-4.093118
Sum squared resid	2.580535	Schwarz criterion		-4.074167
Log likelihood	4272.029	Hannan-Quinn criter.		-4.086174
Durbin-Watson stat	1.783757			



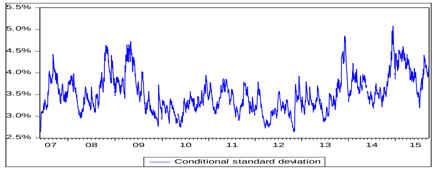


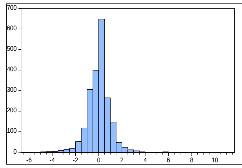


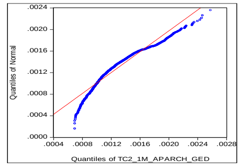
APARCH (1,1)_GED

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.00000147	0.000475	-0.0031	0.9975
	Variance Equation			
C(2)	0.001292	0.001531	0.843581	0.3989
C(3)	0.035324	0.012591	2.805566	0.005
C(4)	-0.016776	0.213652	-0.07852	0.9374
C(5)	0.950327	0.020808	45.67195	0
C(6)	0.899245	0.338829	2.653979	0.008
GED PARAMETER	0.915633	0.02957	30.9649	0
R-squared	-0.00013	Mean dependent var		-0.000403
Adjusted R-squared	-0.00013	S.D. dependent var		0.035197
S.E. of regression	0.0352	Akaike info criterion		-4.115023
Sum squared resid	2.580869	Schwarz criterion		-4.096072
Log likelihood	4294.854	Hannan-Quinn criter.		-4.108079
Durbin-Watson stat	1.783526			



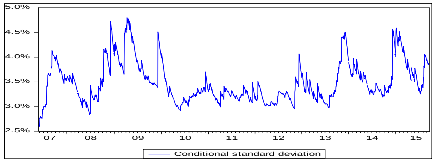


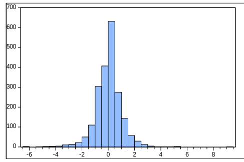


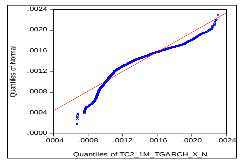
TARCH (1,1)_X_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1) + C(6)*SPREAD_TC2_S_TC2_3M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000628	0.000816	-0.768865	0.442
	Variance Equation			
C	1.73E-05	4.11E-06	4.212595	0
RESID(-1)^2	0.009177	0.002001	4.586799	0
RESID(-1)^2*(RESID(-1)<0)	0.008703	0.003272	2.660293	0.0078
GARCH(-1)	0.972819	0.004353	223.4815	0
SPREAD_TC2_S_TC2_3M	-2.07E-05	3.64E-06	-5.704922	0
R-squared	-0.000041	Mean dependent var		-0.000403
Adjusted R-squared	-0.000041	S.D. dependent var		0.035197
S.E. of regression	0.035198	Akaike info criterion		-3.874851
Sum squared resid	2.580638	Schwarz criterion		-3.858607
Log likelihood	4043.595	Hannan-Quinn criter.		-3.868899
Durbin-Watson stat	1.783686			



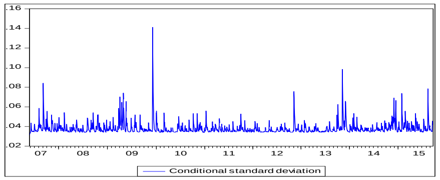


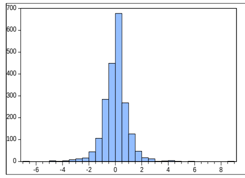


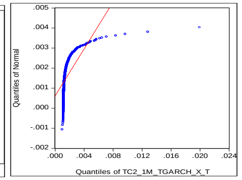
TARCH (1,1)_X_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1) + C(6)*SPREAD_TC2_S_TC2_3M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000355	0.000593	-0.59925	0.549
	Variance Equation			
C	0.000439	0.000145	3.035466	0.0024
RESID(-1)^2	0.191062	0.066519	2.872274	0.0041
RESID(-1)^2*(RESID(-1)<0)	-0.176611	0.065971	-2.677103	0.0074
GARCH(-1)	0.619541	0.104986	5.901202	0
SPREAD_TC2_S_TC2_3M	-3.23E-05	0.000101	-0.319933	0.749
T-DIST. DOF	3.050933	0.248645	12.27024	0
R-squared	-0.000002	Mean dependent var		-0.000403
Adjusted R-squared	-0.000002	S.D. dependent var		0.035197
S.E. of regression	0.035197	Akaike info criterion		-4.082186
Sum squared resid	2.580537	Schwarz criterion		-4.063234
Log likelihood	4260.637	Hannan-Quinn criter.		-4.075242
Durbin-Watson stat	1.783755			



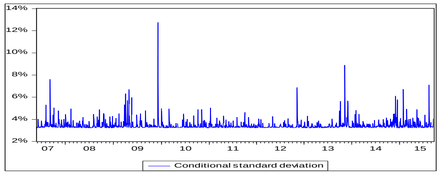


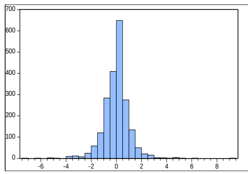


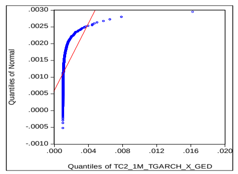
TARCH (1,1)_X_GED

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1) + C(6)*SPREAD_TC2_S_TC2_3M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000000285	0.000457	-0.000624	0.9995
	Variance Equation			
C	0.000672	0.000211	3.188106	0.0014
RESID(-1)^2	0.155347	0.066472	2.337009	0.0194
RESID(-1)^2*(RESID(-1)<0)	-0.14106	0.066649	-2.116451	0.0343
GARCH(-1)	0.360384	0.18509	1.947068	0.0515
SPREAD_TC2_S_TC2_3M	-3.61E-05	0.00012	-0.302049	0.7626
GED PARAMETER	0.933564	0.03027	30.84115	0
R-squared	-0.000131	Mean dependent var		-0.000403
Adjusted R-squared	-0.000131	S.D. dependent var		0.035197
S.E. of regression	0.0352	Akaike info criterion		-4.104581
Sum squared resid	2.580871	Schwarz criterion		-4.08563
Log likelihood	4283.973	Hannan-Quinn criter.		-4.097637
Durbin-Watson stat	1.783525			

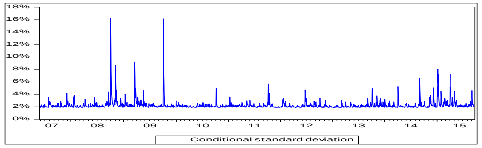


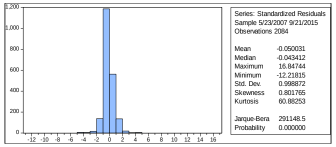


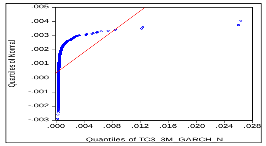


TC2 3 MONTHS

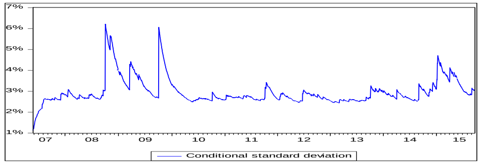
GARCH (1,1)_N				
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000877	0.000405	2.165412	0.0304
	Variance Equation			
C	1.94E-04	1.24E-05	15.63778	0
RESID(-1)^2	0.221559	8.53E-03	25.97904	0
GARCH(-1)	4.62E-01	2.98E-02	15.51369	0
R-squared	-0.002517	Mean dependent var		-0.000256
Adjusted R-squared	-0.002517	S.D. dependent var		0.022583
S.E. of regression	0.022612	Akaike info criterion		-4.793228
Sum squared resid	1.065028	Schwarz criterion		-4.782399
Log likelihood	4998.544	Hannan-Quinn criter.		-4.78926
Durbin-Watson stat	1.996715			

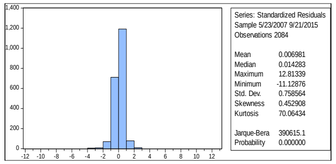


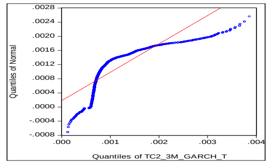




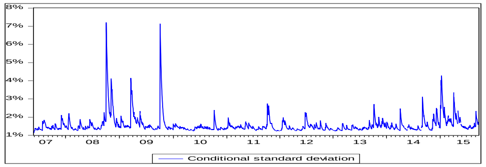
GARCH (1,1)_T				
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.0004	0.000278	-1.437117	0.1507
	Variance Equation			
C	1.60E-05	8.38E-06	1.904272	0.0569
RESID(-1)^2	0.025397	0.012832	1.979272	0.0478
GARCH(-1)	0.969032	0.007831	123.7442	0
T-DIST. DOF	2.26423	0.131242	17.25228	0
R-squared	-0.00004	Mean dependent var		-0.000256
Adjusted R-squared	-0.00004	S.D. dependent var		0.022583
S.E. of regression	0.022584	Akaike info criterion		-5.401983
Sum squared resid	1.062396	Schwarz criterion		-5.388447
Log likelihood	5633.867	Hannan-Quinn criter.		-5.397023
Durbin-Watson stat	2.001661			

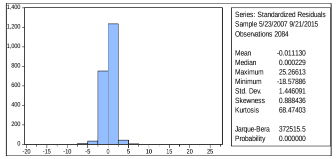


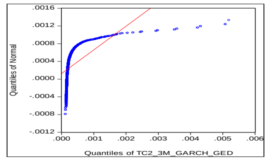




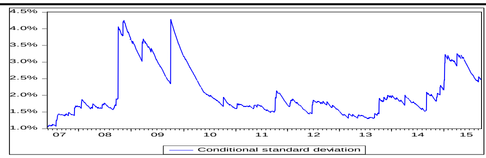
GARCH (1,1)_GED				
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.00000332	0.000264	-0.012571	0.99
	Variance Equation			
C	2.60E-05	4.08E-06	6.362509	0
RESID(-1)^2	0.042108	0.006791	6.200323	0.00E+00
GARCH(-1)	0.824824	0.02347	35.14413	0
GED PARAMETER	1.062538	0.012312	86.29991	0
R-squared	-0.000125	Mean dependent var		-0.000256
Adjusted R-squared	-0.000125	S.D. dependent var		0.022583
S.E. of regression	0.022585	Akaike info criterion		-5.373957
Sum squared resid	1.062487	Schwarz criterion		-5.360421
Log likelihood	5604.664	Hannan-Quinn criter.		-5.368997
Durbin-Watson stat	2.001491			

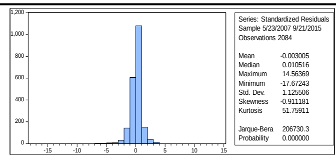


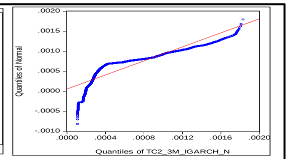




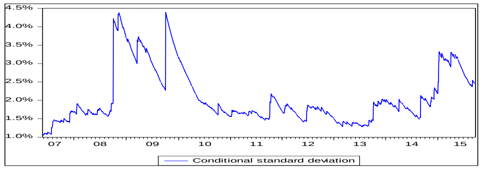
IGARCH (1,1)_N				
GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000193	0.000328	-0.588055	0.5565
	Variance Equation			
RESID(-1)^2	0.011048	0.000162	68.06048	0
GARCH(-1)	0.988952	0.000162	6092.257	0
R-squared	-0.000008	Mean dependent var		-0.000256
Adjusted R-squared	-0.000008	S.D. dependent var		0.022583
S.E. of regression	0.022584	Akaike info criterion		-4.741681
Sum squared resid	1.062362	Schwarz criterion		-4.736266
Log likelihood	4942.832	Hannan-Quinn criter.		-4.739697
Durbin-Watson stat	2.001726			

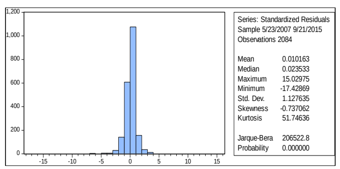


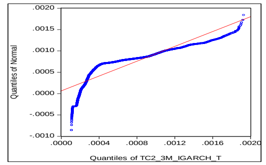




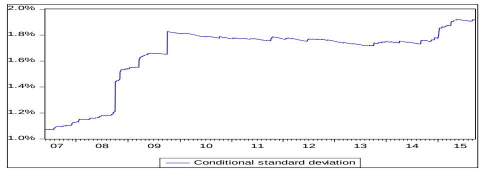
IGARCH (1,1)_T				
GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000432	0.000263	-1.644597	0.1001
	Variance Equation			
RESID(-1)^2	0.012138	0.001575	7.70824	0
GARCH(-1)	0.987862	0.001575	627.3616	0
T-DIST. DOF	2.729453	0.049178	55.50201	0
R-squared	-0.000061	Mean dependent var		-0.000256
Adjusted R-squared	-0.000061	S.D. dependent var		0.022583
S.E. of regression	0.022584	Akaike info criterion		-5.373721
Sum squared resid	1.062418	Schwarz criterion		-5.365599
Log likelihood	5602.418	Hannan-Quinn criter.		-5.370745
Durbin-Watson stat	2.00162			

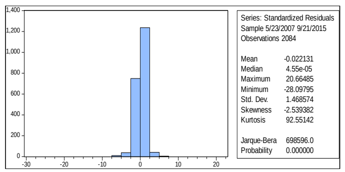


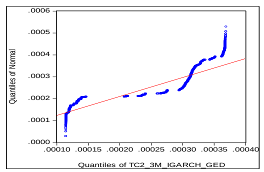




IGARCH (1,1)_GED				
GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000000799	0.00029	-0.002754	0.9978
	Variance Equation			
RESID(-1)^2	0.000525	3.95E-05	13.28144	0
GARCH(-1)	0.999475	3.95E-05	25284.57	0
GED PARAMETER	1.090801	0.009868	110.5448	0
R-squared	-0.000128	Mean dependent var		-0.000256
Adjusted R-squared	-0.000128	S.D. dependent var		0.022583
S.E. of regression	0.022585	Akaike info criterion		-5.291735
Sum squared resid	1.062489	Schwarz criterion		-5.283613
Log likelihood	5516.988	Hannan-Quinn criter.		-5.288759
Durbin-Watson stat	2.001486			



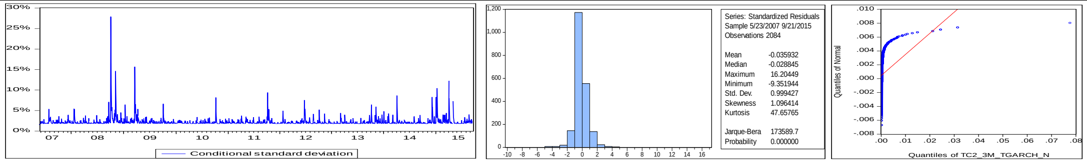




(GJR)TGARCH (1,1)_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1)

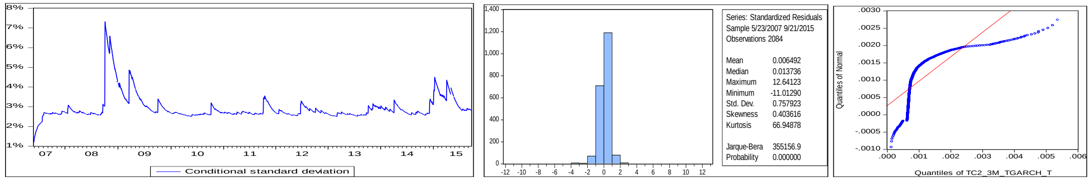
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000555	0.000305	1.818785	0.0689
	Variance Equation			
C	1.93E-04	9.41E-06	20.56518	0
RESID(-1)^2	0.034603	0.010627	3.256153	0.0011
RESID(-1)^2*(RESID(-1)<0)	0.626084	0.026243	23.85699	0
GARCH(-1)	0.402505	0.019494	20.64806	0
R-squared	-0.001289	Mean dependent var		-0.000256
Adjusted R-squared	-0.001289	S.D. dependent var		0.022583
S.E. of regression	0.022598	Akaike info criterion		-4.829387
Sum squared resid	1.063723	Schwarz criterion		-4.81585
Log likelihood	5037.221	Hannan-Quinn criter.		-4.824427
Durbin-Watson stat	1.999165			



(GJR)TGARCH (1,1)_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1)

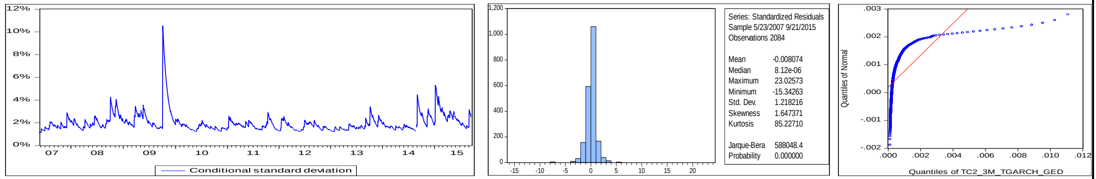
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000381	0.000279	-1.365131	0.1722
	Variance Equation			
C	1.87E-05	9.63E-06	1.946489	0.0516
RESID(-1)^2	0.003694	0.005106	0.723515	0.4694
RESID(-1)^2*(RESID(-1)<0)	0.034448	0.018661	1.846006	0.0649
GARCH(-1)	0.967322	0.00853	113.3994	0
T-DIST. DOF	2.272459	0.134878	16.84824	0
R-squared	-0.000031	Mean dependent var		-0.000256
Adjusted R-squared	-0.000031	S.D. dependent var		0.022583
S.E. of regression	0.022584	Akaike info criterion		-5.403885
Sum squared resid	1.062386	Schwarz criterion		-5.387641
Log likelihood	5636.848	Hannan-Quinn criter.		-5.397933
Durbin-Watson stat	2.001681			



(GJR)TGARCH (1,1)_ged

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1)

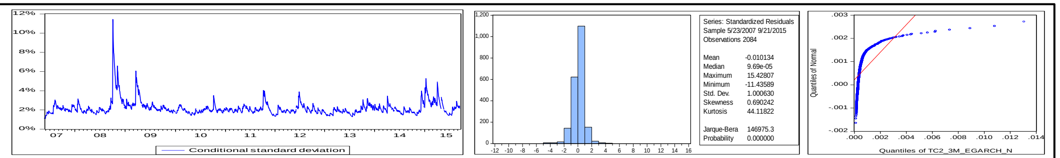
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000000145	0.000156	-0.000926	0.9993
	Variance Equation			
C	8.81E-06	2.65E-06	3.323969	0.0009
RESID(-1)^2	0.093284	0.021523	4.334194	0
RESID(-1)^2*(RESID(-1)<0)	-0.081721	0.021263	-3.843359	0.0001
GARCH(-1)	0.927131	0.013076	70.90535	0
GED PARAMETER	0.632845	0.016355	38.69472	0
R-squared	-0.000129	Mean dependent var		-0.000256
Adjusted R-squared	-0.000129	S.D. dependent var		0.022583
S.E. of regression	0.022585	Akaike info criterion		-5.636248
Sum squared resid	1.06249	Schwarz criterion		-5.620004
Log likelihood	5878.971	Hannan-Quinn criter.		-5.630296
Durbin-Watson stat	2.001485			



EGARCH (1,1)_N

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

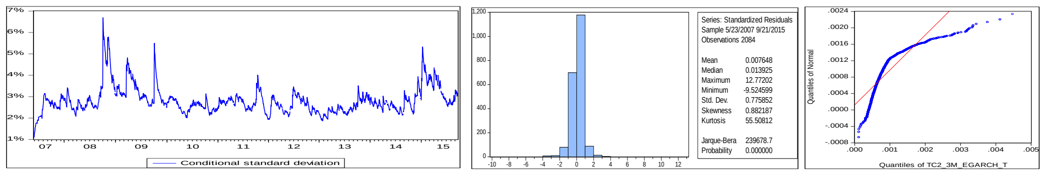
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000002	0.000394	-0.00507	0.996
	Variance Equation			
C(2)	-0.383047	0.033379	-11.47571	0
C(3)	0.132908	0.004888	27.19154	0
C(4)	-0.111441	0.008319	-13.39664	0
C(5)	0.960393	0.004204	228.4512	0
R-squared	-0.000127	Mean dependent var		-0.000256
Adjusted R-squared	-0.000127	S.D. dependent var		0.022583
S.E. of regression	0.022585	Akaike info criterion		-4.878212
Sum squared resid	1.062488	Schwarz criterion		-4.864676
Log likelihood	5088.097	Hannan-Quinn criter.		-4.873252
Durbin-Watson stat	2.001488			



EGARCH (1,1)_T

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

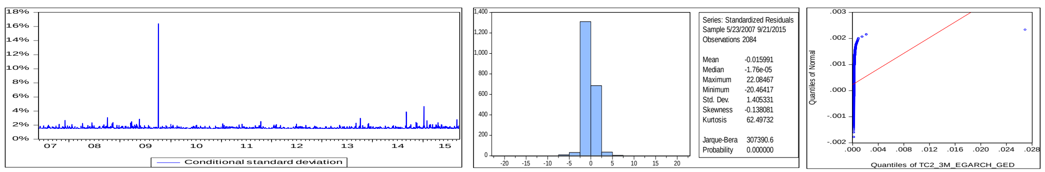
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.00038	0.000277	-1.370224	0.1706
	Variance Equation			
C(2)	-0.2453	0.067303	-3.644723	0.0003
C(3)	0.127951	0.034979	3.65799	0.0003
C(4)	-0.011068	0.019215	-0.576003	0.5646
C(5)	0.973556	0.008534	114.0841	0
T-DIST. DOF	2.300616	0.130145	17.67739	0
R-squared	-0.00003	Mean dependent var		-0.000256
Adjusted R-squared	-0.00003	S.D. dependent var		0.022583
S.E. of regression	0.022584	Akaike info criterion		-5.408944
Sum squared resid	1.062385	Schwarz criterion		-5.3927
Log likelihood	5642.119	Hannan-Quinn criter.		-5.402992
Durbin-Watson stat	2.001682			



EGARCH (1,1)_GED

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

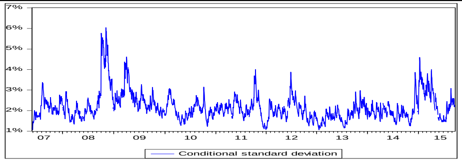
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000000272	0.00021	0.001298	0.999
	Variance Equation			
C(2)	-7.061593	0.94372	-7.482724	0
C(3)	0.142236	0.03066	4.639146	0
C(4)	0.073711	0.026318	2.800844	0.0051
C(5)	0.158412	0.113809	1.391912	0.1639
GED PARAMETER	0.929307	0.015587	59.61898	0
R-squared	-0.000129	Mean dependent var		-0.000256
Adjusted R-squared	-0.000129	S.D. dependent var		0.022583
S.E. of regression	0.022585	Akaike info criterion		-5.433605
Sum squared resid	1.062491	Schwarz criterion		-5.417361
Log likelihood	5667.816	Hannan-Quinn criter.		-5.427653
Durbin-Watson stat	2.001484			

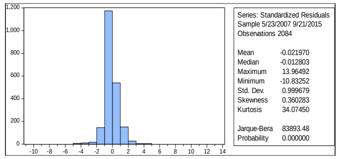


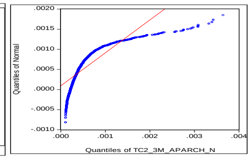
APARCH (1,1)_N

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000245	0.000214	1.144476	0.2524
	Variance Equation			
C(2)	0.003084	0.000393	7.839427	0.00E+00
C(3)	0.087135	0.003375	25.81566	0
C(4)	0.677861	0.036685	18.47806	0
C(5)	0.918882	0.004456	206.2278	0.00E+00
C(6)	0.597992	0.034766	17.2006	0
R-squared	-4.92E-04	Mean dependent var		-0.000256
Adjusted R-squared	-0.000492	S.D. dependent var		0.022583
S.E. of regression	0.022589	Akaike info criterion		-4.897464
Sum squared resid	1.062877	Schwarz criterion		-4.88122
Log likelihood	5109.157	Hannan-Quinn criter.		-4.891512
Durbin-Watson stat	2.000757			



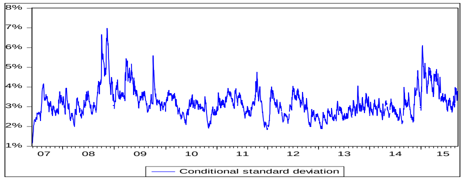


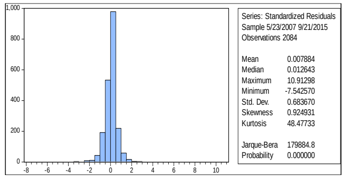


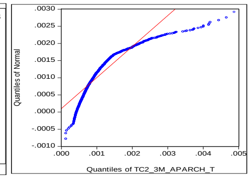
APARCH (1,1)_T

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000391	0.000273	-1.433665	0.1517
	Variance Equation			
C(2)	0.003355	0.002342	1.432411	0.152
C(3)	0.095502	0.028055	3.404077	0.0007
C(4)	-0.100293	0.16732	-0.599409	0.5489
C(5)	0.919908	0.017084	53.84689	0
C(6)	0.699563	0.164593	4.250254	0
T-DIST. DOF	2.220583	0.124945	17.77246	0
R-squared	-0.000036	Mean dependent var		-0.000256
Adjusted R-squared	-0.000036	S.D. dependent var		0.022583
S.E. of regression	0.022584	Akaike info criterion		-5.412369
Sum squared resid	1.062392	Schwarz criterion		-5.393418
Log likelihood	5646.688	Hannan-Quinn criter.		-5.405425
Durbin-Watson stat	2.00167			



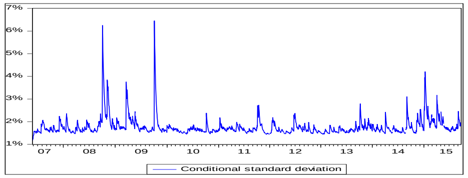


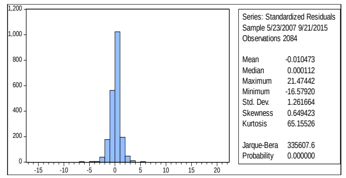


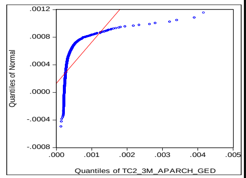
APARCH (1,1)_GED

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.00000189	0.000262	-0.007214	0.9942
	Variance Equation			
C(2)	0.000132	0.000151	0.873725	0.3823
C(3)	0.052488	0.01471	3.568138	0.0004
C(4)	-0.031996	0.102255	-0.312905	0.7544
C(5)	0.831743	0.035438	23.47058	0
C(6)	1.679658	0.28399	5.9145	0
GED PARAMETER	0.979632	0.017202	56.94896	0
R-squared	-0.000127	Mean dependent var		-0.000256
Adjusted R-squared	-0.000127	S.D. dependent var		0.022583
S.E. of regression	0.022585	Akaike info criterion		-5.435625
Sum squared resid	1.062488	Schwarz criterion		-5.416674
Log likelihood	5670.921	Hannan-Quinn criter.		-5.428681
Durbin-Watson stat	2.001488			



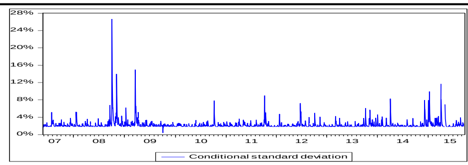


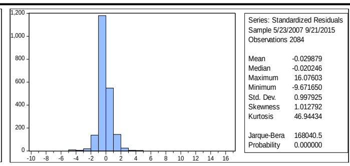


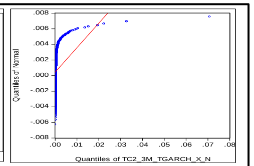
TARCH (1,1)_X_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1) + C(6)*SPREAD_TC2_S_TC2_3M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000391	0.000343	1.142355	0.2533
	Variance Equation			
C	0.00018	8.56E-06	21.06955	0
RESID(-1)^2	-0.003198	0.002589	-1.235182	0.2168
RESID(-1)^2*(RESID(-1)<0)	0.605168	0.021567	28.0603	0
GARCH(-1)	0.459717	0.017557	26.18479	0
SPREAD_TC2_S_TC2_3M	-1.81E-06	1.49E-05	-0.121414	0.9034
R-squared	-0.000822	Mean dependent var		-0.000256
Adjusted R-squared	-0.000822	S.D. dependent var		0.022583
S.E. of regression	0.022593	Akaike info criterion		-4.827309
Sum squared resid	1.063227	Schwarz criterion		-4.811066
Log likelihood	5036.056	Hannan-Quinn criter.		-4.821357
Durbin-Watson stat	2.000097			



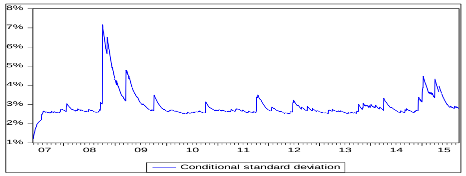


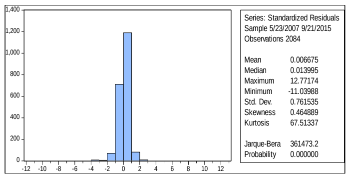


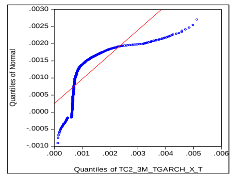
TARCH (1,1)_X_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1) + C(6)*SPREAD_TC2_S_TC2_3M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000387	0.000279	-1.386776	0.1655
	Variance Equation			
C	1.76E-05	9.01E-06	1.955109	0.0506
RESID(-1)^2	0.004436	0.005376	0.825171	0.4093
RESID(-1)^2*(RESID(-1)<0)	0.031743	0.01728	1.836949	0.0662
GARCH(-1)	0.968724	0.008185	118.3514	0
SPREAD_TC2_S_TC2_3M	2.74E-06	7.81E-06	0.350338	0.7261
T-DIST. DOF	2.27488	0.134793	16.87689	0
R-squared	-0.000034	Mean dependent var		-0.000256
Adjusted R-squared	-0.000034	S.D. dependent var		0.022583
S.E. of regression	0.022584	Akaike info criterion		-5.402967
Sum squared resid	1.062389	Schwarz criterion		-5.384016
Log likelihood	5636.892	Hannan-Quinn criter.		-5.396023
Durbin-Watson stat	2.001675			



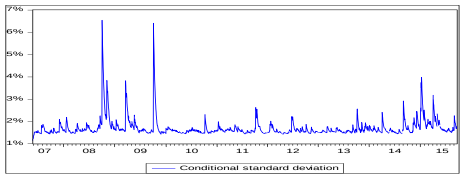


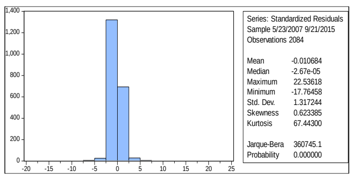


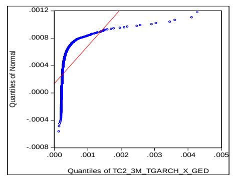
TARCH (1,1)_X_GED

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1) + C(6)*SPREAD_TC2_S_TC2_3M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000000419	0.000316	0.001327	0.9989
	Variance Equation			
C	3.41E-05	6.41E-06	5.321057	0
RESID(-1)^2	0.033394	0.009684	3.448523	0.0006
RESID(-1)^2*(RESID(-1)<0)	0.000564	0.011452	0.049274	0.9607
GARCH(-1)	0.833518	0.027782	30.00255	0
SPREAD_TC2_S_TC2_3M	7.42E-06	6.32E-06	1.174792	0.2401
GED PARAMETER	1.118312	0.013828	80.87331	0
R-squared	-0.000129	Mean dependent var		-0.000256
Adjusted R-squared	-0.000129	S.D. dependent var		0.022583
S.E. of regression	0.022585	Akaike info criterion		-5.358141
Sum squared resid	1.062491	Schwarz criterion		-5.339189
Log likelihood	5590.182	Hannan-Quinn criter.		-5.351197
Durbin-Watson stat	2.001484			





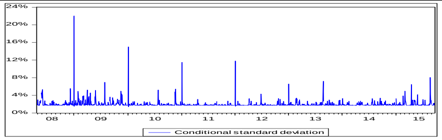


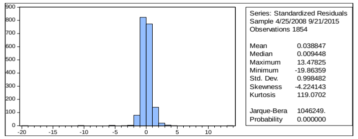
TC5 SPOT

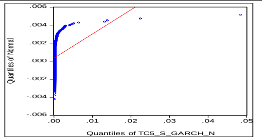
GARCH (1,1)_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.001668	0.000513	-3.2535	0.0011
	Variance Equation			
C	2.96E-04	3.99E-06	74.23679	0
RESID(-1)^2	4.13E-01	3.85E-02	10.72694	0
GARCH(-1)	-0.004739	0.012263	-0.386477	0.6991
R-squared	-0.004981	Mean dependent var		-2.38E-04
Adjusted R-squarec	-0.004981	S.D. dependent var		2.03E-02
S.E. of regression	0.020321	Akaike info criterion		-5.060566
Sum squared resid	0.765162	Schwarz criterion		-5.048645
Log likelihood	4695.144	Hannan-Quinn criter.		-5.056172
Durbin-Watson stat	0.978272			



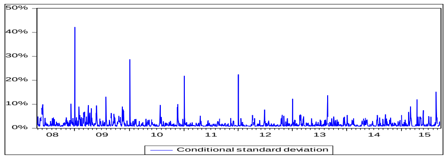


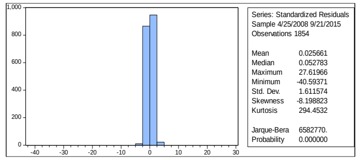


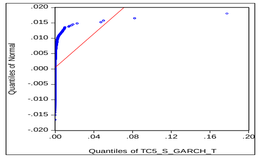
GARCH (1,1)_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.002036	0.000211	-9.647723	0
	Variance Equation			
C	6.21E-05	6.32E-06	9.830196	0
RESID(-1)^2	1.526721	0.180961	8.436726	0
GARCH(-1)	0.031555	0.020816	1.515933	0.1295
T-DIST. DOF	3.285437	0.184078	17.84808	0
R-squared	-0.007877	Mean dependent var		-2.38E-04
Adjusted R-squarec	-0.007877	S.D. dependent var		0.02027
S.E. of regression	0.02035	Akaike info criterion		-5.917876
Sum squared resid	0.767366	Schwarz criterion		-5.902976
Log likelihood	5490.871	Hannan-Quinn criter.		-5.912384
Durbin-Watson stat	0.975462			



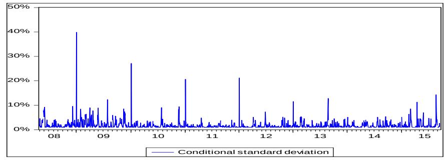


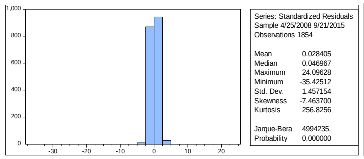


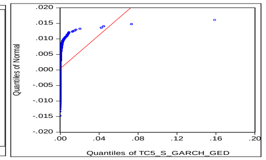
GARCH (1,1)_GED

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.002006	0.000158	-12.66788	0
	Variance Equation			
C	8.72E-05	6.91E-06	12.62738	0
RESID(-1)^2	1.36E+00	1.74E-01	7.83E+00	0
GARCH(-1)	0.001823	0.008078	0.225633	0.8215
GED PARAMETER	0.85521	0.016256	52.60753	0
R-squared	-0.007615	Mean dependent var		-2.38E-04
Adjusted R-squarec	-0.007615	S.D. dependent var		0.02027
S.E. of regression	0.020347	Akaike info criterion		-5.792388
Sum squared resid	0.767166	Schwarz criterion		-5.777488
Log likelihood	5374.544	Hannan-Quinn criter.		-5.786896
Durbin-Watson stat	0.975716			



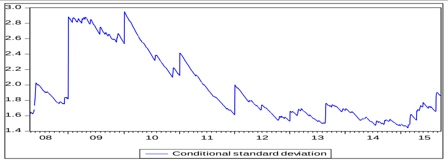


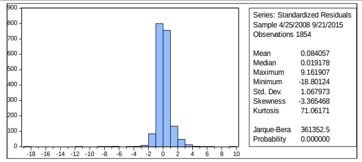


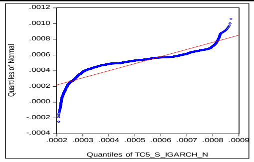
IGARCH (1,1)_N

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.001851	0.000129	-14.3341	0
	Variance Equation			
RESID(-1)^2	4.31E-03	8.83E-05	48.83525	0
GARCH(-1)	0.995688	8.83E-05	11276.62	0
R-squared	-0.006339	Mean dependent var		-2.38E-04
Adjusted R-squarec	-0.006339	S.D. dependent var		0.02027
S.E. of regression	0.020334	Akaike info criterion		-4.923064
Sum squared resid	0.766195	Schwarz criterion		-4.917104
Log likelihood	4565.68	Hannan-Quinn criter.		-4.920867
Durbin-Watson stat	0.976953			



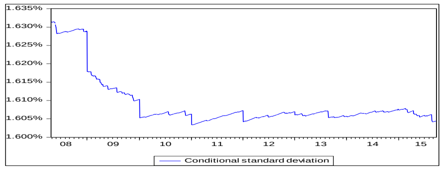


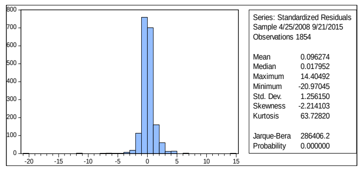


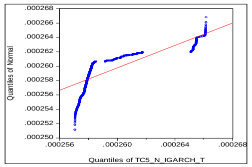
IGARCH (1,1)_T

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.001785	0.000271	-6.579695	0
	Variance Equation			
RESID(-1)^2	-3.06E-05	8.66E-05	-0.35351	0.7237
GARCH(-1)	1.000031	8.66E-05	11553.82	0
T-DIST. DOF	3.052784	0.168151	18.15502	0
R-squared	-0.005827	Mean dependent var		-2.38E-04
Adjusted R-squarec	-0.005827	S.D. dependent var		0.02027
S.E. of regression	0.020329	Akaike info criterion		-5.580326
Sum squared resid	0.765806	Schwarz criterion		-5.571386
Log likelihood	5175.962	Hannan-Quinn criter.		-5.577031
Durbin-Watson stat	0.97745			



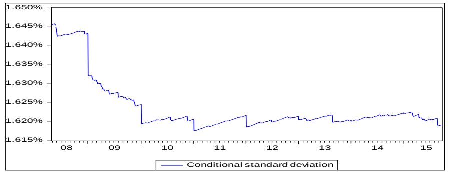


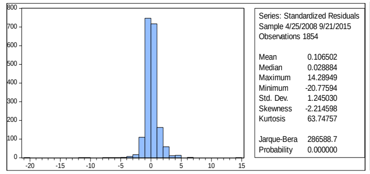


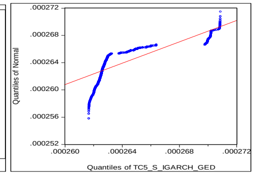
IGARCH (1,1)_GED

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

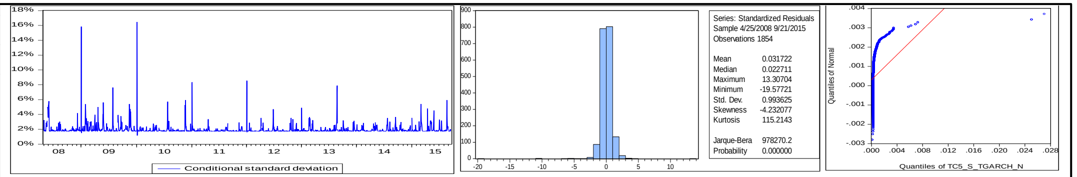
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.001965	0.000179	-10.97483	0
	Variance Equation			
RESID(-1)^2	-3.12E-05	5.51E-05	-0.566847	0.5708
GARCH(-1)	1.000031	5.51E-05	18151.8	0
GED PARAMETER	0.787556	0.018284	43.07262	0
R-squared	-0.007262	Mean dependent var		-2.38E-04
Adjusted R-squarec	-0.007262	S.D. dependent var		0.02027
S.E. of regression	0.020344	Akaike info criterion		-5.567808
Sum squared resid	0.766898	Schwarz criterion		-5.558867
Log likelihood	5164.358	Hannan-Quinn criter.		-5.564512
Durbin-Watson stat	0.976057			



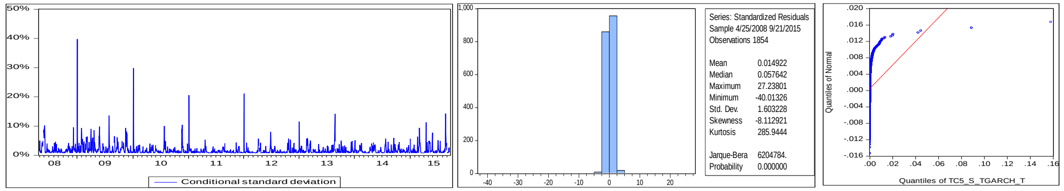




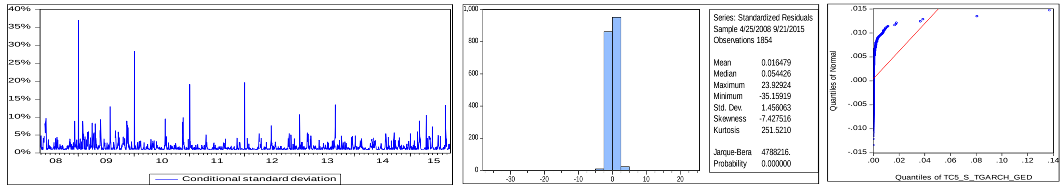
(GJR)TGARCH (1,1)_N				
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.001908	0.000537	-3.550786	0.0004
	Variance Equation			
C	3.04E-04	6.85E-06	44.39272	0
RESID(-1)^2	0.496527	0.062168	7.986923	0
RESID(-1)^2*(RESID	-0.284211	0.073885	-3.846681	0.0001
GARCH(-1)	-0.006264	0.021541	-0.290811	0.7712
R-squared	-0.006795	Mean dependent var		-0.000238
Adjusted R-squarec	-0.006795	S.D. dependent var		0.02027
S.E. of regression	0.020339	Akaike info criterion		-5.063425
Sum squared resid	0.766542	Schwarz criterion		-5.048524
Log likelihood	4698.795	Hannan-Quinn criter.		-5.057933
Durbin-Watson stat	0.97651			



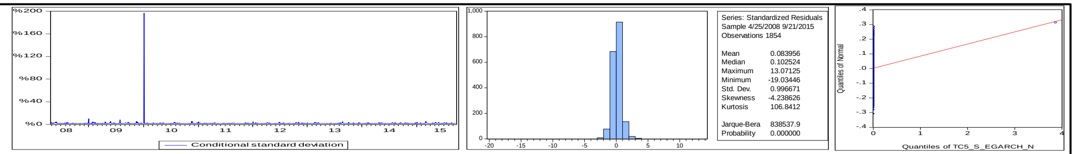
(GJR)TGARCH (1,1)_T				
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.002108	0.000216	-9.769346	0
	Variance Equation			
C	6.35E-05	6.37E-06	9.972332	0
RESID(-1)^2	1.64E+00	2.27E-01	7.25E+00	0
RESID(-1)^2*(RESID	-0.288634	0.255125	-1.131345	0.2579
GARCH(-1)	0.026062	0.019583	1.330836	0.1832
T-DIST. DOF	3.298294	0.18437	17.88954	0
R-squared	-0.008522	Mean dependent var		-2.38E-04
Adjusted R-squarec	-0.008522	S.D. dependent var		2.03E-02
S.E. of regression	0.020356	Akaike info criterion		-5.917689
Sum squared resid	0.767857	Schwarz criterion		-5.899808
Log likelihood	5491.698	Hannan-Quinn criter.		-5.911098
Durbin-Watson stat	0.974838			



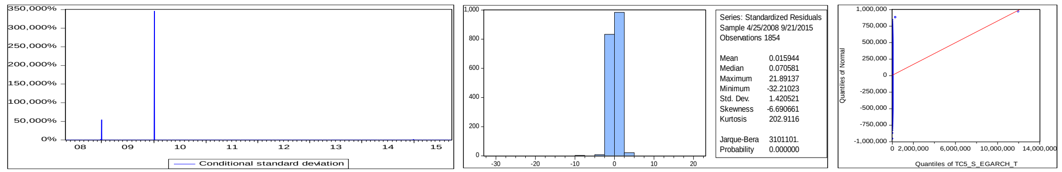
(GJR)TGARCH (1,1)_ged				
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.002086	0.000161	-12.94427	0
	Variance Equation			
C	8.75E-05	6.94E-06	12.61715	0
RESID(-1)^2	1.50E+00	2.55E-01	5.869054	0
RESID(-1)^2*(RESID	-3.19E-01	3.10E-01	-1.027158	0.3043
GARCH(-1)	0.001826	0.008478	0.215337	0.8295
GED PARAMETER	0.856125	0.016213	52.80558	0
R-squared	-0.00832	Mean dependent var		-0.000238
Adjusted R-squarec	-0.00832	S.D. dependent var		2.03E-02
S.E. of regression	0.020354	Akaike info criterion		-5.792159
Sum squared resid	0.767703	Schwarz criterion		-5.774279
Log likelihood	5375.332	Hannan-Quinn criter.		-5.785569
Durbin-Watson stat	0.975034			



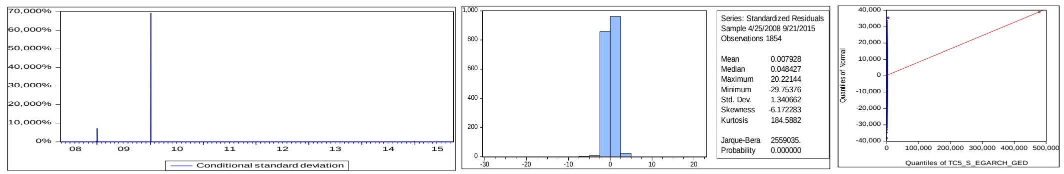
EGARCH (1,1)_N				
LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.003346	0.00033	-10.12921	0
	Variance Equation			
C(2)	-7.192548	0.535264	-13.43739	0
C(3)	0.458862	0.037846	12.12457	0
C(4)	0.270959	0.032817	8.256718	0
C(5)	0.123464	0.066324	1.861527	0.0627
R-squared	-0.023532	Mean dependent var		-2.38E-04
Adjusted R-squarec	-0.023532	S.D. dependent var		0.02027
S.E. of regression	0.020507	Akaike info criterion		-5.0429
Sum squared resid	0.779286	Schwarz criterion		-5.027999
Log likelihood	4679.768	Hannan-Quinn criter.		-5.037408
Durbin-Watson stat	0.960542			



EGARCH (1,1)_T				
LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.002374	0.000246	-9.666323	0
	Variance Equation			
C(2)	-5.308551	0.310376	-17.10362	0
C(3)	0.926586	0.052666	17.59357	0
C(4)	0.245139	0.037457	6.544628	0
C(5)	0.444915	0.034522	12.88791	0
T-DIST. DOF	3.334714	0.193714	17.21459	0
R-squared	-0.011116	Mean dependent var		-0.000238
Adjusted R-squarec	-0.011116	S.D. dependent var		0.02027
S.E. of regression	0.020383	Akaike info criterion		-5.823263
Sum squared resid	0.769832	Schwarz criterion		-5.805383
Log likelihood	5404.165	Hannan-Quinn criter.		-5.816673
Durbin-Watson stat	0.972337			



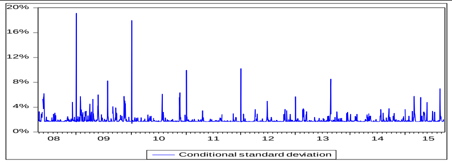
EGARCH (1,1)_GED				
LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.002138	0.000173	-12.36083	0
	Variance Equation			
C(2)	-5.802837	0.457398	-12.68662	0
C(3)	8.47E-01	5.06E-02	16.73412	0
C(4)	0.25206	0.044198	5.703021	0
C(5)	0.373388	0.052274	7.142926	0
GED PARAMETER	0.856062	0.015724	54.44423	0
R-squared	-0.008791	Mean dependent var		-2.38E-04
Adjusted R-squarec	-0.008791	S.D. dependent var		2.03E-02
S.E. of regression	0.020359	Akaike info criterion		-5.728051
Sum squared resid	0.768062	Schwarz criterion		-5.710171
Log likelihood	5315.904	Hannan-Quinn criter.		-5.721461
Durbin-Watson stat	0.974578			

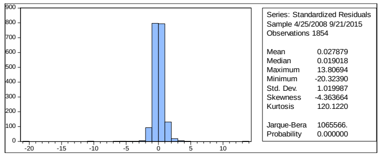


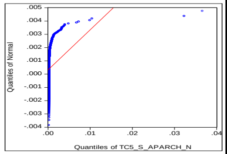
APARCH (1,1)_N

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.001832	0.000509	-3.595584	0.0003
	Variance Equation			
C(2)	9.68E-05	1.69E-04	5.74E-01	0.566
C(3)	0.39922	6.06E-02	6.585987	0
C(4)	-0.160519	0.057085	-2.811918	0.0049
C(5)	-0.001847	0.016565	-1.11E-01	0.9112
C(6)	2.261674	0.426714	5.300208	0
R-squared	-0.006187	Mean dependent var		-2.38E-04
Adjusted R-squarec	-0.006187	S.D. dependent var		2.03E-02
S.E. of regression	0.020333	Akaike info criterion		-5.062973
Sum squared resid	0.766079	Schwarz criterion		-5.045092
Log likelihood	4699.376	Hannan-Quinn criter.		-5.056382
Durbin-Watson stat	0.9771			



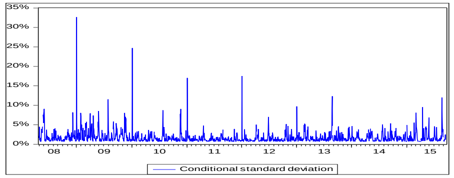


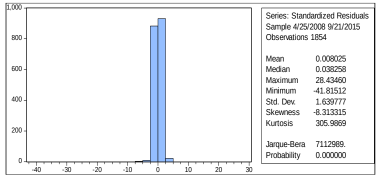


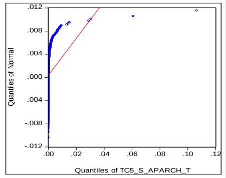
APARCH (1,1)_T

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.001888	0.000207	-9.119758	0
	Variance Equation			
C(2)	0.002011	0.002087	0.963534	0.3353
C(3)	1.001202	0.165817	6.037984	0
C(4)	-0.052509	0.046499	-1.12925	0.2588
C(5)	0.078984	0.040563	1.947162	0.0515
C(6)	1.230054	0.227755	5.400778	0
T-DIST. DOF	3.290586	0.183426	17.93956	0
R-squared	-0.006634	Mean dependent var		-2.38E-04
Adjusted R-squarec	-0.006634	S.D. dependent var		2.03E-02
S.E. of regression	0.020337	Akaike info criterion		-5.919388
Sum squared resid	0.76642	Schwarz criterion		-5.898528
Log likelihood	5494.273	Hannan-Quinn criter.		-5.911699
Durbin-Watson stat	0.976667			



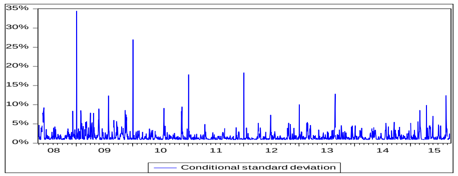


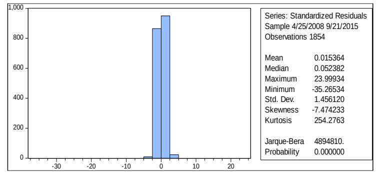


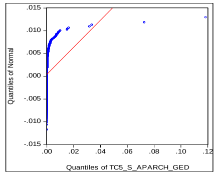
APARCH (1,1)_GED

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.002074	0.000159	-13.00821	0
	Variance Equation			
C(2)	0.000409	0.000831	0.491536	0.623
C(3)	1.142276	0.301208	3.792311	0.0001
C(4)	-0.070077	0.061433	-1.14072	0.254
C(5)	0.005307	0.020118	0.263789	0.7919
C(6)	1.658518	0.450962	3.677729	0.0002
GED PARAMETER	0.852673	0.016281	52.37366	0
R-squared	-0.008207	Mean dependent var		-0.000238
Adjusted R-squarec	-0.008207	S.D. dependent var		0.02027
S.E. of regression	0.020353	Akaike info criterion		-5.79128
Sum squared resid	0.767618	Schwarz criterion		-5.770419
Log likelihood	5375.517	Hannan-Quinn criter.		-5.783591
Durbin-Watson stat	0.975142			



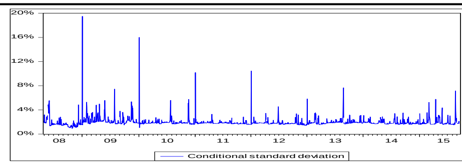


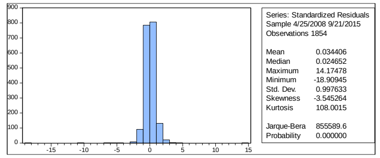


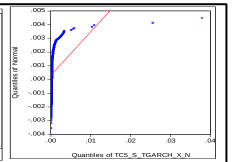
TARCH (1,1)_X_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1) + C(6)*SPREAD_TC5_S_TC5_3M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.001936	0.000627	-3.087909	0.002
	Variance Equation			
C	2.97E-04	3.96E-06	75.1273	0
RESID(-1)^2	4.71E-01	6.26E-02	7.513969	0
RESID(-1)^2*(RESID	-0.147667	0.075264	-1.961984	0.0498
GARCH(-1)	-0.006035	0.012013	-0.502391	0.6154
SPREAD_TC5_S_TC5	-2.83E-04	1.85E-05	-15.33369	0
R-squared	-0.007025	Mean dependent var		-2.38E-04
Adjusted R-squarec	-0.007025	S.D. dependent var		0.02027
S.E. of regression	0.020341	Akaike info criterion		-5.074094
Sum squared resid	0.766718	Schwarz criterion		-5.056213
Log likelihood	4709.685	Hannan-Quinn criter.		-5.067503
Durbin-Watson stat	0.976287			



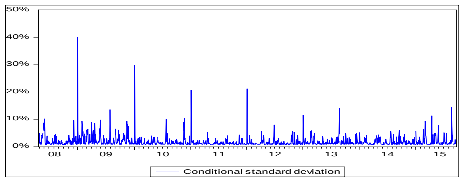


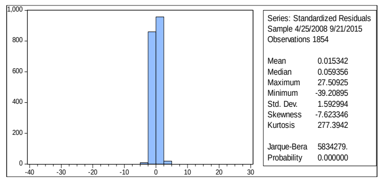


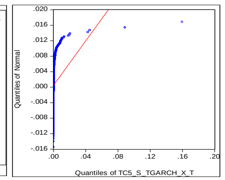
TARCH (1,1)_X_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1) + C(6)*SPREAD_TC5_S_TC5_3M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.002117	0.000217	-9.776541	0
	Variance Equation			
C	6.48E-05	6.41E-06	10.10972	0
RESID(-1)^2	1.65E+00	2.27E-01	7.239011	0
RESID(-1)^2*(RESID	-0.275432	0.25835	-1.066121	0.2864
GARCH(-1)	0.018755	0.017708	1.059112	0.2895
SPREAD_TC5_S_TC5	-2.27E-05	2.61E-05	-0.867507	0.3857
T-DIST. DOF	3.302156	0.184848	17.86419	0
R-squared	-0.008597	Mean dependent var		-2.38E-04
Adjusted R-squarec	-0.008597	S.D. dependent var		0.02027
S.E. of regression	0.020357	Akaike info criterion		-5.917073
Sum squared resid	0.767914	Schwarz criterion		-5.896212
Log likelihood	5492.127	Hannan-Quinn criter.		-5.909384
Durbin-Watson stat	0.974765			



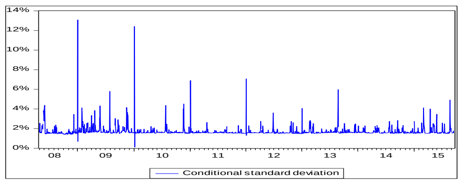


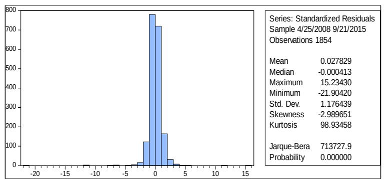


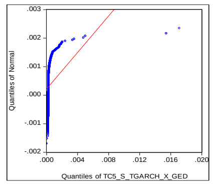
TARCH (1,1)_X_GED

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1) + C(6)*SPREAD_TC5_S_TC5_3M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.001488	0.000192	-7.757731	0
	Variance Equation			
C	2.40E-04	1.47E-05	16.37117	0
RESID(-1)^2	0.283057	7.02E-02	4.029979	0.0001
RESID(-1)^2*(RESID	-0.138795	0.053139	-2.611936	0.009
GARCH(-1)	-1.52E-02	0.002763	-5.494074	0
SPREAD_TC5_S_TC5	-5.96E-05	7.82E-05	-0.762573	0.4457
GED PARAMETER	0.803299	0.01887	42.56973	0
R-squared	-0.003809	Mean dependent var		-2.38E-04
Adjusted R-squarec	-0.003809	S.D. dependent var		0.02027
S.E. of regression	0.020309	Akaike info criterion		-5.664039
Sum squared resid	0.764269	Schwarz criterion		-5.643178
Log likelihood	5257.564	Hannan-Quinn criter.		-5.65635
Durbin-Watson stat	0.979414			





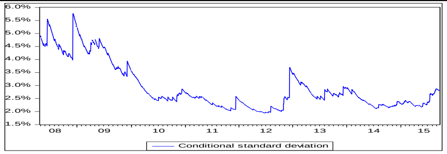


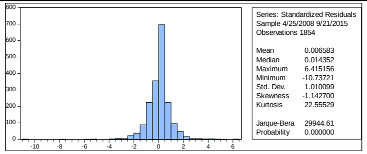
TC5 1 MONTH

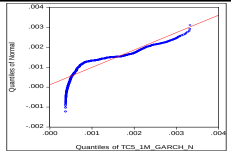
GARCH (1,1)_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000366	0.000581	-0.630117	0.5286
	Variance Equation			
C	3.26E-06	2.06E-07	15.7936	0
RESID(-1)^2	9.79E-03	6.92E-04	14.13777	0
GARCH(-1)	0.985485	0.000717	1375.251	0
R-squared	-0.000011	Mean dependent var		-2.64E-04
Adjusted R-squarec	-0.000011	S.D. dependent var		3.11E-02
S.E. of regression	0.031107	Akaike info criterion		-4.281105
Sum squared resid	1.793008	Schwarz criterion		-4.269185
Log likelihood	3972.585	Hannan-Quinn criter.		-4.276712
Durbin-Watson stat	1.96144			



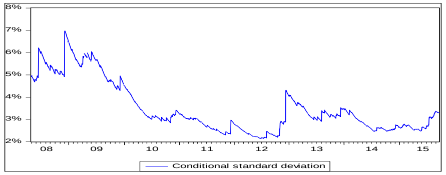


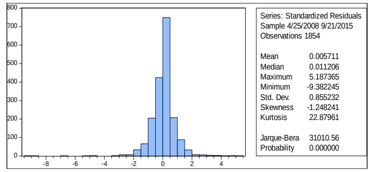


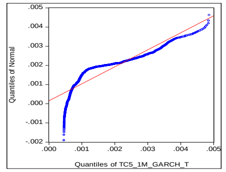
GARCH (1,1)_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000342	0.000409	-0.835083	0.4037
	Variance Equation			
C	2.04E-06	1.22E-06	1.671819	0.0946
RESID(-1)^2	0.013687	0.004639	2.950587	0.0032
GARCH(-1)	0.988201	0.002537	389.4996	0
T-DIST. DOF	2.473762	0.142113	17.40706	0
R-squared	-0.000006	Mean dependent var		-2.64E-04
Adjusted R-squarec	-0.000006	S.D. dependent var		0.031106
S.E. of regression	0.031107	Akaike info criterion		-4.699111
Sum squared resid	1.793	Schwarz criterion		-4.68421
Log likelihood	4361.076	Hannan-Quinn criter.		-4.693619
Durbin-Watson stat	1.961448			



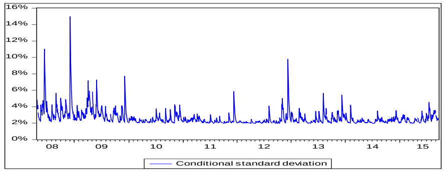


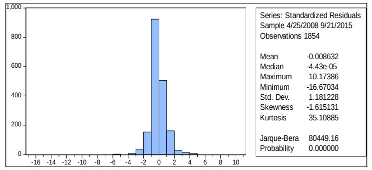


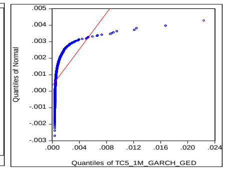
GARCH (1,1)_GED

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000000996	0.000334	0.002986	0.9976
	Variance Equation			
C	1.05E-04	2.08E-05	5.018218	0
RESID(-1)^2	1.21E-01	2.56E-02	4.74E+00	0
GARCH(-1)	0.716031	0.044543	16.07488	0
GED PARAMETER	0.916161	0.021211	43.19357	0
R-squared	-0.000072	Mean dependent var		-2.64E-04
Adjusted R-squarec	-0.000072	S.D. dependent var		0.031106
S.E. of regression	0.031108	Akaike info criterion		-4.710432
Sum squared resid	1.793118	Schwarz criterion		-4.695531
Log likelihood	4371.57	Hannan-Quinn criter.		-4.70494
Durbin-Watson stat	1.961319			



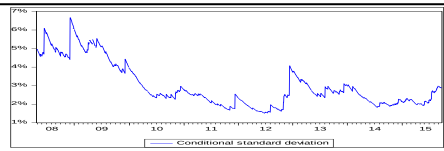


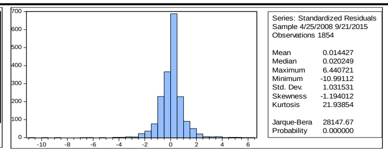


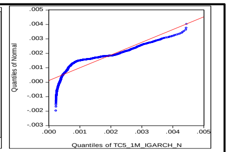
IGARCH (1,1)_N

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000509	0.000434	-1.172589	0.241
	Variance Equation			
RESID(-1)^2	1.40E-02	4.51E-04	31.15144	0
GARCH(-1)	0.985957	0.000451	2187.098	0
R-squared	-0.000062	Mean dependent var		-2.64E-04
Adjusted R-squarec	-0.000062	S.D. dependent var		0.031106
S.E. of regression	0.031107	Akaike info criterion		-4.261939
Sum squared resid	1.7931	Schwarz criterion		-4.255979
Log likelihood	3952.817	Hannan-Quinn criter.		-4.259742
Durbin-Watson stat	1.961339			



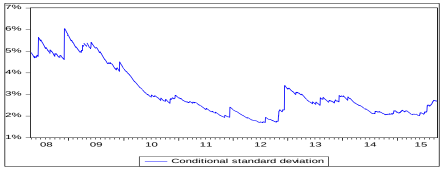


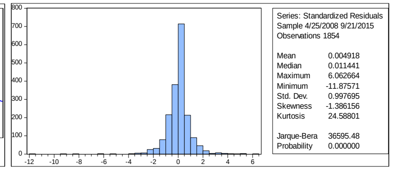


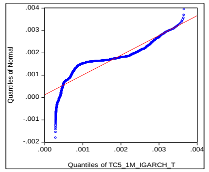
IGARCH (1,1)_T

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000303	0.0004	-0.757535	0.4487
	Variance Equation			
RESID(-1)^2	0.008577	0.00135	6.355368	0
GARCH(-1)	0.991423	0.00135	734.5816	0
T-DIST. DOF	2.711721	0.059094	45.88802	0
R-squared	-0.000002	Mean dependent var		-2.64E-04
Adjusted R-squarec	-0.000002	S.D. dependent var		0.031106
S.E. of regression	0.031107	Akaike info criterion		-4.696777
Sum squared resid	1.792991	Schwarz criterion		-4.687837
Log likelihood	4356.912	Hannan-Quinn criter.		-4.693482
Durbin-Watson stat	1.961458			



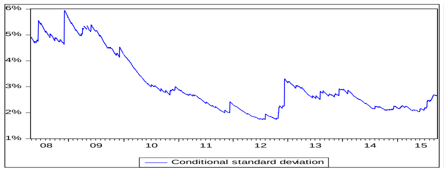


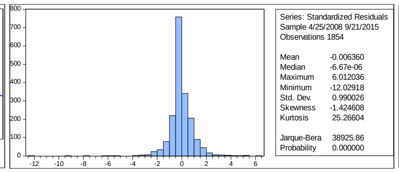


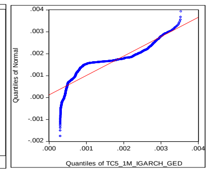
IGARCH (1,1)_GED

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000000169	0.000105	0.001611	0.9987
	Variance Equation			
RESID(-1)^2	0.007728	1.23E-03	6.284162	0
GARCH(-1)	0.992272	0.00123	806.9356	0
GED PARAMETER	0.794346	0.02995	26.52212	0
R-squared	-0.000072	Mean dependent var		-0.000264
Adjusted R-squarec	-0.000072	S.D. dependent var		0.031106
S.E. of regression	0.031108	Akaike info criterion		-4.778763
Sum squared resid	1.793117	Schwarz criterion		-4.769823
Log likelihood	4432.913	Hannan-Quinn criter.		-4.775468
Durbin-Watson stat	1.96132			







(GJR)TGARCH (1,1)_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000312	0.000588	-0.531186	0.5953
	Variance Equation			
C	3.36E-06	3.07E-07	10.94394	0
RESID(-1)^2	0.01483	0.001236	12.00324	0
RESID(-1)^2*(RESID	-0.004165	0.001819	-2.289607	0.022
GARCH(-1)	0.982822	0.000886	1109.19	0
R-squared	-0.000002	Mean dependent var		-0.000264
Adjusted R-squarec	-0.000002	S.D. dependent var		0.031106
S.E. of regression	0.031107	Akaike info criterion		-4.280259
Sum squared resid	1.792993	Schwarz criterion		-4.265358
Log likelihood	3972.8	Hannan-Quinn criter.		-4.274767
Durbin-Watson stat	1.961456			

(GJR)TGARCH (1,1)_T

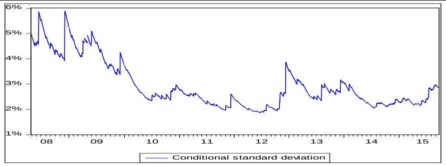
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1)

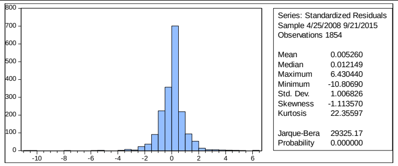
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000354	0.000407	-0.868623	0.3851
	Variance Equation			
C	1.95E-06	1.34E-06	1.45E+00	0.1463
RESID(-1)^2	0.021874	0.009252	2.364217	0.0181
RESID(-1)^2*(RESID	-0.009803	0.008581	-1.142401	0.2533
GARCH(-1)	0.986737	0.00296	333.3799	0
T-DIST. DOF	2.451021	0.143267	17.10804	0
R-squared	-0.000008	Mean dependent var		-2.64E-04
Adjusted R-squarec	-0.000008	S.D. dependent var		0.031106
S.E. of regression	0.031107	Akaike info criterion		-4.698633
Sum squared resid	1.793004	Schwarz criterion		-4.680753
Log likelihood	4361.633	Hannan-Quinn criter.		-4.692043
Durbin-Watson stat	1.961444			

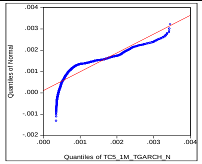
(GJR)TGARCH (1,1)_ged

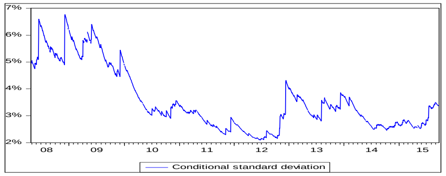
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1)

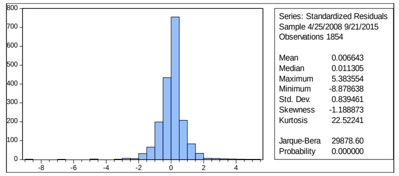
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000000434	0.000333	-0.001301	0.999
	Variance Equation			
C	1.30E-04	2.44E-05	5.3253	0
RESID(-1)^2	0.167399	0.039667	4.220115	0
RESID(-1)^2*(RESID	-0.056129	0.040132	-1.398597	0.1619
GARCH(-1)	0.661088	0.050985	12.96635	0
GED PARAMETER	0.929658	0.020989	44.29356	0
R-squared	-0.000072	Mean dependent var		-0.000264
Adjusted R-squarec	-0.000072	S.D. dependent var		0.031106
S.E. of regression	0.031108	Akaike info criterion		-4.701314
Sum squared resid	1.793117	Schwarz criterion		-4.683433
Log likelihood	4364.118	Hannan-Quinn criter.		-4.694723
Durbin-Watson stat	1.961321			

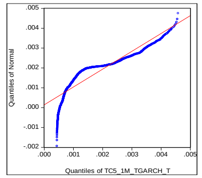


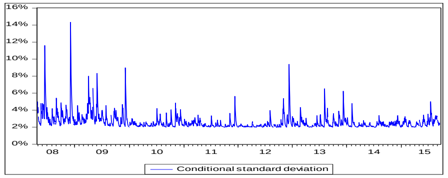


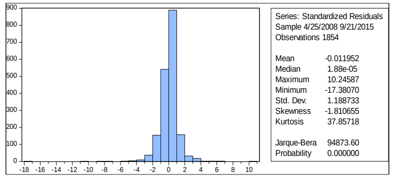


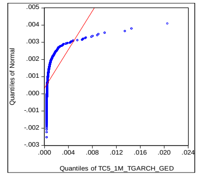












EGARCH (1,1)_N

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000561	0.000523	-1.073977	0.2828
	Variance Equation			
C(2)	-1.20E-01	1.01E-02	-11.90312	0
C(3)	0.090956	0.005771	15.76154	0
C(4)	0.014772	0.003242	4.556469	0
C(5)	0.991166	0.001074	922.891	0
R-squared	-0.000092	Mean dependent var		-0.000264
Adjusted R-squarec	-0.000092	S.D. dependent var		3.11E-02
S.E. of regression	0.031108	Akaike info criterion		-4.302292
Sum squared resid	1.793153	Schwarz criterion		-4.287392
Log likelihood	3993.225	Hannan-Quinn criter.		-4.2968
Durbin-Watson stat	1.961281			

EGARCH (1,1)_T

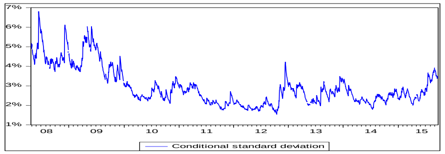
LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

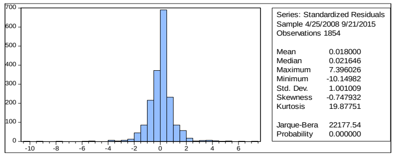
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000362	0.000398	-0.908466	0.3636
	Variance Equation			
C(2)	-0.046808	0.013627	-3.435026	0.0006
C(3)	0.070841	0.017833	3.972441	0.0001
C(4)	0.00909	0.013221	0.687525	0.4918
C(5)	0.998248	0.001593	626.6364	0
T-DIST. DOF	2.408723	0.143286	16.8106	0
R-squared	-0.00001	Mean dependent var		-0.000264
Adjusted R-squarec	-0.00001	S.D. dependent var		0.031106
S.E. of regression	0.031107	Akaike info criterion		-4.710588
Sum squared resid	1.793006	Schwarz criterion		-4.692708
Log likelihood	4372.715	Hannan-Quinn criter.		-4.703998
Durbin-Watson stat	1.961441			

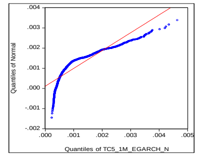
EGARCH (1,1)_GED

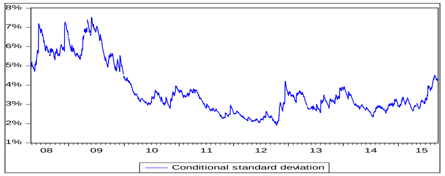
LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4) *RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

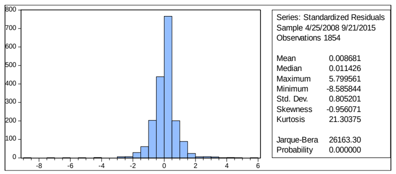
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.00000323	0.000333	0.009715	0.9922
	Variance Equation			
C(2)	-0.348977	0.075624	-4.614658	0
C(3)	0.12416	0.022367	5.551138	0
C(4)	0.020903	0.012522	1.669256	0.0951
C(5)	0.964728	0.008821	109.3699	0
GED PARAMETER	0.923402	0.023715	38.93774	0
R-squared	-0.000074	Mean dependent var		-0.000264
Adjusted R-squarec	-0.000074	S.D. dependent var		0.031106
S.E. of regression	0.031108	Akaike info criterion		-4.742921
Sum squared resid	1.79312	Schwarz criterion		-4.72504
Log likelihood	4402.688	Hannan-Quinn criter.		-4.73633
Durbin-Watson stat	1.961317			

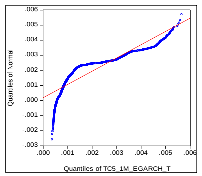


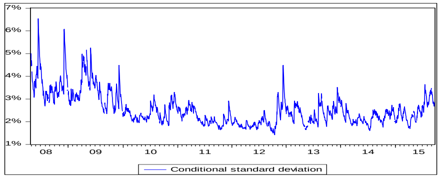


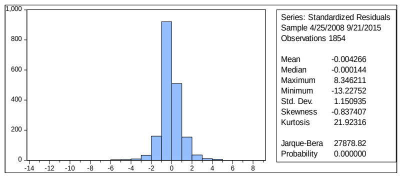


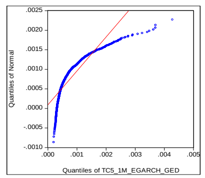








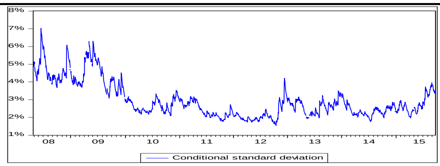


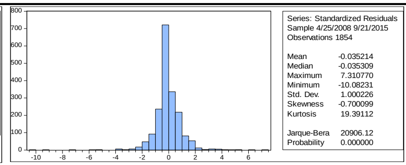


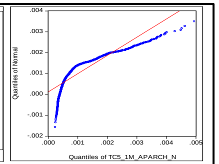
APARCH (1,1)_N

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000869	0.000618	1.40573	0.1598
	Variance Equation			
C(2)	0.000259	9.03E-05	2.87E+00	0.0041
C(3)	0.051558	3.32E-03	15.54974	0
C(4)	-0.197393	0.047619	-4.145265	0
C(5)	0.958298	0.00281	3.41E+02	0
C(6)	1.023065	0.075132	13.61685	0
R-squared	-0.001326	Mean dependent var		-2.64E-04
Adjusted R-squarec	-0.001326	S.D. dependent var		3.11E-02
S.E. of regression	0.031127	Akaike info criterion		-4.305643
Sum squared resid	1.795366	Schwarz criterion		-4.287762
Log likelihood	3997.331	Hannan-Quinn criter.		-4.299052
Durbin-Watson stat	1.958863			



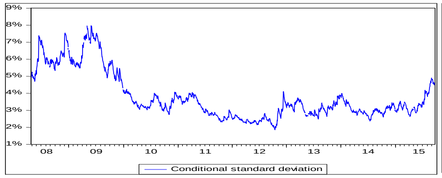


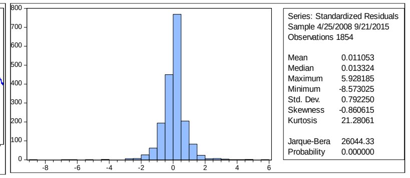


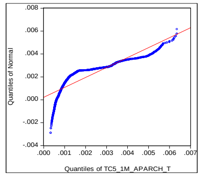
APARCH (1,1)_T

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000425	0.000397	-1.071483	0.284
	Variance Equation			
C(2)	0.000192	0.000214	0.895226	0.3707
C(3)	0.040631	0.010226	3.97345	0.0001
C(4)	-0.126652	0.191801	-0.660333	0.509
C(5)	0.976679	0.005588	174.784	0
C(6)	0.80297	0.161913	4.959279	0
T-DIST. DOF	2.387848	0.141577	16.86609	0
R-squared	-0.000027	Mean dependent var		-2.64E-04
Adjusted R-squarec	-0.000027	S.D. dependent var		0.031106
S.E. of regression	0.031107	Akaike info criterion		-4.710799
Sum squared resid	1.793037	Schwarz criterion		-4.689938
Log likelihood	4373.911	Hannan-Quinn criter.		-4.70311
Durbin-Watson stat	1.961408			



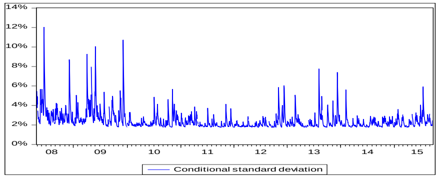


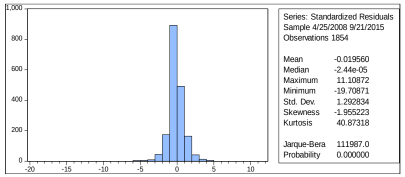


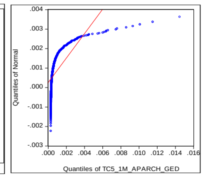
APARCH (1,1)_GED

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000000493	0.000347	0.001419	0.9989
	Variance Equation			
C(2)	0.000191	0.000215	0.886379	0.3754
C(3)	0.139803	0.025285	5.529062	0
C(4)	-0.425496	0.063175	-6.735223	0
C(5)	0.656803	0.04552	14.4288	0
C(6)	1.844943	0.30397	6.069489	0
GED PARAMETER	0.96484	0.019991	48.26354	0
R-squared	-0.000072	Mean dependent var		-2.64E-04
Adjusted R-squarec	-0.000072	S.D. dependent var		0.031106
S.E. of regression	0.031108	Akaike info criterion		-4.672157
Sum squared resid	1.793118	Schwarz criterion		-4.651296
Log likelihood	4338.09	Hannan-Quinn criter.		-4.664468
Durbin-Watson stat	1.96132			



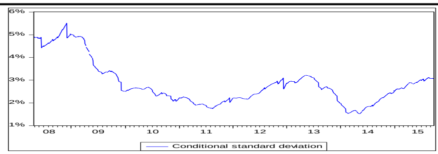


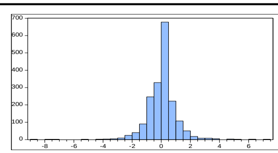


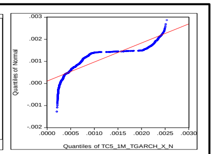
TARCH (1,1)_X_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1) + C(6)*SPREAD_TC5_S_TC5_3M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.00063	0.000329	-1.915674	0.0554
	Variance Equation			
C	1.76E-06	1.86E-07	9.449872	0
RESID(-1)^2	-4.35E-03	1.35E-04	-32.33034	0
RESID(-1)^2*(RESID	0.000515	0.000673	0.765288	0.4441
GARCH(-1)	1.001588	0.000675	1483.297	0
SPREAD_TC5_S_TC5	2.48E-05	1.55E-06	16.00652	0
R-squared	-0.000139	Mean dependent var		-2.64E-04
Adjusted R-squarec	-0.000139	S.D. dependent var		0.031106
S.E. of regression	0.031109	Akaike info criterion		-4.361619
Sum squared resid	1.793238	Schwarz criterion		-4.343738
Log likelihood	4049.221	Hannan-Quinn criter.		-4.355028
Durbin-Watson stat	1.961188			



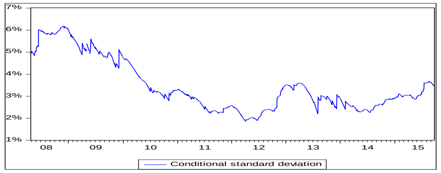


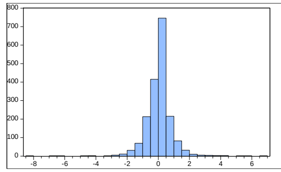


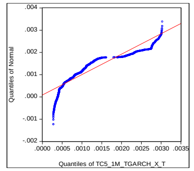
TARCH (1,1)_X_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1) + C(6)*SPREAD_TC5_S_TC5_3M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000361	0.000404	-0.893659	0.3715
	Variance Equation			
C	7.65E-07	6.31E-07	1.213167	0.2251
RESID(-1)^2	1.76E-02	6.23E-03	2.831411	0.0046
RESID(-1)^2*(RESID	-0.018234	0.007628	-2.390453	0.0168
GARCH(-1)	0.993324	0.00149	666.5506	0
SPREAD_TC5_S_TC5	4.26E-05	1.35E-05	3.150254	0.0016
T-DIST. DOF	2.499607	0.143101	17.46746	0
R-squared	-0.00001	Mean dependent var		-2.64E-04
Adjusted R-squarec	-0.00001	S.D. dependent var		0.031106
S.E. of regression	0.031107	Akaike info criterion		-4.707252
Sum squared resid	1.793006	Schwarz criterion		-4.686392
Log likelihood	4370.623	Hannan-Quinn criter.		-4.699563
Durbin-Watson stat	1.961442			



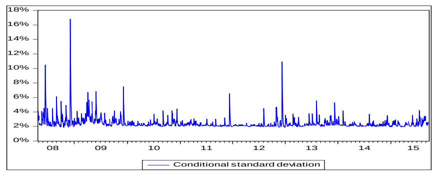


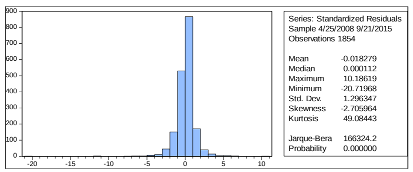


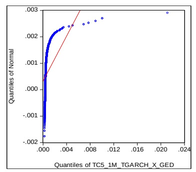
TARCH (1,1)_X_GED

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1) + C(6)*SPREAD_TC5_S_TC5_3M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.00000245	0.000411	-0.00597	0.9952
	Variance Equation			
C	0.000194	3.16E-05	6.125954	0
RESID(-1)^2	0.11366	0.029293	3.880078	0.0001
RESID(-1)^2*(RESID	4.16E-02	0.03855	1.080362	0.28
GARCH(-1)	5.12E-01	6.83E-02	7.497339	0
SPREAD_TC5_S_TC5	-9.90E-05	3.51E-05	-2.818471	0.0048
GED PARAMETER	1.013257	0.021733	46.62197	0
R-squared	-0.00007	Mean dependent var		-0.000264
Adjusted R-squarec	-0.00007	S.D. dependent var		0.031106
S.E. of regression	0.031108	Akaike info criterion		-4.650241
Sum squared resid	1.793115	Schwarz criterion		-4.62938
Log likelihood	4317.773	Hannan-Quinn criter.		-4.642552
Durbin-Watson stat	1.961323			





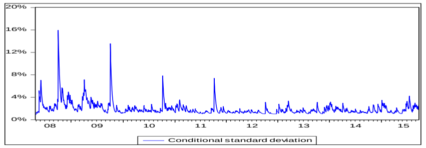


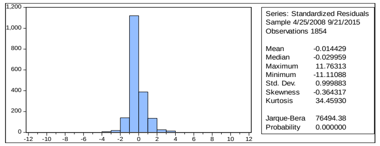
TC5 3 MONTH

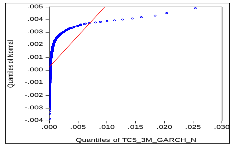
GARCH (1,1)_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	4.43E-04	0.000307	1.443184	0.149
	Variance Equation			
C	2.34E-05	1.43E-06	16.27324	0
RESID(-1)^2	0.221129	0.007706	28.69608	0
GARCH(-1)	0.782947	0.007904	99.05509	0
R-squared	-0.00108	Mean dependent var		-2.22E-04
Adjusted R-squarec	-0.00108	S.D. dependent var		0.020239
S.E. of regression	0.02025	Akaike info criterion		-5.213785
Sum squared resid	0.759823	Schwarz criterion		-5.201865
Log likelihood	4837.179	Hannan-Quinn criter.		-5.209392
Durbin-Watson stat	1.898909			



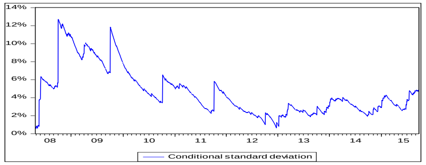


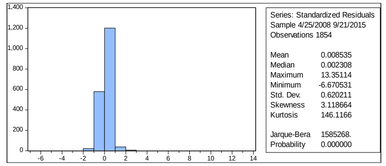


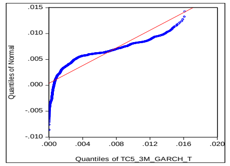
GARCH (1,1)_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-7.60E-05	0.000194	-0.390719	0.696
	Variance Equation			
C	-7.83E-06	2.46E-06	-3.187727	0.0014
RESID(-1)^2	0.117097	0.038352	3.053211	0.0023
GARCH(-1)	0.986153	0.001219	809.2373	0
T-DIST. DOF	2.057485	0.018598	110.6284	0
R-squared	-0.000052	Mean dependent var		-2.22E-04
Adjusted R-squarec	-0.000052	S.D. dependent var		0.020239
S.E. of regression	0.020239	Akaike info criterion		-5.86973
Sum squared resid	0.759042	Schwarz criterion		-5.854829
Log likelihood	5446.239	Hannan-Quinn criter.		-5.864238
Durbin-Watson stat	1.900862			



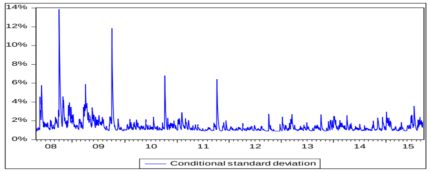


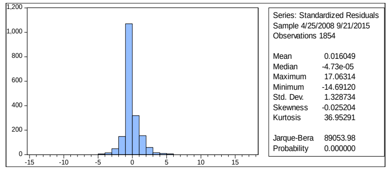


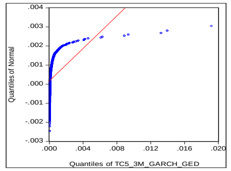
GARCH (1,1)_GED

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	5.33E-07	0.0000691	0.007719	0.9938
	Variance Equation			
C	2.68E-05	4.17E-06	6.43E+00	0
RESID(-1)^2	0.169081	0.023792	7.106489	0
GARCH(-1)	0.668513	0.033868	1.97E+01	0
GED PARAMETER	0.800687	0.021114	37.92239	0
R-squared	-0.000121	Mean dependent var		-0.000222
Adjusted R-squarec	-0.000121	S.D. dependent var		0.020239
S.E. of regression	0.02024	Akaike info criterion		-6.065064
Sum squared resid	0.759095	Schwarz criterion		-6.050163
Log likelihood	5627.314	Hannan-Quinn criter.		-6.059572
Durbin-Watson stat	1.900732			



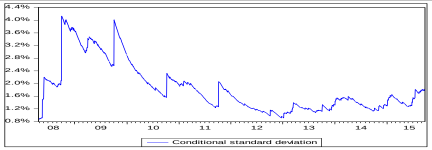


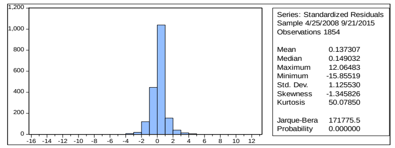


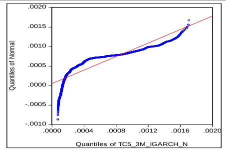
IGARCH (1,1)_N

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-2.14E-03	0.0000925	-23.16127	0
	Variance Equation			
RESID(-1)^2	0.011633	0.000141	82.53789	0
GARCH(-1)	0.988367	0.000141	7012.565	0
R-squared	-0.00902	Mean dependent var		-0.000222
Adjusted R-squarec	-0.00902	S.D. dependent var		0.020239
S.E. of regression	0.02033	Akaike info criterion		-5.015134
Sum squared resid	0.765849	Schwarz criterion		-5.009174
Log likelihood	4651.03	Hannan-Quinn criter.		-5.012938
Durbin-Watson stat	1.883968			



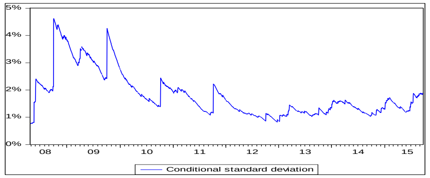


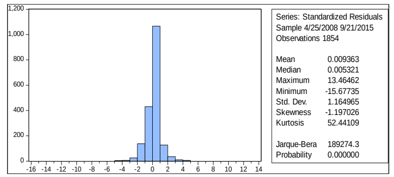


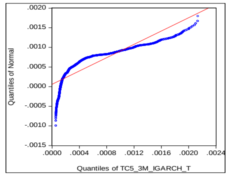
IGARCH (1,1)_T

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-7.39E-05	0.000215	-0.344501	0.7305
	Variance Equation			
RESID(-1)^2	0.015235	0.001754	8.686443	0
GARCH(-1)	0.984765	0.001754	561.477	0
T-DIST. DOF	2.441828	0.026487	92.1887	0
R-squared	-0.000053	Mean dependent var		-2.22E-04
Adjusted R-squarec	-0.000053	S.D. dependent var		0.020239
S.E. of regression	0.020239	Akaike info criterion		-5.841061
Sum squared resid	0.759043	Schwarz criterion		-5.832121
Log likelihood	5417.664	Hannan-Quinn criter.		-5.837766
Durbin-Watson stat	1.90086			



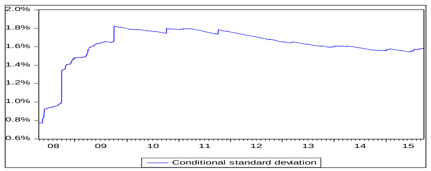


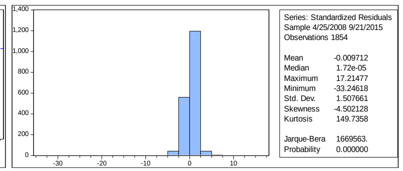


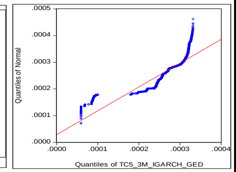
IGARCH (1,1)_GED

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-2.84E-07	0.00015	-0.001899	0.9985
	Variance Equation			
RESID(-1)^2	7.17E-04	5.74E-05	12.48685	0
GARCH(-1)	0.999283	5.74E-05	17394.88	0
GED PARAMETER	0.905845	0.011036	82.08091	0
R-squared	-0.00012	Mean dependent var		-2.22E-04
Adjusted R-squarec	-0.00012	S.D. dependent var		0.020239
S.E. of regression	0.02024	Akaike info criterion		-5.741072
Sum squared resid	0.759094	Schwarz criterion		-5.732131
Log likelihood	5324.973	Hannan-Quinn criter.		-5.737776
Durbin-Watson stat	1.900733			



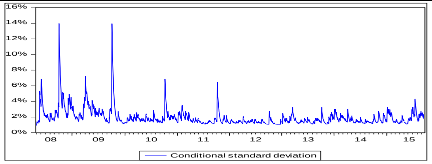


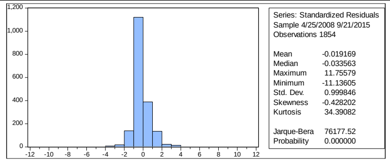


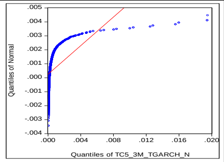
(GJR)TGARCH (1,1)_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	5.00E-04	0.000406	1.230849	0.2184
	Variance Equation			
C	2.16E-05	1.34E-06	16.1009	0
RESID(-1)^2	0.233959	0.010236	22.85574	0
RESID(-1)^2*(RESID	-0.066735	0.014804	-4.507927	0
GARCH(-1)	0.799483	0.007612	105.0337	0
R-squared	-0.001273	Mean dependent var		-2.22E-04
Adjusted R-squarec	-0.001273	S.D. dependent var		0.020239
S.E. of regression	0.020252	Akaike info criterion		-5.213689
Sum squared resid	0.759969	Schwarz criterion		-5.198789
Log likelihood	4838.09	Hannan-Quinn criter.		-5.208197
Durbin-Watson stat	1.898544			



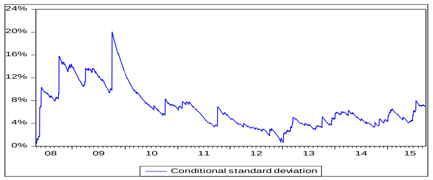


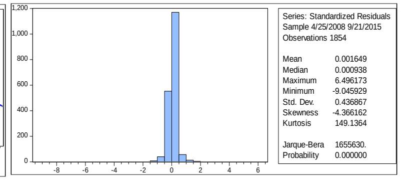


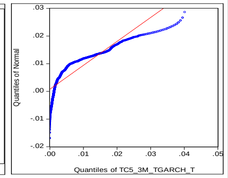
(GJR)TGARCH (1,1)_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-4.64E-05	0.000193	-0.240118	0.8102
	Variance Equation			
C	-1.43E-05	5.09E-06	-2.817551	0.0048
RESID(-1)^2	0.377267	0.149192	2.52874	0.0114
RESID(-1)^2*(RESID	-0.227301	0.104471	-2.175733	0.0296
GARCH(-1)	0.984988	0.001451	678.9224	0
T-DIST. DOF	2.026249	0.009718	208.5016	0
R-squared	-0.000075	Mean dependent var		-0.000222
Adjusted R-squarec	-0.000075	S.D. dependent var		0.020239
S.E. of regression	0.02024	Akaike info criterion		-5.875302
Sum squared resid	0.75906	Schwarz criterion		-5.857422
Log likelihood	5452.405	Hannan-Quinn criter.		-5.868712
Durbin-Watson stat	1.900818			



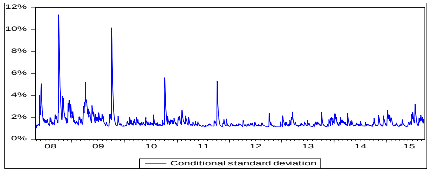


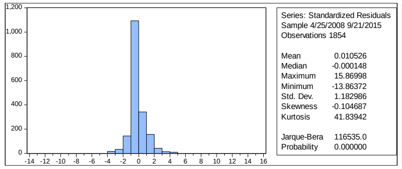


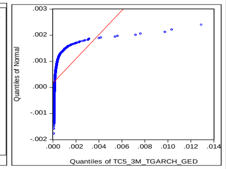
(GJR)TGARCH (1,1)_ged

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	1.97E-06	0.000123	0.015962	0.9873
	Variance Equation			
C	3.52E-05	6.67E-06	5.275491	0
RESID(-1)^2	1.24E-01	2.58E-02	4.794976	0
RESID(-1)^2*(RESID	-0.011632	0.0327	-0.355714	0.7221
GARCH(-1)	0.733223	0.038622	18.98437	0
GED PARAMETER	0.82426	0.022629	36.42461	0.00E+00
R-squared	-0.000122	Mean dependent var		-2.22E-04
Adjusted R-squarec	-0.000122	S.D. dependent var		0.020239
S.E. of regression	0.02024	Akaike info criterion		-6.016892
Sum squared resid	0.759096	Schwarz criterion		-5.999011
Log likelihood	5583.659	Hannan-Quinn criter.		-6.010301
Durbin-Watson stat	1.900729			



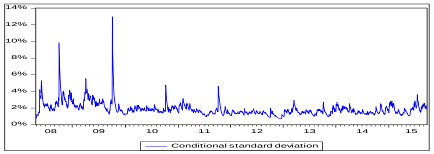


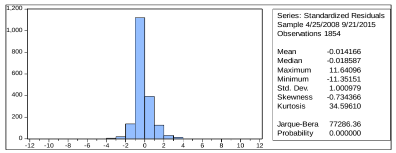


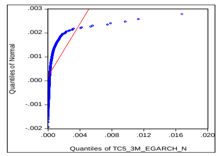
EGARCH (1,1)_N

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	2.88E-04	0.000255	1.131112	0.258
	Variance Equation			
C(2)	-0.681003	0.038294	-17.78358	0
C(3)	0.267132	0.011672	22.88649	0
C(4)	0.035339	0.006903	5.119592	0
C(5)	0.93353	0.004014	232.5564	0
R-squared	-0.000635	Mean dependent var		-2.22E-04
Adjusted R-squarec	-0.000635	S.D. dependent var		0.020239
S.E. of regression	0.020245	Akaike info criterion		-5.228696
Sum squared resid	0.759485	Schwarz criterion		-5.213796
Log likelihood	4852.002	Hannan-Quinn criter.		-5.223204
Durbin-Watson stat	1.899754			



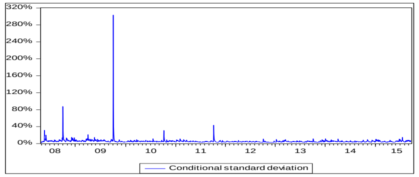


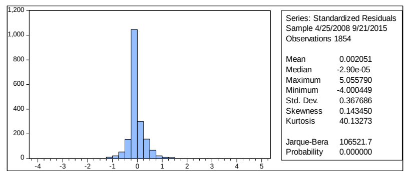


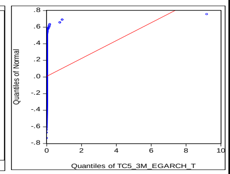
EGARCH (1,1)_T

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	1.24E-06	0.000223	0.005557	0.9956
	Variance Equation			
C(2)	-1.778646	0.389715	-4.563962	0
C(3)	1.479948	1.130234	1.309418	0.1904
C(4)	0.16669	0.157452	1.058676	0.2897
C(5)	0.752599	0.03372	22.31889	0
T-DIST. DOF	2.04128	0.06396	31.91493	0
R-squared	-0.000121	Mean dependent var		-2.22E-04
Adjusted R-squarec	-0.000121	S.D. dependent var		0.020239
S.E. of regression	0.02024	Akaike info criterion		-5.836061
Sum squared resid	0.759095	Schwarz criterion		-5.81818
Log likelihood	5416.029	Hannan-Quinn criter.		-5.82947
Durbin-Watson stat	1.90073			



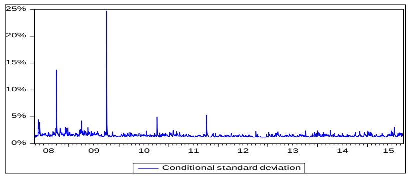


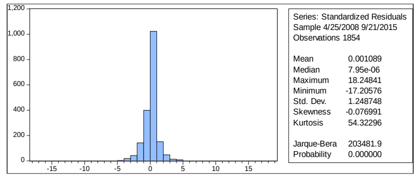


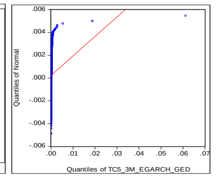
EGARCH (1,1)_GED

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-1.11E-07	0.000261	-0.000426	0.9997
	Variance Equation			
C(2)	-3.540056	0.561746	-6.301882	0
C(3)	2.83E-01	3.82E-02	7.405358	0
C(4)	0.032157	0.026081	1.233004	0.2176
C(5)	0.600869	0.065371	9.191715	0
GED PARAMETER	0.937324	0.017872	52.44679	0
R-squared	-0.00012	Mean dependent var		-2.22E-04
Adjusted R-squarec	-0.00012	S.D. dependent var		2.02E-02
S.E. of regression	0.02024	Akaike info criterion		-5.894217
Sum squared resid	0.759094	Schwarz criterion		-5.876337
Log likelihood	5469.94	Hannan-Quinn criter.		-5.887627
Durbin-Watson stat	1.900733			



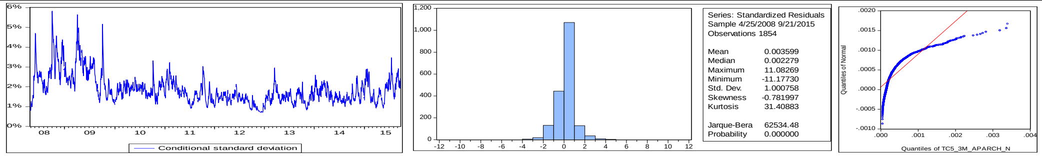




APARCH (1,1)_N

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

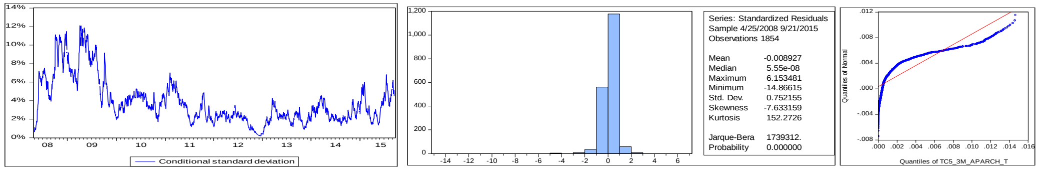
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-3.58E-05	0.000269	-0.132984	0.8942
	Variance Equation			
C(2)	0.004548	1.41E-03	3.24E+00	0.0012
C(3)	0.131479	8.01E-03	16.41789	0
C(4)	-0.034885	0.034795	-1.002596	0.3161
C(5)	0.859252	0.008111	1.06E+02	0
C(6)	0.681706	0.091459	7.453676	0
R-squared	-0.000084	Mean dependent var		-2.22E-04
Adjusted R-squarec	-0.000084	S.D. dependent var		2.02E-02
S.E. of regression	0.02024	Akaike info criterion		-5.250823
Sum squared resid	0.759067	Schwarz criterion		-5.232942
Log likelihood	4873.513	Hannan-Quinn criter.		-5.244232
Durbin-Watson stat	1.900801			



APARCH (1,1)_T

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

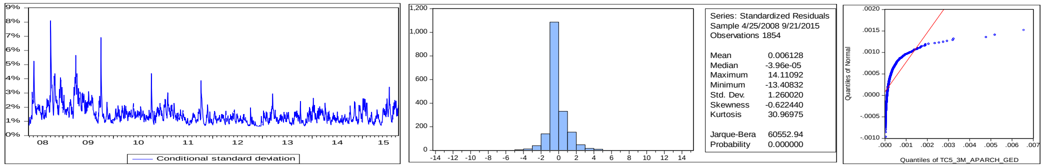
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-1.46E-09	0.00000185	-0.00079	0.9994
	Variance Equation			
C(2)	0.00095	0.001079	0.881146	0.3782
C(3)	0.128708	0.024387	5.277814	0
C(4)	-0.170604	0.098883	-1.725316	0.0845
C(5)	0.946258	0.004576	206.8035	0
C(6)	0.550605	0.064406	8.548955	0
T-DIST. DOF	2.086074	0.048453	43.05358	0
R-squared	-0.00012	Mean dependent var		-2.22E-04
Adjusted R-squarec	-0.00012	S.D. dependent var		2.02E-02
S.E. of regression	0.02024	Akaike info criterion		-5.930795
Sum squared resid	0.759094	Schwarz criterion		-5.909935
Log likelihood	5504.847	Hannan-Quinn criter.		-5.923106
Durbin-Watson stat	1.900733			



APARCH (1,1)_GED

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

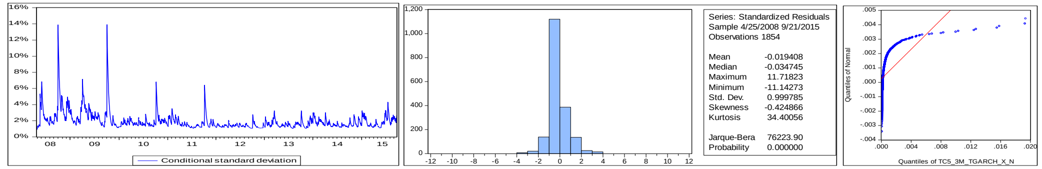
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	4.74E-07	0.0000465	0.010185	0.9919
	Variance Equation			
C(2)	0.002935	0.0016	1.834773	0.0665
C(3)	0.20465	0.024943	8.20478	0
C(4)	-0.004263	0.080664	-0.052843	0.9579
C(5)	0.747823	0.029219	25.59349	0
C(6)	0.881103	0.110369	7.983247	0
GED PARAMETER	0.780507	0.023094	33.79659	0
R-squared	-0.000121	Mean dependent var		-2.22E-04
Adjusted R-squarec	-0.000121	S.D. dependent var		0.020239
S.E. of regression	0.02024	Akaike info criterion		-6.118755
Sum squared resid	0.759094	Schwarz criterion		-6.097894
Log likelihood	5679.086	Hannan-Quinn criter.		-6.111066
Durbin-Watson stat	1.900732			



TARCH (1,1)_X_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1) + C(6)*SPREAD_TC5_S_TC5_3M

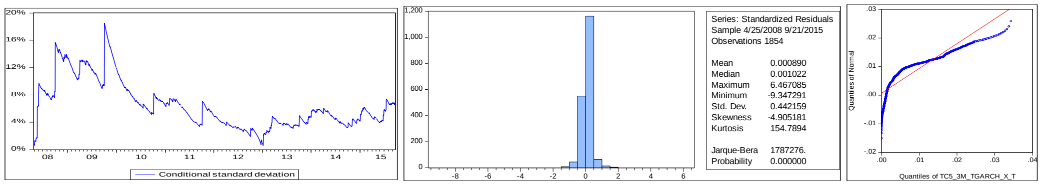
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	5.16E-04	0.000406	1.271009	0.2037
	Variance Equation			
C	2.19E-05	1.47E-06	14.85684	0
RESID(-1)^2	0.232666	0.010281	22.62969	0
RESID(-1)^2*(RESID	-0.067647	0.014788	-4.574501	0
GARCH(-1)	8.00E-01	7.92E-03	100.973	0
SPREAD_TC5_S_TC5	7.92E-06	5.16E-06	1.533784	0.1251
R-squared	-0.001331	Mean dependent var		-0.000222
Adjusted R-squarec	-0.001331	S.D. dependent var		0.020239
S.E. of regression	0.020252	Akaike info criterion		-5.212847
Sum squared resid	0.760013	Schwarz criterion		-5.194966
Log likelihood	4838.309	Hannan-Quinn criter.		-5.206256
Durbin-Watson stat	1.898435			



TARCH (1,1)_X_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1) + C(6)*SPREAD_TC5_S_TC5_3M

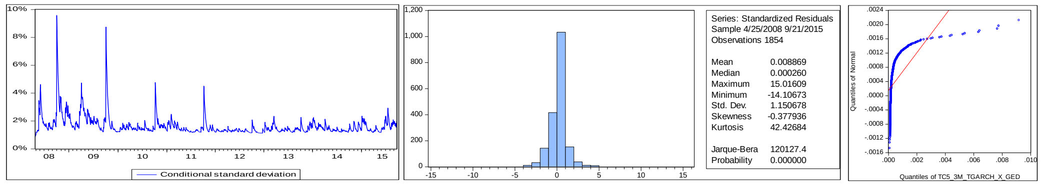
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-4.93E-05	0.000195	-0.252492	0.8007
	Variance Equation			
C	-1.14E-05	6.14E-06	-1.851552	0.0641
RESID(-1)^2	0.317201	0.190077	1.668799	0.0952
RESID(-1)^2*(RESID	-0.158559	0.106774	-1.484992	0.1375
GARCH(-1)	9.85E-01	1.52E-03	646.3442	0
SPREAD_TC5_S_TC5	-1.51E-05	1.67E-05	-0.904596	0.3657
T-DIST. DOF	2.027805	0.016618	122.0269	0
R-squared	-0.000073	Mean dependent var		-0.000222
Adjusted R-squarec	-0.000073	S.D. dependent var		0.020239
S.E. of regression	0.02024	Akaike info criterion		-5.87462
Sum squared resid	0.759058	Schwarz criterion		-5.85376
Log likelihood	5452.773	Hannan-Quinn criter.		-5.866931
Durbin-Watson stat	1.900823			



TARCH (1,1)_X_GED

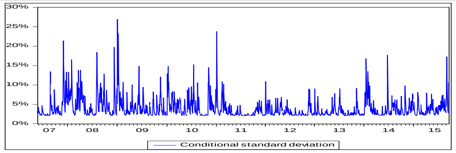
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1) + C(6)*SPREAD_TC5_S_TC5_3M

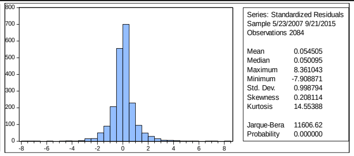
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-3.65E-06	0.000145	-0.025166	0.9799
	Variance Equation			
C	2.32E-05	4.92E-06	4.706084	0
RESID(-1)^2	0.090177	0.019208	4.694641	0
RESID(-1)^2*(RESID	-0.011845	0.024289	-0.487693	0.6258
GARCH(-1)	8.23E-01	0.029764	27.65018	0
SPREAD_TC5_S_TC5	-1.93E-06	1.09E-05	-0.176999	0.8595
GED PARAMETER	0.836544	0.022817	36.66303	0
R-squared	-0.000116	Mean dependent var		-2.22E-04
Adjusted R-squarec	-0.000116	S.D. dependent var		0.020239
S.E. of regression	0.02024	Akaike info criterion		-5.998889
Sum squared resid	0.759091	Schwarz criterion		-5.978028
Log likelihood	5567.97	Hannan-Quinn criter.		-5.9912
Durbin-Watson stat	1.90074			

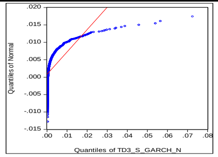


TD3 Spot

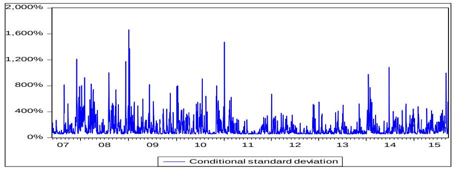
GARCH (1,1)_N				
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.003373	0.000553	-6.097201	0
	Variance Equation			
C	2.11E-04	6.33E-06	33.29871	0
RESID(-1)^2	5.19E-01	0.024985	20.76393	0
GARCH(-1)	0.508886	0.010447	48.71089	0
R-squared	-0.00598	Mean dependent var		-1.31E-04
Adjusted R-squarec	-0.00598	S.D. dependent var		0.041935
S.E. of regression	0.04206	Akaike info criterion		-3.850612
Sum squared resid	3.684924	Schwarz criterion		-3.839783
Log likelihood	4016.338	Hannan-Quinn criter.		-3.846644
Durbin-Watson stat	0.88457			

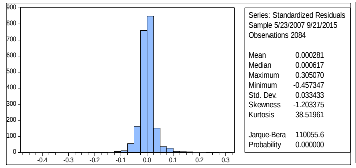


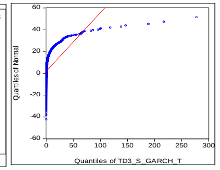




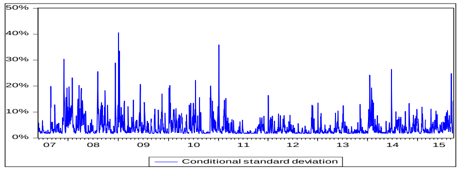
GARCH (1,1)_T				
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.002427	0.00035	-6.932596	0
	Variance Equation			
C	2.75E-01	9.10E+01	0.003021	0.9976
RESID(-1)^2	2019.451	668482.1	0.003021	0.9976
GARCH(-1)	0.138297	0.02386	5.796257	0
T-DIST. DOF	2.000382	0.126522	15.8105	0
R-squared	-0.002997	Mean dependent var		-1.31E-04
Adjusted R-squarec	-0.002997	S.D. dependent var		0.041935
S.E. of regression	0.041998	Akaike info criterion		-4.324175
Sum squared resid	3.673999	Schwarz criterion		-4.310638
Log likelihood	4510.79	Hannan-Quinn criter.		-4.319215
Durbin-Watson stat	0.887201			

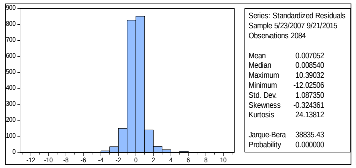


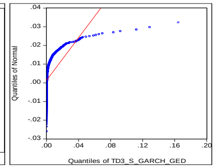




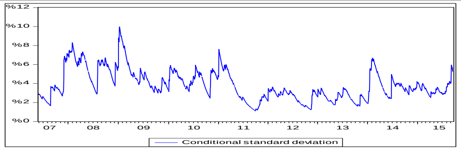
GARCH (1,1)_GED				
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.002083	0.00022	-9.476886	0
	Variance Equation			
C	2.03E-04	2.20E-05	9.24976	0
RESID(-1)^2	1.192052	0.161546	7.38E+00	0
GARCH(-1)	0.268757	0.027693	9.704932	0
GED PARAMETER	0.729392	0.02388	30.544	0
R-squared	-0.002167	Mean dependent var		-1.31E-04
Adjusted R-squarec	-0.002167	S.D. dependent var		0.041935
S.E. of regression	0.04198	Akaike info criterion		-4.309582
Sum squared resid	3.670958	Schwarz criterion		-4.296045
Log likelihood	4495.584	Hannan-Quinn criter.		-4.304622
Durbin-Watson stat	0.887936			

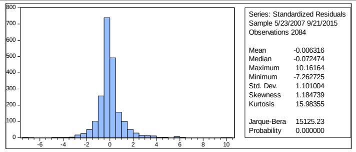


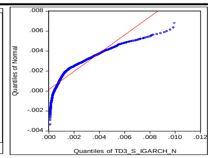




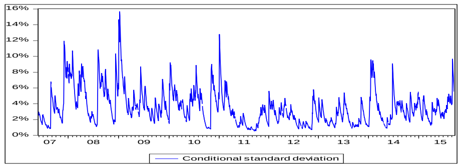
IGARCH (1,1)_N				
GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000779	0.000335	2.325892	0.02
	Variance Equation			
RESID(-1)^2	0.033629	0.000648	51.86938	0
GARCH(-1)	0.966371	0.000648	1490.527	0
R-squared	-0.000471	Mean dependent var		-1.31E-04
Adjusted R-squarec	-0.000471	S.D. dependent var		0.041935
S.E. of regression	0.041945	Akaike info criterion		-3.637877
Sum squared resid	3.664747	Schwarz criterion		-3.632462
Log likelihood	3792.667	Hannan-Quinn criter.		-3.635893
Durbin-Watson stat	0.88944			

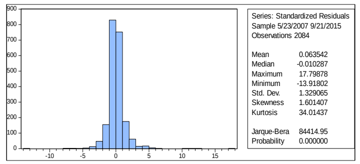


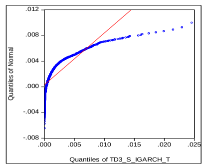




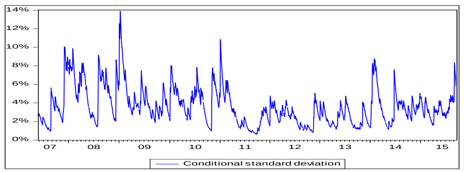
IGARCH (1,1)_T				
GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.00164	0.000329	-4.990712	0
	Variance Equation			
RESID(-1)^2	0.134634	0.007428	18.12514	0
GARCH(-1)	0.865366	0.007428	116.5003	0
T-DIST. DOF	3.17441	0.099749	31.8241	0
R-squared	-0.001294	Mean dependent var		-1.31E-04
Adjusted R-squarec	-0.001294	S.D. dependent var		0.041935
S.E. of regression	0.041962	Akaike info criterion		-4.17036
Sum squared resid	3.667761	Schwarz criterion		-4.162238
Log likelihood	4348.515	Hannan-Quinn criter.		-4.167384
Durbin-Watson stat	0.888709			

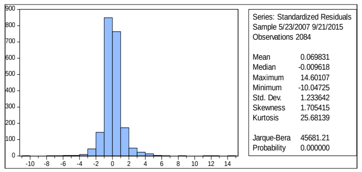


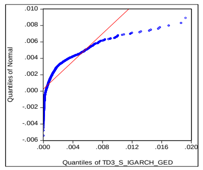




IGARCH (1,1)_GED				
GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.001638	0.000208	-7.87373	0
	Variance Equation			
RESID(-1)^2	9.13E-02	0.005296	17.23255	0
GARCH(-1)	0.90873	0.005296	171.5768	0
GED PARAMETER	0.74122	0.019875	37.29488	0
R-squared	-0.001291	Mean dependent var		-1.31E-04
Adjusted R-squarec	-0.001291	S.D. dependent var		0.041935
S.E. of regression	0.041962	Akaike info criterion		-4.20829
Sum squared resid	3.667748	Schwarz criterion		-4.200169
Log likelihood	4388.039	Hannan-Quinn criter.		-4.205314
Durbin-Watson stat	0.888713			



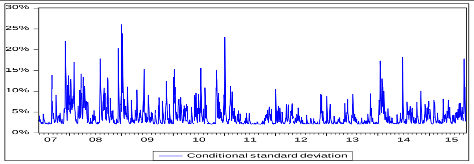


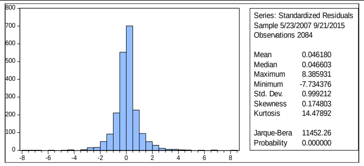


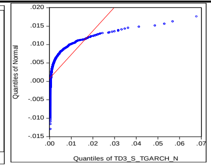
(GJR)TGARCH (1,1)_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.003283	0.000742	-4.421323	0
	Variance Equation			
C	2.09E-04	6.36E-06	32.85457	0
RESID(-1)^2	0.552113	0.032227	17.13181	0
RESID(-1)^2*(RESID	-0.066998	0.034588	-1.937009	0.0527
GARCH(-1)	0.509465	0.010429	48.85291	0
R-squared	-0.005649	Mean dependent var		-1.31E-04
Adjusted R-squarec	-0.005649	S.D. dependent var		0.041935
S.E. of regression	0.042053	Akaike info criterion		-3.850201
Sum squared resid	3.683713	Schwarz criterion		-3.836664
Log likelihood	4016.909	Hannan-Quinn criter.		-3.845241
Durbin-Watson stat	0.884861			



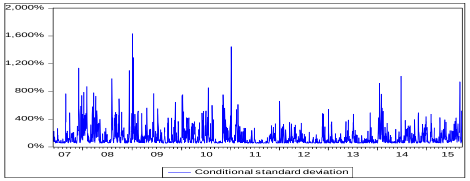


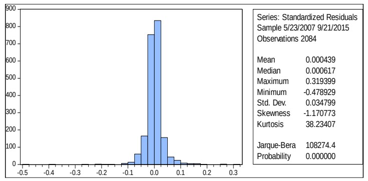


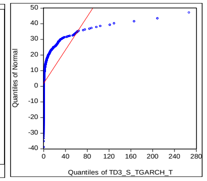
(GJR)TGARCH (1,1)_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.0024	0.000356	-6.735262	0
	Variance Equation			
C	2.50E-01	7.61E+01	0.003291	0.9974
RESID(-1)^2	1.77E+03	5.39E+05	0.003292	0.9974
RESID(-1)^2*(RESID	164.8527	50086.77	0.003291	0.9974
GARCH(-1)	0.141389	0.024004	5.890095	0
T-DIST. DOF	2.000415	0.126581	15.80345	0
R-squared	-0.002929	Mean dependent var		-1.31E-04
Adjusted R-squarec	-0.002929	S.D. dependent var		4.19E-02
S.E. of regression	0.041996	Akaike info criterion		-4.323368
Sum squared resid	3.673749	Schwarz criterion		-4.307124
Log likelihood	4510.949	Hannan-Quinn criter.		-4.317416
Durbin-Watson stat	0.887261			



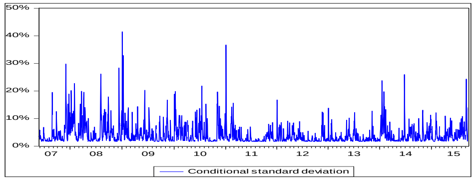


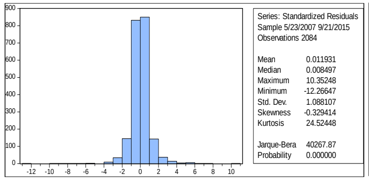


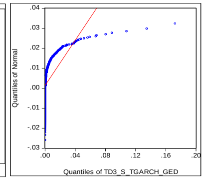
(GJR)TGARCH (1,1)_ged

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.002084	0.000211	-9.857234	0
	Variance Equation			
C	2.06E-04	2.22E-05	9.260049	0
RESID(-1)^2	1.148089	0.174886	6.56478	0
RESID(-1)^2*(RESID	0.099159	0.209201	0.473991	0.6355
GARCH(-1)	0.265381	0.027781	9.552718	0
GED PARAMETER	0.728623	0.02392	30.46028	0
R-squared	-0.002168	Mean dependent var		-1.31E-04
Adjusted R-squarec	-0.002168	S.D. dependent var		0.041935
S.E. of regression	0.04198	Akaike info criterion		-4.308743
Sum squared resid	3.670964	Schwarz criterion		-4.292499
Log likelihood	4495.71	Hannan-Quinn criter.		-4.302791
Durbin-Watson stat	0.887934			



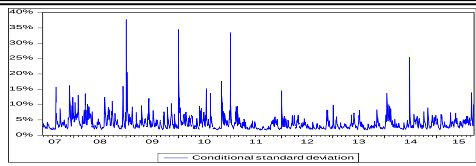


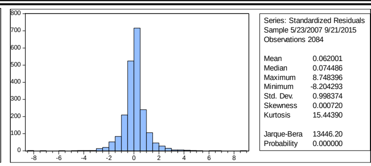


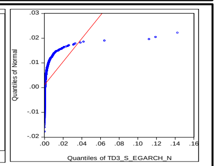
EGARCH (1,1)_N

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.004105	0.000407	-10.08782	0
	Variance Equation			
C(2)	-1.693895	0.045746	-37.02846	0
C(3)	0.623129	0.019994	31.16602	0
C(4)	0.044951	0.010768	4.174501	0
C(5)	0.805652	0.00597	134.9463	0
R-squared	-0.008984	Mean dependent var		-1.31E-04
Adjusted R-squarec	-0.008984	S.D. dependent var		0.041935
S.E. of regression	0.042123	Akaike info criterion		-3.852598
Sum squared resid	3.695928	Schwarz criterion		-3.839061
Log likelihood	4019.407	Hannan-Quinn criter.		-3.847638
Durbin-Watson stat	0.881937			



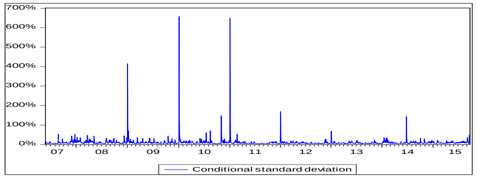


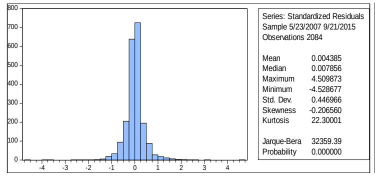


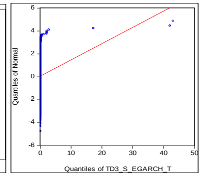
EGARCH (1,1)_T

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.002417	0.00039	-6.191174	0
	Variance Equation			
C(2)	-1.975902	0.381414	-5.18046	0
C(3)	2.211037	1.470938	1.503147	0.1328
C(4)	0.106687	0.11058	0.964796	0.3346
C(5)	0.726592	0.025042	29.01493	0
T-DIST. DOF	2.090211	0.127796	16.35585	0
R-squared	-0.002971	Mean dependent var		-0.000131
Adjusted R-squarec	-0.002971	S.D. dependent var		0.041935
S.E. of regression	0.041997	Akaike info criterion		-4.288714
Sum squared resid	3.673904	Schwarz criterion		-4.27247
Log likelihood	4474.84	Hannan-Quinn criter.		-4.282762
Durbin-Watson stat	0.887224			



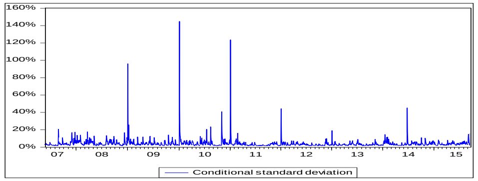


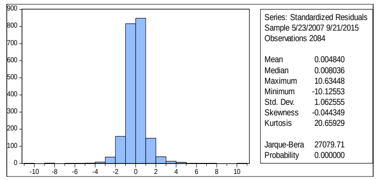


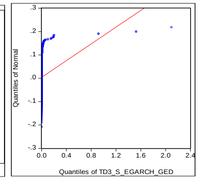
EGARCH (1,1)_GED

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.002094	0.00024	-8.714721	0
	Variance Equation			
C(2)	-2.19595	0.184237	-11.91917	0
C(3)	0.813807	0.058016	14.02731	0
C(4)	0.044293	0.038083	1.163068	0.2448
C(5)	0.754228	0.02486	30.33913	0
GED PARAMETER	0.741087	0.024289	30.51085	0
R-squared	-0.00219	Mean dependent var		-1.31E-04
Adjusted R-squarec	-0.00219	S.D. dependent var		0.041935
S.E. of regression	0.041981	Akaike info criterion		-4.292973
Sum squared resid	3.671044	Schwarz criterion		-4.276729
Log likelihood	4479.278	Hannan-Quinn criter.		-4.287021
Durbin-Watson stat	0.887915			







APARCH (1,1)_N

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.003629	0.0006	-6.049038	0
	Variance Equation			
C(2)	0.001495	3.58E-04	4.18E+00	0
C(3)	0.437399	0.021732	20.12653	0
C(4)	-0.02953	0.018072	-1.63403	0.1023
C(5)	0.573225	0.013883	4.13E+01	0
C(6)	1.415797	0.072024	19.65737	0
R-squared	-0.006959	Mean dependent var		-1.31E-04
Adjusted R-squarec	-0.006959	S.D. dependent var		0.041935
S.E. of regression	0.042081	Akaike info criterion		-3.85417
Sum squared resid	3.688512	Schwarz criterion		-3.837926
Log likelihood	4022.045	Hannan-Quinn criter.		-3.848218
Durbin-Watson stat	0.88371			

APARCH (1,1)_T

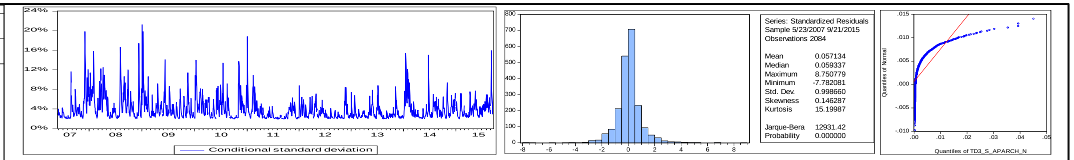
@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

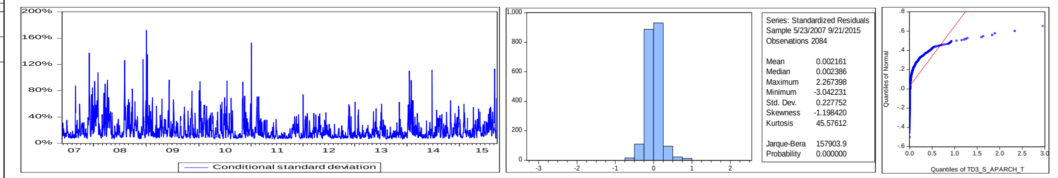
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.002157	0.00031	-6.953475	0
	Variance Equation			
C(2)	0.068636	0.200962	0.34154	0.7327
C(3)	3.383923	9.989213	0.338758	0.7348
C(4)	0.033875	0.046355	0.730774	0.4649
C(5)	0.228632	0.039073	5.851389	0
C(6)	0.859023	0.143265	5.996036	0
T-DIST. DOF	2.017529	0.120615	16.72702	0
R-squared	-0.002335	Mean dependent var		-1.31E-04
Adjusted R-squarec	-0.002335	S.D. dependent var		0.041935
S.E. of regression	0.041984	Akaike info criterion		-4.333478
Sum squared resid	3.671573	Schwarz criterion		-4.314527
Log likelihood	4522.484	Hannan-Quinn criter.		-4.326534
Durbin-Watson stat	0.887787			

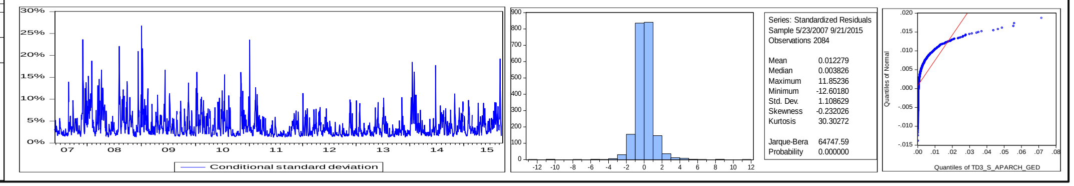
APARCH (1,1)_GED

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.001962	0.000213	-9.19681	0
	Variance Equation			
C(2)	0.009932	0.005509	1.802657	0.0714
C(3)	0.653898	0.094636	6.909589	0
C(4)	0.024247	0.051072	0.474763	0.635
C(5)	0.393131	0.040063	9.812761	0
C(6)	0.929469	0.156983	5.920818	0
GED PARAMETER	0.733898	0.023841	30.78293	0
R-squared	-0.001906	Mean dependent var		-1.31E-04
Adjusted R-squarec	-0.001906	S.D. dependent var		0.041935
S.E. of regression	0.041975	Akaike info criterion		-4.315307
Sum squared resid	3.670001	Schwarz criterion		-4.296356
Log likelihood	4503.55	Hannan-Quinn criter.		-4.308363
Durbin-Watson stat	0.888167			







TARCH (1,1)_X_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1) + C(6)*SPREAD_TD3_S_3M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.003622	0.000771	-4.696996	0
	Variance Equation			
C	2.53E-04	7.23E-06	34.97577	0
RESID(-1)^2	0.683721	0.039774	17.1901	0
RESID(-1)^2*(RESID	-0.136843	0.044068	-3.105309	0.0019
GARCH(-1)	0.442909	0.009279	47.73143	0
SPREAD_TD3_S_3M	2.93E-04	2.27E-05	12.92049	0
R-squared	-0.00693	Mean dependent var		-1.31E-04
Adjusted R-squarec	-0.00693	S.D. dependent var		0.041935
S.E. of regression	0.04208	Akaike info criterion		-3.863266
Sum squared resid	3.688407	Schwarz criterion		-3.847022
Log likelihood	4031.523	Hannan-Quinn criter.		-3.857314
Durbin-Watson stat	0.883735			

TARCH (1,1)_X_T

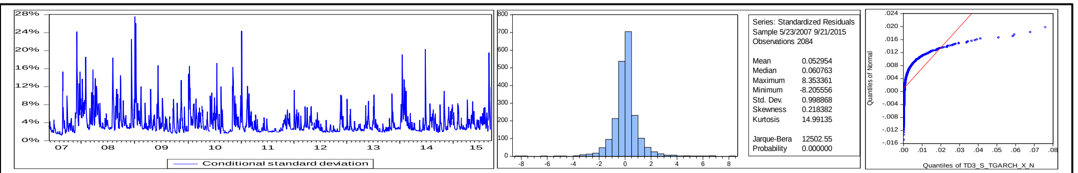
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1) + C(6)*SPREAD_TD3_S_3M

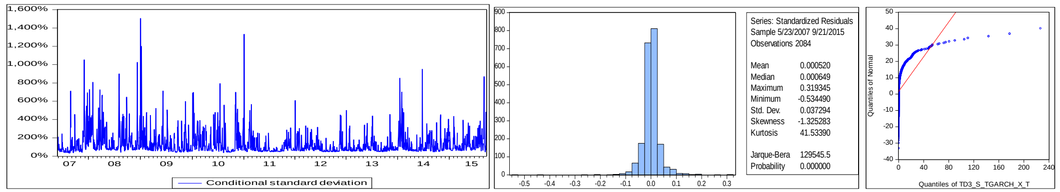
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.002391	0.000351	-6.813275	0
	Variance Equation			
C	2.52E-01	6.63E+01	0.003799	0.997
RESID(-1)^2	1535.192	404123.8	0.003799	0.997
RESID(-1)^2*(RESID	110.4911	29124.43	0.003794	0.997
GARCH(-1)	0.118328	0.023928	4.945116	0
SPREAD_TD3_S_3M	2.74E-01	72.08918	0.003799	0.997
T-DIST. DOF	2.000486	0.128137	15.61211	0
R-squared	-0.002906	Mean dependent var		-1.31E-04
Adjusted R-squarec	-0.002906	S.D. dependent var		0.041935
S.E. of regression	0.041996	Akaike info criterion		-4.328741
Sum squared resid	3.673665	Schwarz criterion		-4.30979
Log likelihood	4517.549	Hannan-Quinn criter.		-4.321797
Durbin-Watson stat	0.887281			

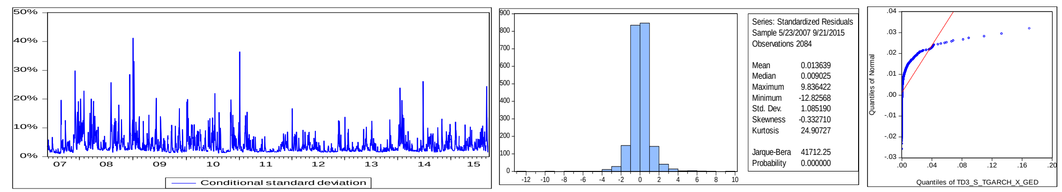
TARCH (1,1)_X_GED

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1) + C(6)*SPREAD_TD3_S_3M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.002084	0.000222	-9.404509	0
	Variance Equation			
C	2.36E-04	2.55E-05	9.263299	0
RESID(-1)^2	1.164992	0.17241	6.757114	0
RESID(-1)^2*(RESID	0.063477	0.212696	0.298441	0.7654
GARCH(-1)	2.44E-01	0.026941	9.066032	0
SPREAD_TD3_S_3M	2.86E-04	7.16E-05	3.999449	0.0001
GED PARAMETER	0.737428	0.024037	30.67895	0
R-squared	-0.002168	Mean dependent var		-1.31E-04
Adjusted R-squarec	-0.002168	S.D. dependent var		0.041935
S.E. of regression	0.04198	Akaike info criterion		-4.315186
Sum squared resid	3.670962	Schwarz criterion		-4.296234
Log likelihood	4503.423	Hannan-Quinn criter.		-4.308242
Durbin-Watson stat	0.887935			





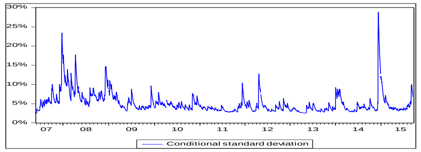


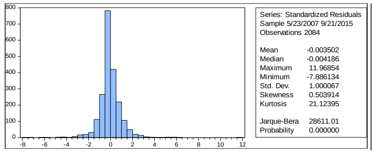
TD3 1 Month

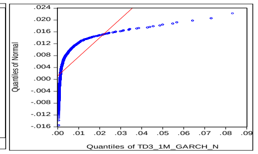
GARCH (1,1)_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.00017	0.000738	0.230847	0.8174
	Variance Equation			
C	7.14E-05	5.09E-06	14.01967	0
RESID(-1)^2	1.16E-01	0.003301	35.08469	0
GARCH(-1)	0.877173	0.003476	252.3296	0
R-squared	-0.000019	Mean dependent var		-6.68E-05
Adjusted R-squared	-0.000019	S.D. dependent var		0.054316
S.E. of regression	0.054317	Akaike info criterion		-3.283388
Sum squared resid	6.145465	Schwarz criterion		-3.272559
Log likelihood	3425.291	Hannan-Quinn criter.		-3.27942
Durbin-Watson stat	2.105442			



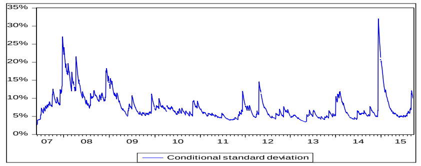


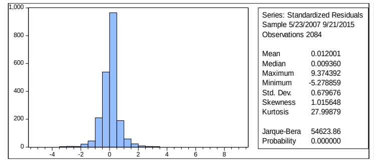


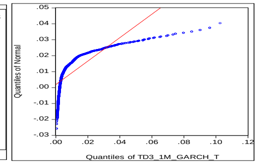
GARCH (1,1)_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000541	0.000588	-0.919043	0.3581
	Variance Equation			
C	6.16E-05	3.46E-05	1.780513	0.075
RESID(-1)^2	0.136795	0.068624	1.993387	0.0462
GARCH(-1)	0.936304	0.009143	102.4053	0
T-DIST. DOF	2.251557	0.145224	15.50404	0
R-squared	-0.000076	Mean dependent var		-6.68E-05
Adjusted R-squared	-0.000076	S.D. dependent var		0.054316
S.E. of regression	0.054318	Akaike info criterion		-3.706422
Sum squared resid	6.145815	Schwarz criterion		-3.692885
Log likelihood	3867.092	Hannan-Quinn criter.		-3.701462
Durbin-Watson stat	2.105322			



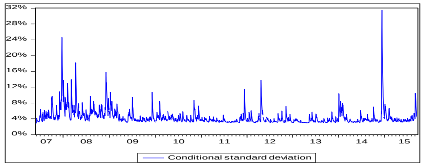


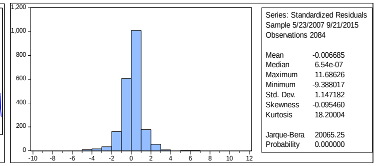


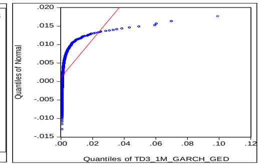
GARCH (1,1)_GED

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-2.37E-08	0.000427	-0.0000554	1
	Variance Equation			
C	2.57E-04	3.98E-05	6.457886	0
RESID(-1)^2	0.153256	0.023358	6.56E+00	0
GARCH(-1)	0.702179	0.030984	22.66232	0
GED PARAMETER	0.859918	0.023913	35.96056	0
R-squared	-0.000002	Mean dependent var		-6.68E-05
Adjusted R-squared	-0.000002	S.D. dependent var		0.054316
S.E. of regression	0.054316	Akaike info criterion		-3.750209
Sum squared resid	6.145357	Schwarz criterion		-3.736673
Log likelihood	3912.718	Hannan-Quinn criter.		-3.745249
Durbin-Watson stat	2.105479			



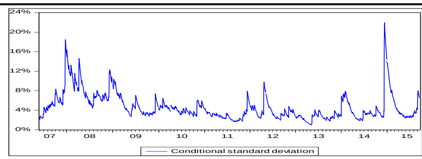


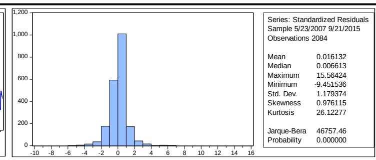


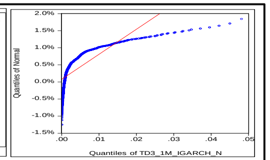
IGARCH (1,1)_N

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.00022	0.0004	-0.549287	0.5828
	Variance Equation			
RESID(-1)^2	0.064819	0.001142	56.735	0
GARCH(-1)	0.935181	0.001142	818.5491	0
R-squared	-0.000008	Mean dependent var		-6.68E-05
Adjusted R-squared	-0.000008	S.D. dependent var		0.054316
S.E. of regression	0.054316	Akaike info criterion		-3.177016
Sum squared resid	6.145396	Schwarz criterion		-3.171601
Log likelihood	3312.45	Hannan-Quinn criter.		-3.175032
Durbin-Watson stat	2.105466			



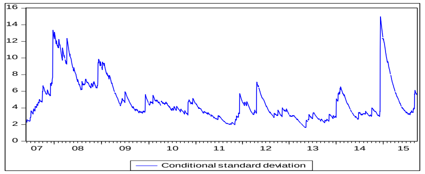


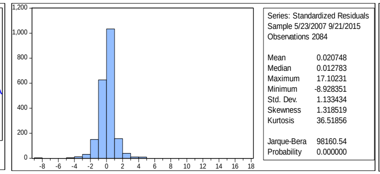


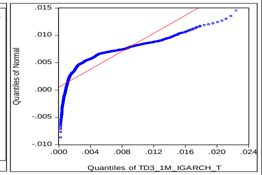
IGARCH (1,1)_T

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000445	0.000572	-0.778195	0.4365
	Variance Equation			
RESID(-1)^2	0.028844	0.002868	10.05777	0
GARCH(-1)	0.971156	0.002868	338.6347	0
T-DIST. DOF	2.883349	0.068016	42.39194	0
R-squared	-0.000048	Mean dependent var		-6.68E-05
Adjusted R-squared	-0.000048	S.D. dependent var		0.054316
S.E. of regression	0.054317	Akaike info criterion		-3.689558
Sum squared resid	6.145645	Schwarz criterion		-3.681436
Log likelihood	3847.519	Hannan-Quinn criter.		-3.686582
Durbin-Watson stat	2.10538			



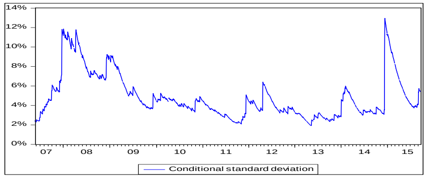


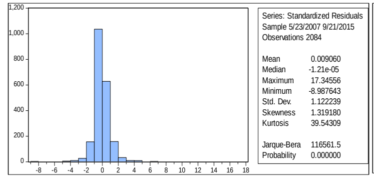


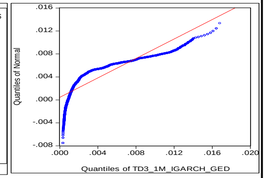
IGARCH (1,1)_GED

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000000459	0.000106	0.004327	0.9965
	Variance Equation			
RESID(-1)^2	2.11E-02	0.002522	8.373826	0
GARCH(-1)	0.978882	0.002522	388.1484	0
GED PARAMETER	0.755761	0.023181	32.60215	0
R-squared	-0.000002	Mean dependent var		-6.68E-05
Adjusted R-squared	-0.000002	S.D. dependent var		0.054316
S.E. of regression	0.054316	Akaike info criterion		-3.797436
Sum squared resid	6.145357	Schwarz criterion		-3.789314
Log likelihood	3959.928	Hannan-Quinn criter.		-3.79446
Durbin-Watson stat	2.105479			



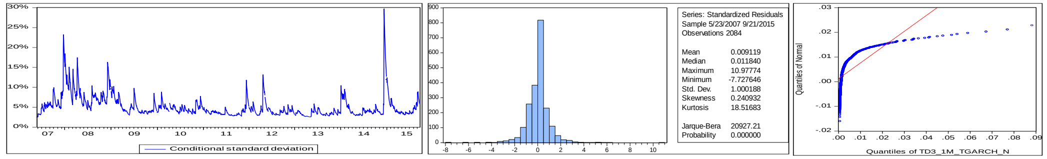




(GJR)TGARCH (1,1)_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1)

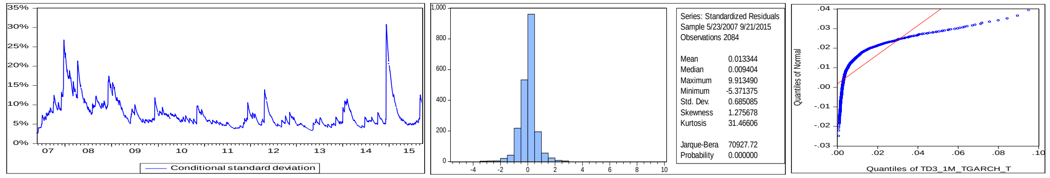
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000467	0.000823	-0.567886	0.5701
	Variance Equation			
C	7.64E-05	5.05E-06	15.14382	0
RESID(-1)^2	0.083923	0.006474	12.96346	0
RESID(-1)^2*(RESID(-	0.072648	0.008237	8.820256	0
GARCH(-1)	0.87186	0.003579	243.5769	0
R-squared	-0.000054	Mean dependent var		-6.68E-05
Adjusted R-squared	-0.000054	S.D. dependent var		0.054316
S.E. of regression	0.054318	Akaike info criterion		-3.288113
Sum squared resid	6.145681	Schwarz criterion		-3.274576
Log likelihood	3431.214	Hannan-Quinn criter.		-3.283153
Durbin-Watson stat	2.105368			



(GJR)TGARCH (1,1)_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1)

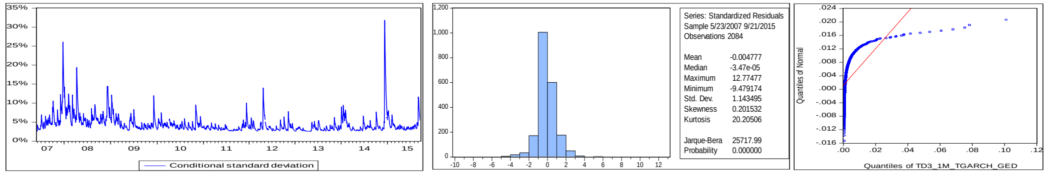
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000545	0.000589	-0.925011	0.355
	Variance Equation			
C	5.10E-05	2.91E-05	1.75006	0.0801
RESID(-1)^2	0.157376	0.080658	1.951142	0.051
RESID(-1)^2*(RESID(-	-0.060337	0.051325	-1.175585	0.2398
GARCH(-1)	0.941585	0.008391	112.2169	0
T-DIST. DOF	2.252381	0.144037	15.63747	0
R-squared	-0.000078	Mean dependent var		-6.68E-05
Adjusted R-squared	-0.000078	S.D. dependent var		0.054316
S.E. of regression	0.054318	Akaike info criterion		-3.706282
Sum squared resid	6.145824	Schwarz criterion		-3.690038
Log likelihood	3867.945	Hannan-Quinn criter.		-3.70033
Durbin-Watson stat	2.105319			



(GJR)TGARCH (1,1)_ged

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1)

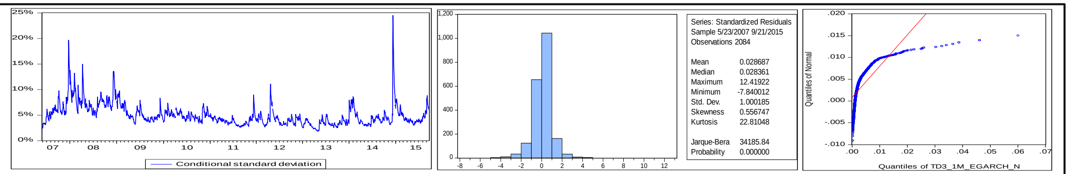
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.00000127	0.000246	0.005182	0.9959
	Variance Equation			
C	1.42E-04	2.60E-05	5.445332	0
RESID(-1)^2	0.197034	0.038081	5.174138	0
RESID(-1)^2*(RESID(-	-0.083112	0.039344	-2.11247	0.0346
GARCH(-1)	0.774015	0.024391	31.7332	0
GED PARAMETER	0.812906	0.025598	31.75635	0
R-squared	-0.000002	Mean dependent var		-6.68E-05
Adjusted R-squared	-0.000002	S.D. dependent var		0.054316
S.E. of regression	0.054316	Akaike info criterion		-3.772054
Sum squared resid	6.145357	Schwarz criterion		-3.75581
Log likelihood	3936.48	Hannan-Quinn criter.		-3.766102
Durbin-Watson stat	2.105479			



EGARCH (1,1)_N

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

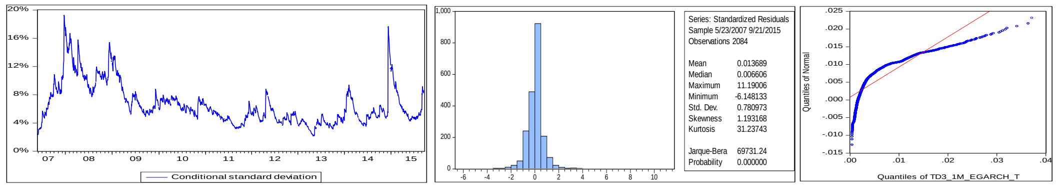
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.001164	0.000697	-1.671476	0.0946
	Variance Equation			
C(2)	-0.377184	0.015633	-24.12773	0
C(3)	0.235671	0.005858	40.23325	0
C(4)	-0.010841	0.006648	-1.63067	0.103
C(5)	0.961942	0.002386	403.1848	0
R-squared	-0.000409	Mean dependent var		-6.68E-05
Adjusted R-squared	-0.000409	S.D. dependent var		0.054316
S.E. of regression	0.054327	Akaike info criterion		-3.291092
Sum squared resid	6.147858	Schwarz criterion		-3.277555
Log likelihood	3434.318	Hannan-Quinn criter.		-3.286132
Durbin-Watson stat	2.104622			



EGARCH (1,1)_T

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

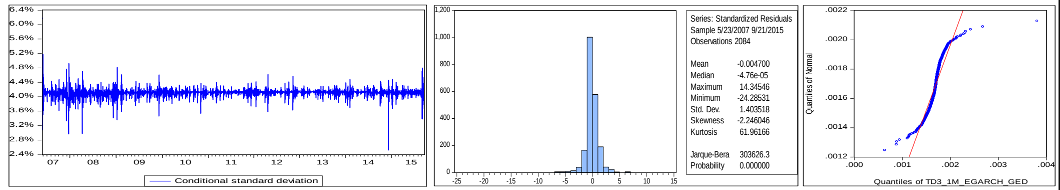
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000339	0.00058	-0.584814	0.5587
	Variance Equation			
C(2)	-0.10108	0.019443	-5.198901	0
C(3)	0.149386	0.030917	4.831903	0
C(4)	0.025052	0.01896	1.321356	0.1864
C(5)	0.994251	0.002609	381.0193	0
T-DIST. DOF	2.340465	0.138372	16.9143	0
R-squared	-0.000025	Mean dependent var		-6.68E-05
Adjusted R-squared	-0.000025	S.D. dependent var		0.054316
S.E. of regression	0.054317	Akaike info criterion		-3.727175
Sum squared resid	6.145502	Schwarz criterion		-3.710931
Log likelihood	3889.717	Hannan-Quinn criter.		-3.721223
Durbin-Watson stat	2.105429			



EGARCH (1,1)_GED

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

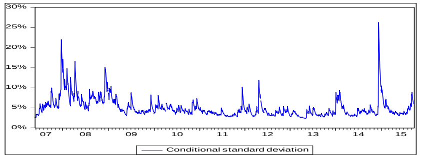
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.00000196	0.000538	0.003651	0.9971
	Variance Equation			
C(2)	-11.10581	1.207151	-9.200023	0
C(3)	-0.045502	0.007804	-5.83045	0
C(4)	-0.021059	0.005893	-3.573892	0.0004
C(5)	-0.744069	0.187145	-3.975884	0.0001
GED PARAMETER	0.927157	0.020152	46.00736	0
R-squared	-0.000002	Mean dependent var		-6.68E-05
Adjusted R-squared	-0.000002	S.D. dependent var		0.054316
S.E. of regression	0.054316	Akaike info criterion		-3.599848
Sum squared resid	6.145357	Schwarz criterion		-3.583604
Log likelihood	3757.041	Hannan-Quinn criter.		-3.593896
Durbin-Watson stat	2.105479			

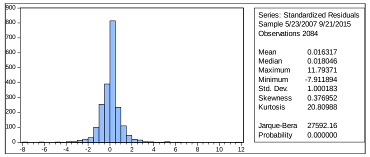


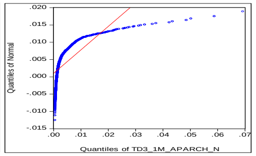
APARCH (1,1)_N

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000721	0.000832	-0.866699	0.3861
	Variance Equation			
C(2)	0.000303	7.64E-05	3.96E+00	0.0001
C(3)	0.131165	0.005247	24.99836	0
C(4)	0.123351	0.025769	4.786813	0
C(5)	0.878092	0.003483	2.52E+02	0
C(6)	1.559551	0.07402	21.06926	0
R-squared	-0.000145	Mean dependent var		-6.68E-05
Adjusted R-squared	-0.000145	S.D. dependent var		0.054316
S.E. of regression	0.05432	Akaike info criterion		-3.28962
Sum squared resid	6.146239	Schwarz criterion		-3.273377
Log likelihood	3433.784	Hannan-Quinn criter.		-3.283668
Durbin-Watson stat	2.105177			



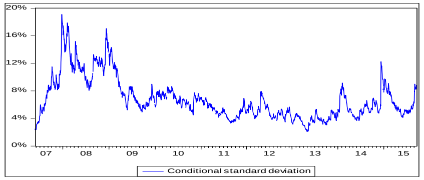


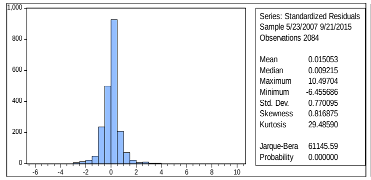


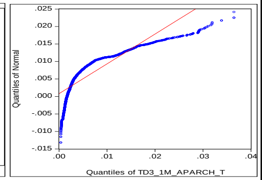
APARCH (1,1)_T

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000478	0.000565	-0.84666	0.3972
	Variance Equation			
C(2)	0.001114	0.000788	1.414195	0.1573
C(3)	0.075344	0.014888	5.060568	0
C(4)	-0.195719	0.15368	-1.273547	0.2028
C(5)	0.954818	0.007433	128.4536	0
C(6)	0.695909	0.138641	5.01952	0
T-DIST. DOF	2.321611	0.136099	17.05819	0
R-squared	-0.000057	Mean dependent var		-6.68E-05
Adjusted R-squared	-0.000057	S.D. dependent var		0.054316
S.E. of regression	0.054318	Akaike info criterion		-3.731038
Sum squared resid	6.145701	Schwarz criterion		-3.712087
Log likelihood	3894.742	Hannan-Quinn criter.		-3.724094
Durbin-Watson stat	2.105361			



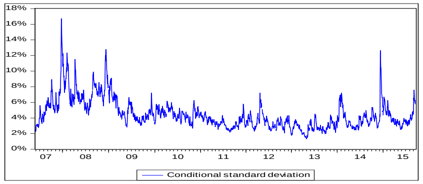


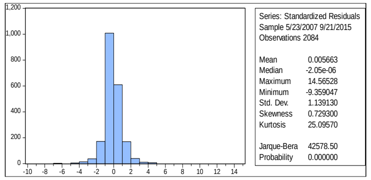


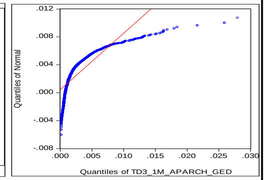
APARCH (1,1)_GED

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	7.46E-08	0.000519	0.000144	0.9999
	Variance Equation			
C(2)	0.003051	0.001294	2.357253	0.0184
C(3)	0.102946	0.011857	8.6819	0
C(4)	-0.141001	0.109392	-1.288958	0.1974
C(5)	0.902611	0.011852	76.15635	0
C(6)	0.721098	0.088893	8.112011	0
GED PARAMETER	0.815451	0.01917	42.53778	0
R-squared	-0.000002	Mean dependent var		-6.68E-05
Adjusted R-squared	-0.000002	S.D. dependent var		0.054316
S.E. of regression	0.054316	Akaike info criterion		-3.803813
Sum squared resid	6.145357	Schwarz criterion		-3.784862
Log likelihood	3970.573	Hannan-Quinn criter.		-3.796869
Durbin-Watson stat	2.105479			



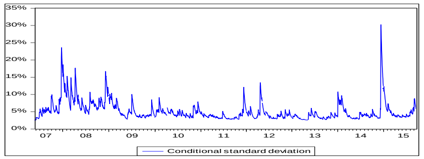


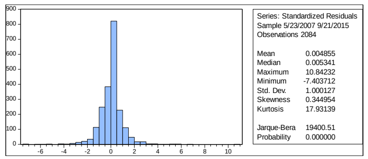


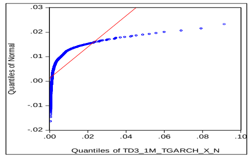
TARCH (1,1)_X_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) +C(5)*GARCH(-1) + C(6)*SPREAD_TD3_S_1M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000212	0.000967	-0.219648	0.8261
	Variance Equation			
C	8.50E-05	5.43E-06	15.64812	0
RESID(-1)^2	0.084739	0.006516	13.00484	0
RESID(-1)^2*(RESID(-	0.07993	0.008522	9.379133	0
GARCH(-1)	0.86628	0.003645	237.6464	0
SPREAD_TD3_S_1M	1.08E-04	2.53E-05	4.275811	0
R-squared	-0.000007	Mean dependent var		-6.68E-05
Adjusted R-squared	-0.000007	S.D. dependent var		0.054316
S.E. of regression	0.054316	Akaike info criterion		-3.288814
Sum squared resid	6.145392	Schwarz criterion		-3.272571
Log likelihood	3432.945	Hannan-Quinn criter.		-3.282862
Durbin-Watson stat	2.105467			



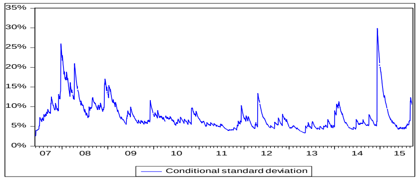


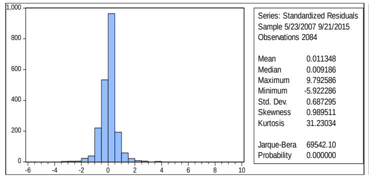


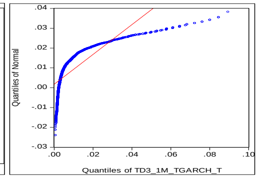
TARCH (1,1)_X_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1) + C(6)*SPREAD_TD3_S_1M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000534	0.00059	-0.90464	0.3657
	Variance Equation			
C	3.99E-05	2.40E-05	1.659336	0.097
RESID(-1)^2	0.144654	0.073475	1.968757	0.049
RESID(-1)^2*(RESID(-	-0.051528	0.047408	-1.086916	0.2771
GARCH(-1)	0.945708	0.007675	123.2151	0
SPREAD_TD3_S_1M	-1.75E-04	0.000132	-1.328554	0.184
T-DIST. DOF	2.251362	0.14101	15.966	0
R-squared	-0.000074	Mean dependent var		-6.68E-05
Adjusted R-squared	-0.000074	S.D. dependent var		0.054316
S.E. of regression	0.054318	Akaike info criterion		-3.706507
Sum squared resid	6.145802	Schwarz criterion		-3.687555
Log likelihood	3869.18	Hannan-Quinn criter.		-3.699563
Durbin-Watson stat	2.105327			



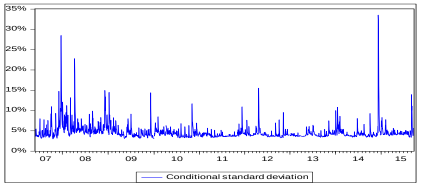


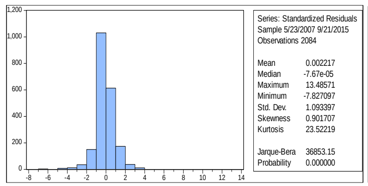


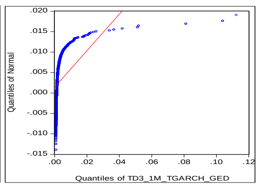
TARCH (1,1)_X_GED

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1) + C(6)*SPREAD_TD3_S_1M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.00000319	0.000294	0.010857	0.9913
	Variance Equation			
C	0.000708	0.000125	5.672066	0
RESID(-1)^2	0.296022	0.069666	4.249186	0
RESID(-1)^2*(RESID(-	-0.165764	0.068228	-2.429554	0.0151
GARCH(-1)	4.85E-01	0.069939	6.937256	0
SPREAD_TD3_S_1M	0.000933	0.000283	3.293992	0.001
GED PARAMETER	0.801931	0.026759	29.96876	0
R-squared	-0.000002	Mean dependent var		-6.68E-05
Adjusted R-squared	-0.000002	S.D. dependent var		0.054316
S.E. of regression	0.054316	Akaike info criterion		-3.749569
Sum squared resid	6.145358	Schwarz criterion		-3.730618
Log likelihood	3914.051	Hannan-Quinn criter.		-3.742625
Durbin-Watson stat	2.105479			





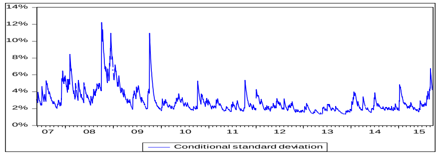


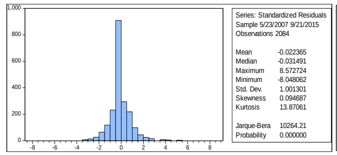
TD3 3 Months

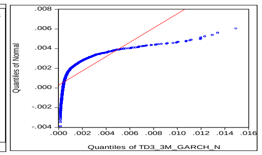
GARCH (1,1)_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000714	0.000488	1.465351	0.1428
	Variance Equation			
C	1.55E-05	1.49E-06	10.40957	0
RESID(-1)^2	9.97E-02	0.005186	19.22635	0
GARCH(-1)	0.895645	0.005374	166.6638	0
R-squared	-0.000646	Mean dependent var		-7.30E-05
Adjusted R-squarec	-0.000646	S.D. dependent var		0.030984
S.E. of regression	0.030994	Akaike info criterion		-4.40777
Sum squared resid	2.001012	Schwarz criterion		-4.396941
Log likelihood	4596.896	Hannan-Quinn criter.		-4.403802
Durbin-Watson stat	1.925357			



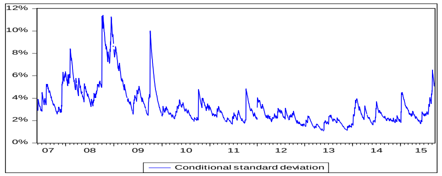


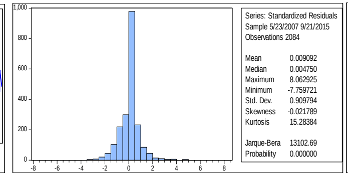


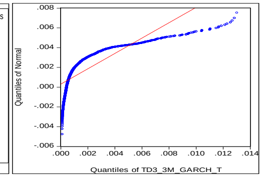
GARCH (1,1)_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.00012	0.000351	-0.340508	0.7335
	Variance Equation			
C	2.43E-06	1.79E-06	1.356239	0.175
RESID(-1)^2	0.078466	0.019621	3.999112	0.0001
GARCH(-1)	0.944248	0.007132	132.3943	0
T-DIST. DOF	2.54658	0.165776	15.36154	0
R-squared	-0.000002	Mean dependent var		-7.30E-05
Adjusted R-squarec	-0.000002	S.D. dependent var		0.030984
S.E. of regression	0.030984	Akaike info criterion		-4.775682
Sum squared resid	1.999725	Schwarz criterion		-4.762145
Log likelihood	4981.261	Hannan-Quinn criter.		-4.770722
Durbin-Watson stat	1.926597			



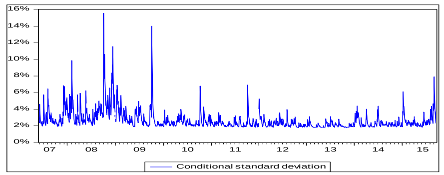


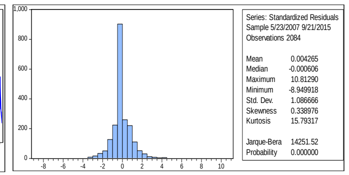


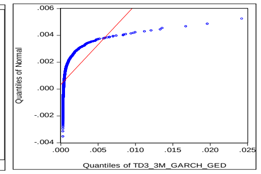
GARCH (1,1)_GED

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.0000134	0.000291	0.045885	0.9634
	Variance Equation			
C	9.87E-05	1.76E-05	5.611666	0
RESID(-1)^2	0.175731	0.029672	5.92E+00	0
GARCH(-1)	0.686303	0.038739	17.71611	0
GED PARAMETER	0.876787	0.025417	34.49593	0
R-squared	-0.000008	Mean dependent var		-7.30E-05
Adjusted R-squarec	-0.000008	S.D. dependent var		0.030984
S.E. of regression	0.030984	Akaike info criterion		-4.896717
Sum squared resid	1.999736	Schwarz criterion		-4.883181
Log likelihood	5107.38	Hannan-Quinn criter.		-4.891757
Durbin-Watson stat	1.926586			



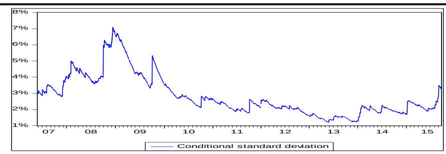


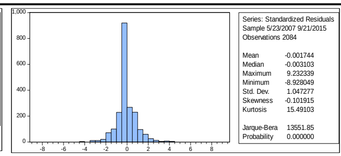


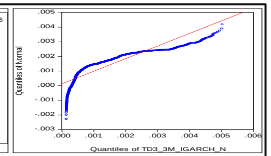
IGARCH (1,1)_N

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.0000673	0.000452	0.148884	0.8816
	Variance Equation			
RESID(-1)^2	0.014887	0.000467	31.90321	0
GARCH(-1)	0.985113	0.000467	2111.073	0
R-squared	-0.000021	Mean dependent var		-7.30E-05
Adjusted R-squarec	-0.000021	S.D. dependent var		0.030984
S.E. of regression	0.030984	Akaike info criterion		-4.371154
Sum squared resid	1.999761	Schwarz criterion		-4.365739
Log likelihood	4556.743	Hannan-Quinn criter.		-4.36917
Durbin-Watson stat	1.926562			



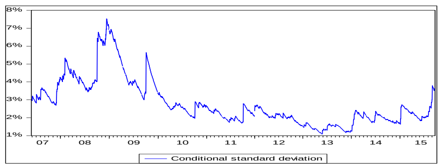


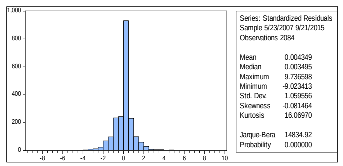


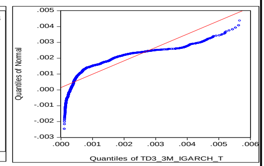
IGARCH (1,1)_T

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.0000749	0.000351	-0.21371	0.8308
	Variance Equation			
RESID(-1)^2	0.019249	0.002555	7.533839	0
GARCH(-1)	0.980751	0.002555	383.8605	0
T-DIST. DOF	2.783178	0.054347	51.21091	0
R-squared	0	Mean dependent var		-7.30E-05
Adjusted R-squarec	0	S.D. dependent var		0.030984
S.E. of regression	0.030984	Akaike info criterion		-4.769338
Sum squared resid	1.99972	Schwarz criterion		-4.761216
Log likelihood	4972.651	Hannan-Quinn criter.		-4.766362
Durbin-Watson stat	1.926601			



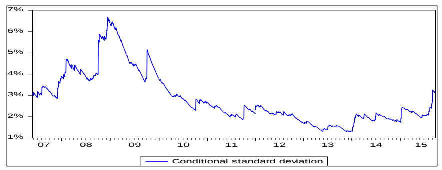


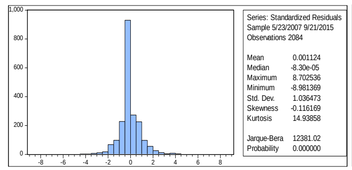


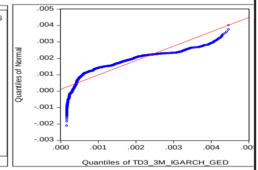
IGARCH (1,1)_GED

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.00000179	0.0000947	0.018949	0.9849
	Variance Equation			
RESID(-1)^2	1.16E-02	0.001822	6.378588	0
GARCH(-1)	0.988376	0.001822	542.3855	0
GED PARAMETER	0.744713	0.027426	27.15402	0
R-squared	-0.000006	Mean dependent var		-7.30E-05
Adjusted R-squarec	-0.000006	S.D. dependent var		0.030984
S.E. of regression	0.030984	Akaike info criterion		-5.024694
Sum squared resid	1.999732	Schwarz criterion		-5.016572
Log likelihood	5238.731	Hannan-Quinn criter.		-5.021718
Durbin-Watson stat	1.92659			



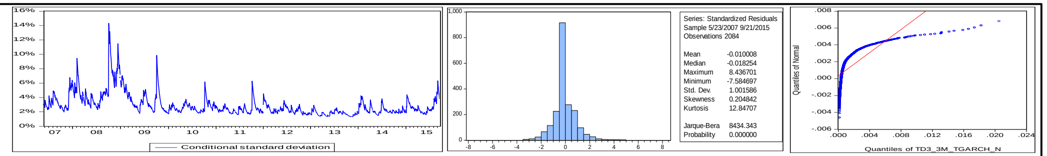




(GJR)TGARCH (1,1)_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1)

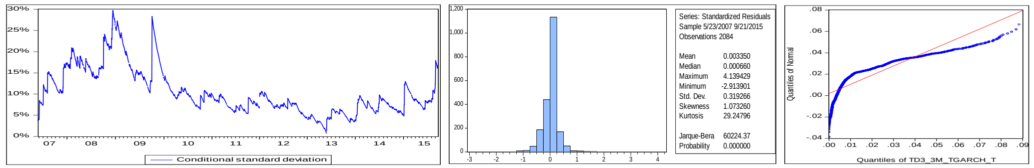
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000415	0.000511	0.81262	0.4164
	Variance Equation			
C	1.64E-05	1.72E-06	9.540286	0
RESID(-1)^2	0.07802	0.005881	13.26694	0
RESID(-1)^2*(RESID	0.062713	0.009038	6.939174	0
GARCH(-1)	0.887659	0.005673	156.4658	0
R-squared	-0.000248	Mean dependent var		-7.30E-05
Adjusted R-squarec	-0.000248	S.D. dependent var		0.030984
S.E. of regression	0.030988	Akaike info criterion		-4.411384
Sum squared resid	2.000217	Schwarz criterion		-4.397847
Log likelihood	4601.662	Hannan-Quinn criter.		-4.406424
Durbin-Watson stat	1.926123			



(GJR)TGARCH (1,1)_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1)

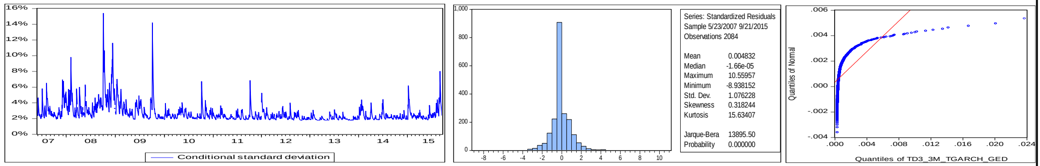
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.0000519	0.000324	-0.160087	0.8728
	Variance Equation			
C	-2.91E-05	3.02E-05	-0.96444	0.3348
RESID(-1)^2	5.96E-01	6.34E-01	0.939803	0.3473
RESID(-1)^2*(RESID	-0.367012	0.404271	-0.907836	0.364
GARCH(-1)	0.974765	0.003132	311.2639	0
T-DIST. DOF	2.036696	0.038953	52.28563	0
R-squared	0	Mean dependent var		-7.30E-05
Adjusted R-squarec	0	S.D. dependent var		3.10E-02
S.E. of regression	0.030984	Akaike info criterion		-4.79397
Sum squared resid	1.999721	Schwarz criterion		-4.777727
Log likelihood	5001.317	Hannan-Quinn criter.		-4.788018
Durbin-Watson stat	1.9266			



(GJR)TGARCH (1,1)_ged

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1)

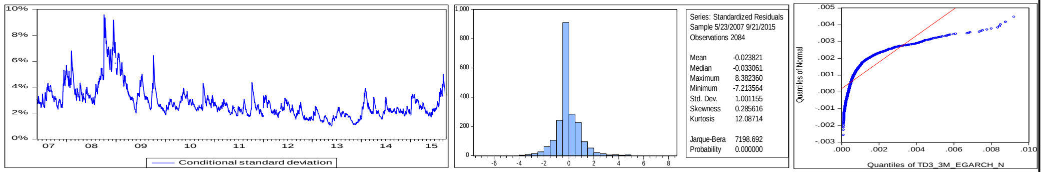
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000000368	0.0004	0.00092	0.9993
	Variance Equation			
C	9.29E-05	1.72E-05	5.392186	0
RESID(-1)^2	0.17966	0.038978	4.609297	0
RESID(-1)^2*(RESID	-0.008249	0.04329	-0.190556	0.8489
GARCH(-1)	0.70041	0.038414	18.23296	0
GED PARAMETER	0.854163	0.020784	41.09626	0
R-squared	-0.000006	Mean dependent var		-7.30E-05
Adjusted R-squarec	-0.000006	S.D. dependent var		0.030984
S.E. of regression	0.030984	Akaike info criterion		-4.91352
Sum squared resid	1.999732	Schwarz criterion		-4.897277
Log likelihood	5125.888	Hannan-Quinn criter.		-4.907568
Durbin-Watson stat	1.92659			



EGARCH (1,1)_N

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

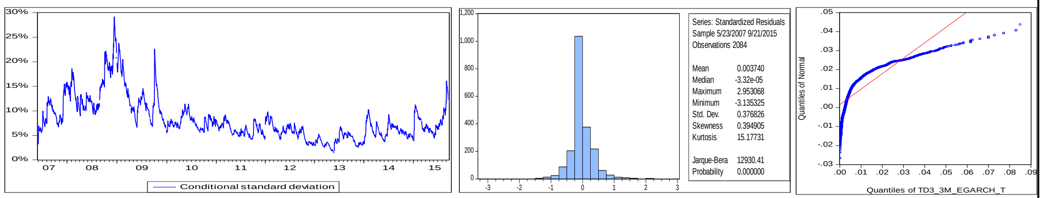
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000776	0.00039	1.99209	0.0464
	Variance Equation			
C(2)	-0.245111	0.018779	-13.05271	0
C(3)	0.165399	0.008564	19.314	0
C(4)	-0.031648	0.004999	-6.330456	0
C(5)	0.980467	0.002196	446.5464	0
R-squared	-0.000752	Mean dependent var		-7.30E-05
Adjusted R-squarec	-0.000752	S.D. dependent var		0.030984
S.E. of regression	0.030996	Akaike info criterion		-4.42654
Sum squared resid	2.001224	Schwarz criterion		-4.413004
Log likelihood	4617.455	Hannan-Quinn criter.		-4.42158
Durbin-Watson stat	1.925154			



EGARCH (1,1)_T

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4) *RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

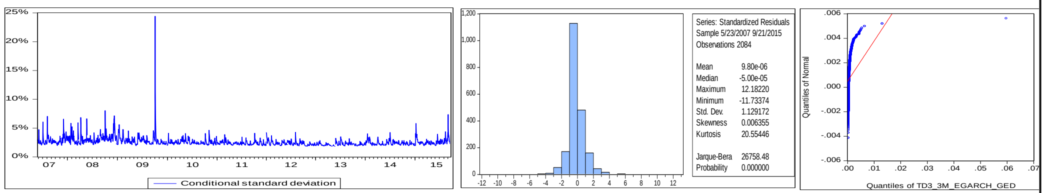
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.00000213	0.000322	0.006604	0.9947
	Variance Equation			
C(2)	-0.104483	0.017517	-5.964501	0
C(3)	0.430423	0.156795	2.745144	0.006
C(4)	0.083576	0.047702	1.752067	0.0798
C(5)	0.998041	0.002463	405.1519	0
T-DIST. DOF	2.060202	0.042666	48.28664	0
R-squared	-0.000006	Mean dependent var		-7.30E-05
Adjusted R-squarec	-0.000006	S.D. dependent var		0.030984
S.E. of regression	0.030984	Akaike info criterion		-4.804487
Sum squared resid	1.999732	Schwarz criterion		-4.788243
Log likelihood	5012.275	Hannan-Quinn criter.		-4.798535
Durbin-Watson stat	1.92659			



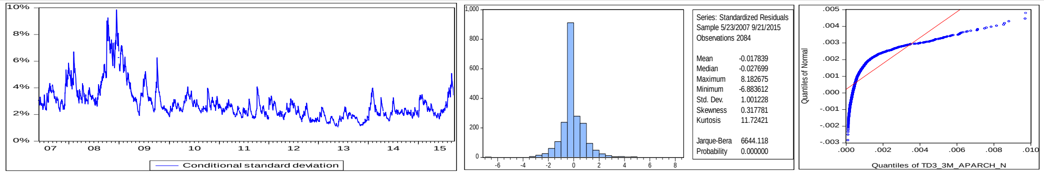
EGARCH (1,1)_GED

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

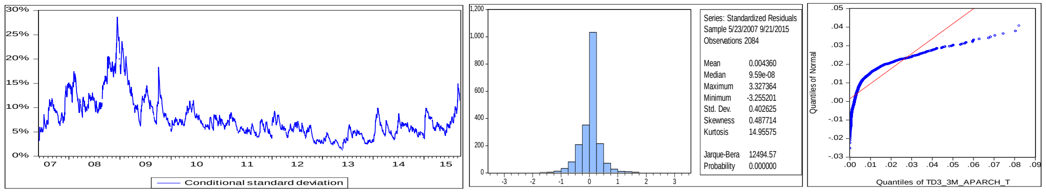
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.00000117	0.000151	0.007763	0.9938
	Variance Equation			
C(2)	-2.356589	0.397138	-5.93393	0
C(3)	0.284907	0.043656	6.526214	0
C(4)	0.095628	0.030063	3.180913	0.0015
C(5)	0.705185	0.052311	13.48057	0
GED PARAMETER	0.800566	0.027802	28.79562	0
R-squared	-0.000006	Mean dependent var		-7.30E-05
Adjusted R-squarec	-0.000006	S.D. dependent var		0.030984
S.E. of regression	0.030984	Akaike info criterion		-4.922236
Sum squared resid	1.999732	Schwarz criterion		-4.905992
Log likelihood	5134.97	Hannan-Quinn criter.		-4.916284
Durbin-Watson stat	1.92659			



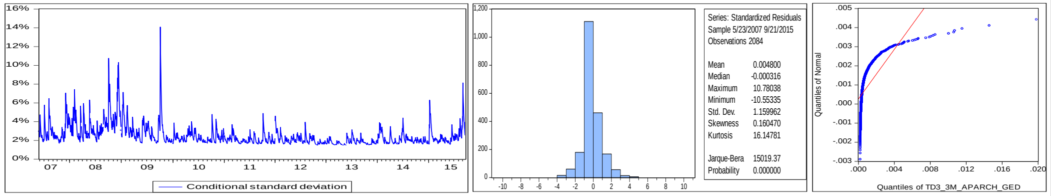
APARCH (1,1)_N				
@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000645	0.000474	1.36126	0.1734
	Variance Equation			
C(2)	0.000573	1.52E-04	3.78E+00	0.0002
C(3)	0.095669	0.00528	18.12038	0
C(4)	0.191217	0.033331	5.737005	0
C(5)	0.919991	0.004711	1.95E+02	0
C(6)	0.998538	0.068254	14.62967	0
R-squared	-0.000537	Mean dependent var		-7.30E-05
Adjusted R-squarec	-0.000537	S.D. dependent var		0.030984
S.E. of regression	0.030992	Akaike info criterion		-4.431074
Sum squared resid	2.000794	Schwarz criterion		-4.41483
Log likelihood	4623.179	Hannan-Quinn criter.		-4.425122
Durbin-Watson stat	1.925567			



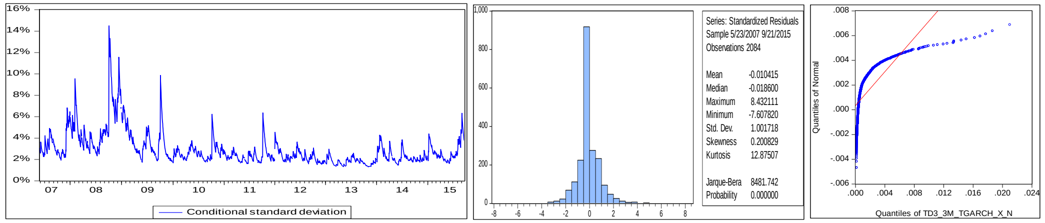
APARCH (1,1)_T				
@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-5.71E-09	0.000321	-0.0000178	1
	Variance Equation			
C(2)	0.000203	0.00034	0.595983	0.5512
C(3)	0.201509	0.069599	2.895296	0.0038
C(4)	-0.233759	0.099549	-2.348183	0.0189
C(5)	0.949014	0.006416	147.9137	0
C(6)	0.903258	0.123856	7.292826	0
T-DIST. DOF	2.067891	0.043881	47.12531	0
R-squared	-0.000006	Mean dependent var		-7.30E-05
Adjusted R-squarec	-0.000006	S.D. dependent var		0.030984
S.E. of regression	0.030984	Akaike info criterion		-4.80526
Sum squared resid	1.999731	Schwarz criterion		-4.786309
Log likelihood	5014.081	Hannan-Quinn criter.		-4.798316
Durbin-Watson stat	1.92659			



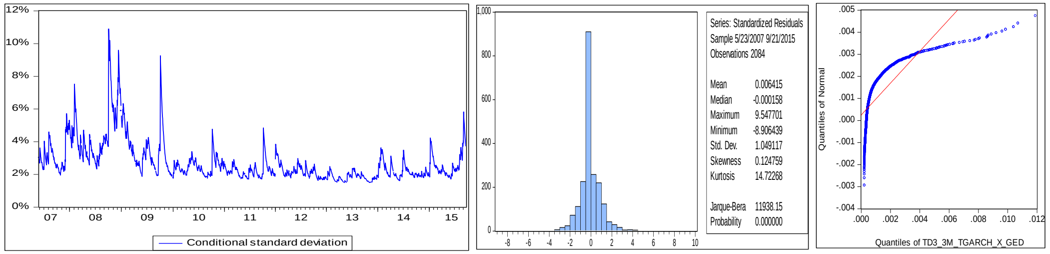
APARCH (1,1)_GED				
@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.00000648	0.000218	0.029736	0.9763
	Variance Equation			
C(2)	0.000126	0.000122	1.030077	0.303
C(3)	0.149326	0.024969	5.980518	0
C(4)	-0.196849	0.063701	-3.0902	0.002
C(5)	0.752624	0.032984	22.81794	0
C(6)	1.802955	0.257714	6.99595	0
GED PARAMETER	0.840156	0.025966	32.35596	0
R-squared	-0.000007	Mean dependent var		-7.30E-05
Adjusted R-squarec	-0.000007	S.D. dependent var		0.030984
S.E. of regression	0.030984	Akaike info criterion		-4.93336
Sum squared resid	1.999734	Schwarz criterion		-4.914409
Log likelihood	5147.561	Hannan-Quinn criter.		-4.926416
Durbin-Watson stat	1.926589			



TARCH (1,1)_X_N				
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1) + C(6)*SPREAD_TD3_S_3M				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000425	0.000511	0.832214	0.4053
	Variance Equation			
C	1.66E-05	1.80E-06	9.229982	0
RESID(-1)^2	0.078037	0.005931	13.1566	0
RESID(-1)^2*(RESID	0.066251	0.009798	6.762057	0
GARCH(-1)	8.86E-01	0.005879	150.7511	0
SPREAD_TD3_S_3M	4.14E-06	3.69E-06	1.122963	0.2615
R-squared	-0.000259	Mean dependent var		-7.30E-05
Adjusted R-squarec	-0.000259	S.D. dependent var		0.030984
S.E. of regression	0.030988	Akaike info criterion		-4.41E+00
Sum squared resid	2.000237	Schwarz criterion		-4.39433
Log likelihood	4601.818	Hannan-Quinn criter.		-4.404622
Durbin-Watson stat	1.926103			



TARCH (1,1)_X_GED				
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1) + C(6)*SPREAD_TD3_S_3M				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.00000347	0.000241	0.0144	0.9885
	Variance Equation			
C	2.05E-05	5.20E-06	3.944495	0.0001
RESID(-1)^2	0.069735	0.015358	4.540539	0
RESID(-1)^2*(RESID	0.009527	0.021276	0.447788	0.6543
GARCH(-1)	0.8977	0.016635	53.96514	0
SPREAD_TD3_S_3M	4.13E-06	9.90E-06	0.417041	0.6766
GED PARAMETER	0.855063	0.028348	30.1632	0
R-squared	-0.000006	Mean dependent var		-7.30E-05
Adjusted R-squarec	-0.000006	S.D. dependent var		0.030984
S.E. of regression	0.030984	Akaike info criterion		-4.932643
Sum squared resid	1.999733	Schwarz criterion		-4.913692
Log likelihood	5146.814	Hannan-Quinn criter.		-4.925699
Durbin-Watson stat	1.926589			

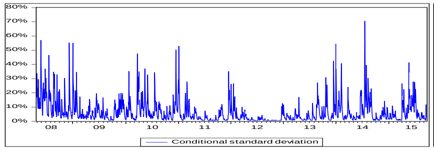


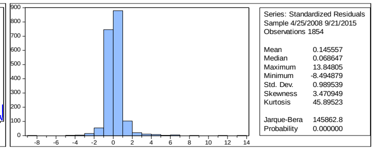
TD7 Spot

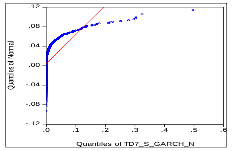
GARCH (1,1)_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.001891	0.000103	-18.3817	0
	Variance Equation			
C	1.28E-05	1.11E-06	11.53448	0
RESID(-1)^2	2.582875	0.074244	34.78912	0
GARCH(-1)	0.425663	0.005739	74.16764	0
R-squared	-0.00081	Mean dependent var		-0.000519
Adjusted R-squarec	-0.00081	S.D. dependent var		0.048226
S.E. of regression	0.048245	Akaike info criterion		-3.791948
Sum squared resid	4.313033	Schwarz criterion		-3.780027
Log likelihood	3519.136	Hannan-Quinn criter.		-3.787554
Durbin-Watson stat	1.121595			



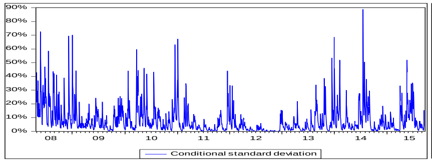


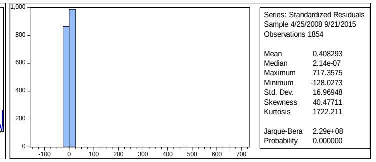


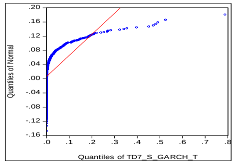
GARCH (1,1)_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-4.3E-09	0.0000275	-0.000157	0.9999
	Variance Equation			
C	6.19E-12	9.84E-12	0.628927	0.5294
RESID(-1)^2	4.144062	1.725866	2.401149	0.0163
GARCH(-1)	0.409869	0.010191	40.2172	0
T-DIST. DOF	2.177493	0.084283	25.83554	0
R-squared	-0.000116	Mean dependent var		-5.19E-04
Adjusted R-squarec	-0.000116	S.D. dependent var		0.048226
S.E. of regression	0.048228	Akaike info criterion		-4.887169
Sum squared resid	4.310039	Schwarz criterion		-4.872269
Log likelihood	4535.406	Hannan-Quinn criter.		-4.881677
Durbin-Watson stat	1.122375			



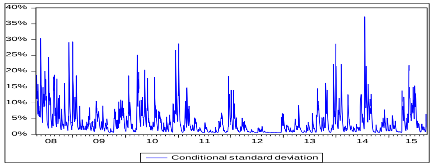


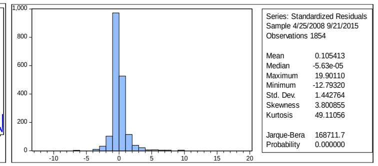


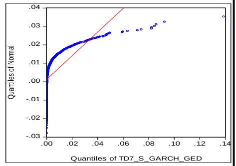
GARCH (1,1)_GED

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000000374	0.000023	0.016254	0.987
	Variance Equation			
C	1.92E-05	3.26E-06	5.885711	0
RESID(-1)^2	0.721571	0.074027	9.75E+00	0
GARCH(-1)	0.534377	0.022144	24.13145	0
GED PARAMETER	0.678185	0.018448	36.76209	0
R-squared	-0.000116	Mean dependent var		-5.19E-04
Adjusted R-squarec	-0.000116	S.D. dependent var		0.048226
S.E. of regression	0.048228	Akaike info criterion		-4.834851
Sum squared resid	4.31004	Schwarz criterion		-4.81995
Log likelihood	4486.906	Hannan-Quinn criter.		-4.829358
Durbin-Watson stat	1.122374			

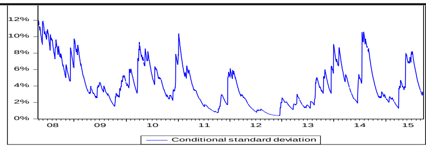


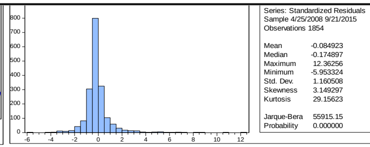


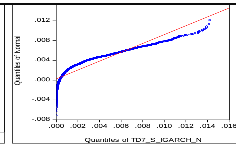


GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.003597	0.0000761	47.25332	0
	Variance Equation			
RESID(-1)^2	0.048313	0.000425	113.6394	0
GARCH(-1)	0.951687	0.000425	2238.512	0
R-squared	-0.007289	Mean dependent var		-5.19E-04
Adjusted R-squarec	-0.007289	S.D. dependent var		0.048226
S.E. of regression	0.048401	Akaike info criterion		-3.578445
Sum squared resid	4.340951	Schwarz criterion		-3.572485
Log likelihood	3319.219	Hannan-Quinn criter.		-3.576249
Durbin-Watson stat	1.114382			



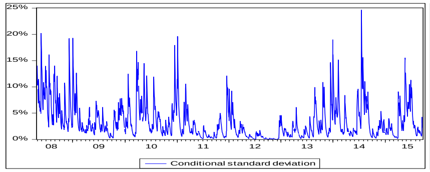


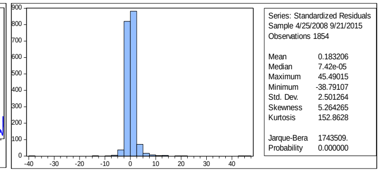


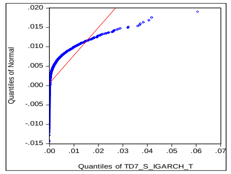
IGARCH (1,1)_T

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000000917	0.0000911	-0.010071	0.992
	Variance Equation			
RESID(-1)^2	0.310848	0.007689	40.42518	0
GARCH(-1)	0.689152	0.007689	89.62286	0
T-DIST. DOF	2.87119	0.067426	42.58295	0
R-squared	-0.000115	Mean dependent var		-5.19E-04
Adjusted R-squarec	-0.000115	S.D. dependent var		0.048226
S.E. of regression	0.048228	Akaike info criterion		-4.704537
Sum squared resid	4.310038	Schwarz criterion		-4.695597
Log likelihood	4364.106	Hannan-Quinn criter.		-4.701242
Durbin-Watson stat	1.122375			



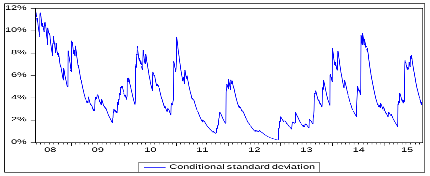


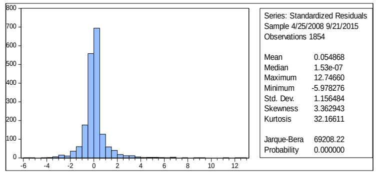


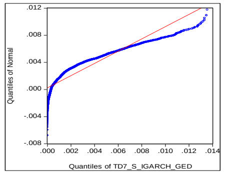
IGARCH (1,1)_GED

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-6.03E-09	0.000000562	-0.010724	0.9914
	Variance Equation			
RESID(-1)^2	3.79E-02	0.002908	13.02903	0
GARCH(-1)	0.962116	0.002908	330.8863	0
GED PARAMETER	0.501617	0.014384	34.87337	0
R-squared	-0.000116	Mean dependent var		-5.19E-04
Adjusted R-squarec	-0.000116	S.D. dependent var		0.048226
S.E. of regression	0.048228	Akaike info criterion		-4.792953
Sum squared resid	4.310039	Schwarz criterion		-4.784013
Log likelihood	4446.068	Hannan-Quinn criter.		-4.789658
Durbin-Watson stat	1.122375			



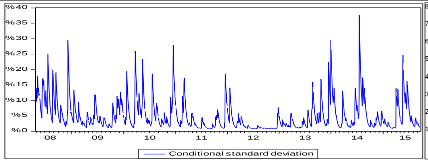


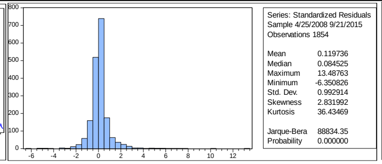


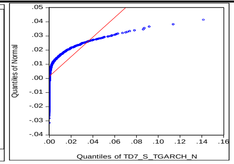
(GJR)TGARCH (1,1)_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.002269	0.000446	-5.092425	0
	Variance Equation			
C	1.31E-05	2.07E-06	6.335247	0
RESID(-1)^2	0.706539	0.026054	27.11813	0
RESID(-1)^2*(RESID	-0.695831	0.026027	-26.73493	0
GARCH(-1)	0.803891	0.002463	326.3222	0
R-squared	-0.001318	Mean dependent var		-5.19E-04
Adjusted R-squarec	-0.001318	S.D. dependent var		0.048226
S.E. of regression	0.048257	Akaike info criterion		-3.882958
Sum squared resid	4.315219	Schwarz criterion		-3.868058
Log likelihood	3604.502	Hannan-Quinn criter.		-3.877466
Durbin-Watson stat	1.121027			



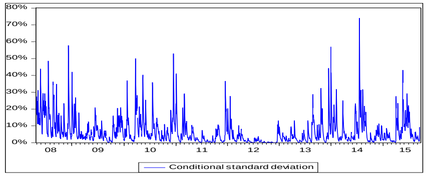


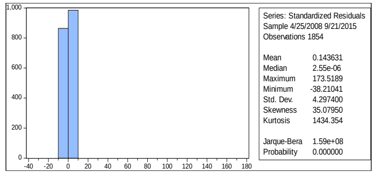


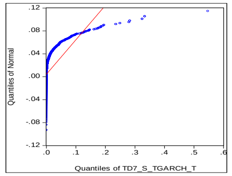
(GJR)TGARCH (1,1)_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-4.44E-08	0.0000883	-0.000503	0.9996
	Variance Equation			
C	7.31E-11	9.09E-11	0.804187	0.4213
RESID(-1)^2	2.85054	0.860601	3.312267	0.0009
RESID(-1)^2*(RESID	-1.367647	0.453496	-3.015789	0.0026
GARCH(-1)	0.51659	0.011094	46.5654	0
T-DIST. DOF	2.253798	0.09363	24.07145	0
R-squared	-0.000116	Mean dependent var		-5.19E-04
Adjusted R-squarec	-0.000116	S.D. dependent var		0.048226
S.E. of regression	0.048228	Akaike info criterion		-4.874444
Sum squared resid	4.310039	Schwarz criterion		-4.856563
Log likelihood	4524.609	Hannan-Quinn criter.		-4.867853
Durbin-Watson stat	1.122375			



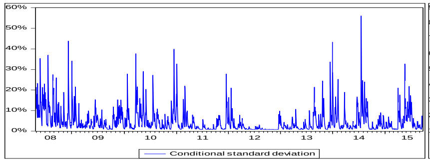


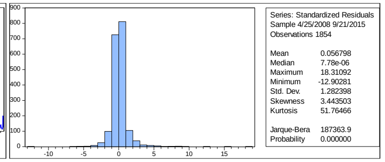


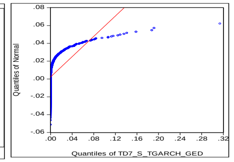
(GJR)TGARCH (1,1)_ged

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000000102	0.00000716	-0.014315	0.9886
	Variance Equation			
C	3.63E-05	7.32E-06	4.962652	0
RESID(-1)^2	1.650506	0.206458	7.994391	0
RESID(-1)^2*(RESID	-0.671525	0.21253	-3.159677	0.0016
GARCH(-1)	0.411221	0.029328	14.02143	0
GED PARAMETER	0.594246	0.019267	30.84313	0
R-squared	-0.000116	Mean dependent var		-0.000519
Adjusted R-squarec	-0.000116	S.D. dependent var		0.048226
S.E. of regression	0.048228	Akaike info criterion		-4.901576
Sum squared resid	4.310039	Schwarz criterion		-4.883696
Log likelihood	4549.761	Hannan-Quinn criter.		-4.894986
Durbin-Watson stat	1.122375			



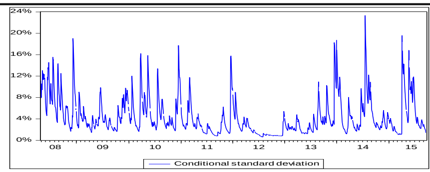


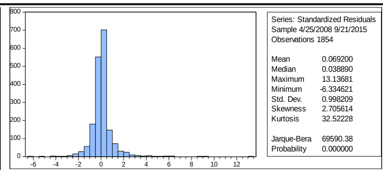


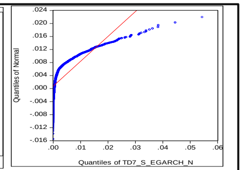
EGARCH (1,1)_N

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4) *RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.001079	0.000211	-5.111854	0
	Variance Equation			
C(2)	-0.257959	0.00901	-28.63095	0
C(3)	0.185013	0.006262	29.54723	0
C(4)	0.240047	0.004564	52.59609	0
C(5)	0.979545	0.001465	668.5096	0
R-squared	-0.000135	Mean dependent var		-5.19E-04
Adjusted R-squarec	-0.000135	S.D. dependent var		0.048226
S.E. of regression	0.048229	Akaike info criterion		-3.923002
Sum squared resid	4.310122	Schwarz criterion		-3.908101
Log likelihood	3641.622	Hannan-Quinn criter.		-3.917509
Durbin-Watson stat	1.122353			



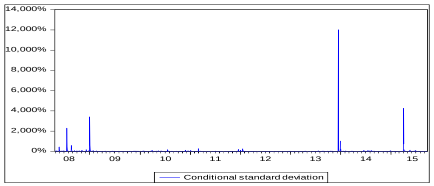


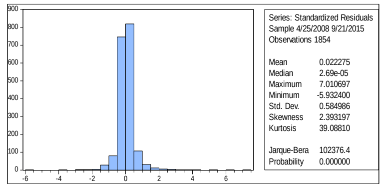


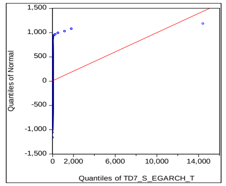
EGARCH (1,1)_T

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000000973	0.000248	-0.003933	0.9969
	Variance Equation			
C(2)	-1.888126	0.229494	-8.227336	0
C(3)	2.311371	1.127756	2.049531	0.0404
C(4)	0.055146	0.079465	0.693963	0.4877
C(5)	0.779474	0.013439	57.99992	0
T-DIST. DOF	2.07901	0.082099	25.32328	0
R-squared	-0.000115	Mean dependent var		-5.19E-04
Adjusted R-squarec	-0.000115	S.D. dependent var		0.048226
S.E. of regression	0.048228	Akaike info criterion		-4.685098
Sum squared resid	4.310038	Schwarz criterion		-4.667218
Log likelihood	4349.086	Hannan-Quinn criter.		-4.678508
Durbin-Watson stat	1.122375			



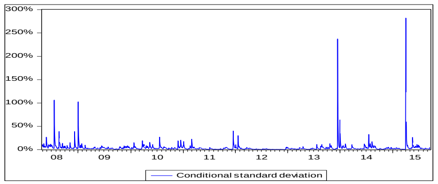


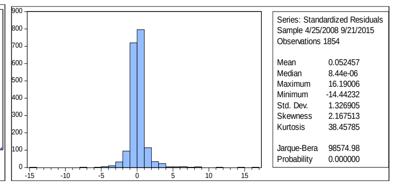


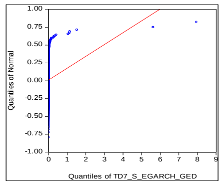
EGARCH (1,1)_GED

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4) *RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000000141	0.0000128	-0.01107	0.9912
	Variance Equation			
C(2)	-1.385532	0.104085	-13.31148	0
C(3)	0.627229	0.04441	14.12371	0
C(4)	0.07908	0.030032	2.633166	0.0085
C(5)	0.867218	0.012047	71.98758	0
GED PARAMETER	0.63823	0.020443	31.2204	0
R-squared	-0.000116	Mean dependent var		-0.000519
Adjusted R-squarec	-0.000116	S.D. dependent var		0.048226
S.E. of regression	0.048228	Akaike info criterion		-4.82675
Sum squared resid	4.310039	Schwarz criterion		-4.808869
Log likelihood	4480.397	Hannan-Quinn criter.		-4.820159
Durbin-Watson stat	1.122375			



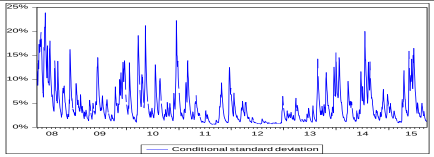


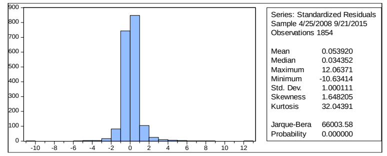


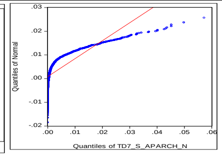
APARCH (1,1)_N

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.00085	0.000109	-7.795069	0
	Variance Equation			
C(2)	0.001813	2.28E-04	7.96E+00	0
C(3)	0.182714	0.004668	39.13938	0
C(4)	-0.910145	0.01253	-72.63476	0
C(5)	0.892204	0.002474	3.61E+02	0
C(6)	0.647681	0.020696	31.29555	0
R-squared	-0.000047	Mean dependent var		-5.19E-04
Adjusted R-squarec	-0.000047	S.D. dependent var		0.048226
S.E. of regression	0.048227	Akaike info criterion		-3.96897
Sum squared resid	4.309744	Schwarz criterion		-3.95109
Log likelihood	3685.236	Hannan-Quinn criter.		-3.96238
Durbin-Watson stat	1.122452			



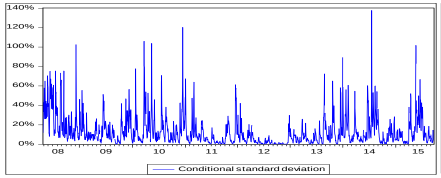


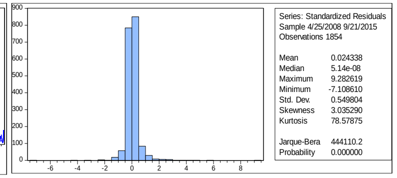


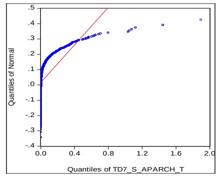
Dependent Variable: DLOG(TD7__DS)

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-2.02E-09	0.00000163	-0.001241	0.999
	Variance Equation			
C(2)	0.010616	0.004518	2.349759	0.0188
C(3)	1.244899	0.41371	3.00911	0.0026
C(4)	-0.295276	0.039771	-7.424355	0
C(5)	0.563825	0.019058	29.58393	0
C(6)	0.608111	0.077852	7.811074	0
T-DIST. DOF	2.05189	0.052431	39.13506	0
R-squared	-0.000116	Mean dependent var		-5.19E-04
Adjusted R-squarec	-0.000116	S.D. dependent var		0.048226
S.E. of regression	0.048228	Akaike info criterion		-4.905556
Sum squared resid	4.310039	Schwarz criterion		-4.884695
Log likelihood	4554.45	Hannan-Quinn criter.		-4.897867
Durbin-Watson stat	1.122374			



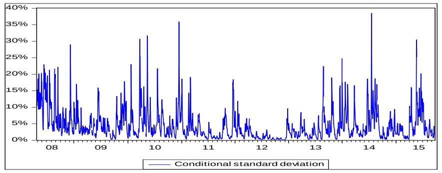


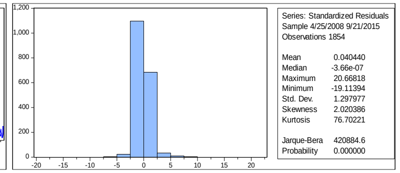


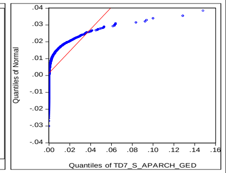
APARCH (1,1)_GED

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	1.17E-09	0.000000391	0.003004	0.9976
	Variance Equation			
C(2)	0.012786	0.004413	2.897204	0.0038
C(3)	0.516937	0.051441	10.04909	0
C(4)	-0.352238	0.056811	-6.200159	0
C(5)	0.606239	0.021403	28.32509	0
C(6)	0.542257	0.062813	8.632895	0
GED PARAMETER	0.555627	0.0177	31.39098	0
R-squared	-0.000116	Mean dependent var		-5.19E-04
Adjusted R-squarec	-0.000116	S.D. dependent var		0.048226
S.E. of regression	0.048228	Akaike info criterion		-5.044633
Sum squared resid	4.310039	Schwarz criterion		-5.023772
Log likelihood	4683.375	Hannan-Quinn criter.		-5.036944
Durbin-Watson stat	1.122374			



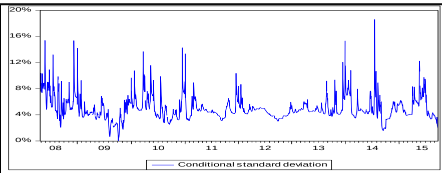


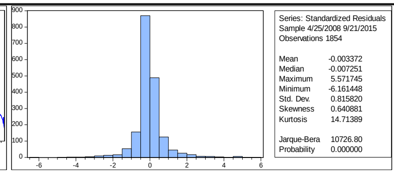


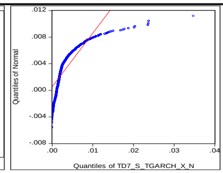
TARCH (1,1)_X_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1) + C(6)*SPREAD_TD7_S_TD7_3M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.00025	0.001647	0.15187	0.8793
	Variance Equation			
C	1.21E-03	9.50E-05	12.6963	0
RESID(-1)^2	0.160746	0.022435	7.164818	0
RESID(-1)^2*(RESID	-0.013777	0.040474	-0.340383	0.7336
GARCH(-1)	0.412332	0.043303	9.522014	0
SPREAD_TD7_S_TD7	3.33E-03	2.47E-04	13.49378	0
R-squared	-0.000254	Mean dependent var		-5.19E-04
Adjusted R-squarec	-0.000254	S.D. dependent var		0.048226
S.E. of regression	0.048232	Akaike info criterion		-3.605314
Sum squared resid	4.310637	Schwarz criterion		-3.587433
Log likelihood	3348.126	Hannan-Quinn criter.		-3.598723
Durbin-Watson stat	1.122219			



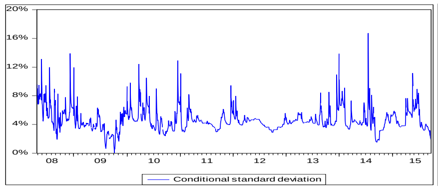


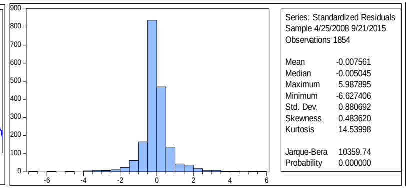


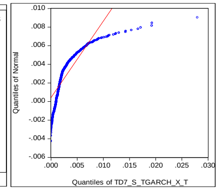
TARCH (1,1)_X_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1) + C(6)*SPREAD_TD7_S_TD7_3M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000165	0.00147	0.112054	0.9108
	Variance Equation			
C	1.14E-03	1.20E-04	9.488801	0
RESID(-1)^2	0.127447	0.0283	4.50346	0
RESID(-1)^2*(RESID	-0.0275	0.04211	-0.653043	0.5137
GARCH(-1)	0.3786	0.060863	6.220531	0
SPREAD_TD7_S_TD7	3.13E-03	0.000316	9.923944	0
T-DIST. DOF	19.96051	2.720451	7.337207	0
R-squared	-0.000201	Mean dependent var		-5.19E-04
Adjusted R-squarec	-0.000201	S.D. dependent var		0.048226
S.E. of regression	0.04823	Akaike info criterion		-3.756479
Sum squared resid	4.310407	Schwarz criterion		-3.735618
Log likelihood	3489.256	Hannan-Quinn criter.		-3.74879
Durbin-Watson stat	1.122279			



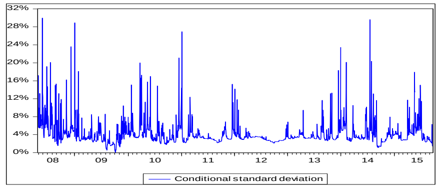


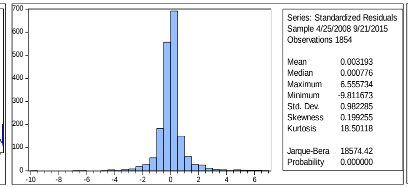


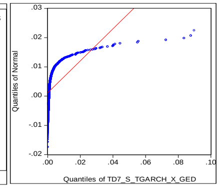
TARCH (1,1)_X_GED

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1) + C(6)*SPREAD_TD7_S_TD7_3M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000025	0.0000612	-0.40892	0.6826
	Variance Equation			
C	9.40E-04	9.50E-05	9.888107	0
RESID(-1)^2	0.461498	0.136591	3.378686	0.0007
RESID(-1)^2*(RESID	0.233771	0.221621	1.05482	0.2915
GARCH(-1)	7.28E-02	0.049307	1.476658	0.1398
SPREAD_TD7_S_TD7	2.56E-03	2.47E-04	10.35917	0
GED PARAMETER	0.566409	0.021453	26.40245	0
R-squared	-0.000105	Mean dependent var		-5.19E-04
Adjusted R-squarec	-0.000105	S.D. dependent var		0.048226
S.E. of regression	0.048228	Akaike info criterion		-4.66936
Sum squared resid	4.309993	Schwarz criterion		-4.648499
Log likelihood	4335.496	Hannan-Quinn criter.		-4.661671





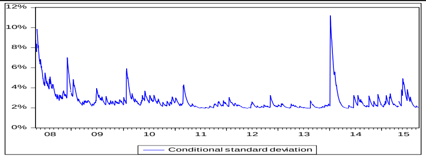


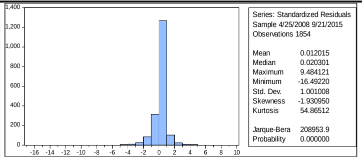
TD7 1 Month

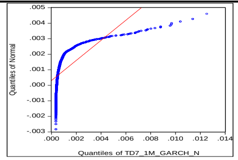
GARCH (1,1)_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.00047	0.000526	-0.893943	0.3714
	Variance Equation			
C	3.46E-05	2.42E-06	14.28669	0
RESID(-1)^2	4.86E-02	3.07E-03	15.8286	0
GARCH(-1)	0.90639	0.005607	161.6572	0
R-squared	-0.000101	Mean dependent var		-1.69E-04
Adjusted R-squarec	-0.000101	S.D. dependent var		0.029935
S.E. of regression	0.029937	Akaike info criterion		-4.450277
Sum squared resid	1.660704	Schwarz criterion		-4.438356
Log likelihood	4129.406	Hannan-Quinn criter.		-4.445883
Durbin-Watson stat	2.254598			



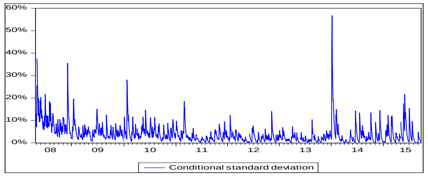


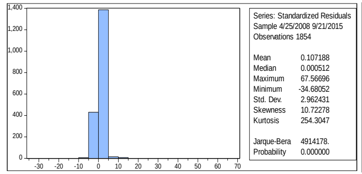


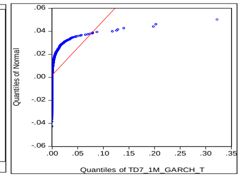
GARCH (1,1)_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.0000124	0.000146	-0.084807	0.9324
	Variance Equation			
C	2.02E-07	2.16E-07	0.935203	0.3497
RESID(-1)^2	1.518297	1.5514	0.978662	0.3277
GARCH(-1)	0.629035	0.008189	76.8103	0
T-DIST. DOF	2.043907	0.046591	43.86936	0
R-squared	-0.000027	Mean dependent var		-1.69E-04
Adjusted R-squarec	-0.000027	S.D. dependent var		0.029935
S.E. of regression	0.029936	Akaike info criterion		-5.883657
Sum squared resid	1.660581	Schwarz criterion		-5.868756
Log likelihood	5459.15	Hannan-Quinn criter.		-5.878165
Durbin-Watson stat	2.254765			



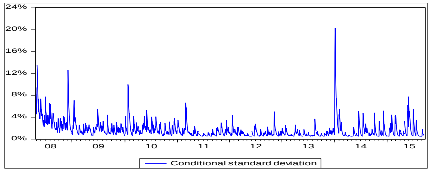


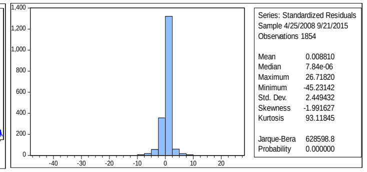


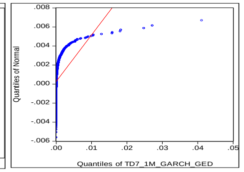
GARCH (1,1)_GED

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-8.47E-08	0.00000453	-0.018699	0.9851
	Variance Equation			
C	9.12E-06	1.01E-06	9.043745	0
RESID(-1)^2	0.189995	0.018206	1.04E+01	0
GARCH(-1)	0.660438	0.016159	40.87151	0
GED PARAMETER	0.61285	0.013809	44.37939	0
R-squared	-0.000032	Mean dependent var		-1.69E-04
Adjusted R-squarec	-0.000032	S.D. dependent var		0.029935
S.E. of regression	0.029936	Akaike info criterion		-6.510122
Sum squared resid	1.660589	Schwarz criterion		-6.495221
Log likelihood	6039.883	Hannan-Quinn criter.		-6.50463
Durbin-Watson stat	2.254755			



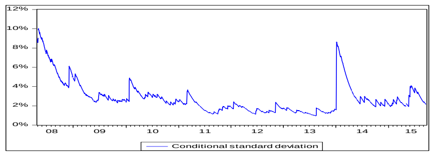


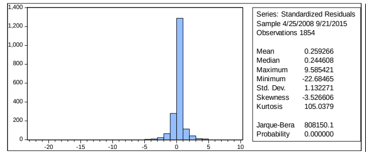


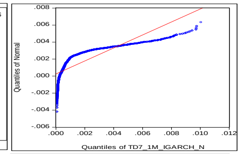
IGARCH (1,1)_N

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.00567	0.0000647	-87.58787	0
	Variance Equation			
RESID(-1)^2	0.028108	0.000512	54.92771	0
GARCH(-1)	0.971892	0.000512	1899.242	0
R-squared	-0.033783	Mean dependent var		-1.69E-04
Adjusted R-squarec	-0.033783	S.D. dependent var		0.029935
S.E. of regression	0.030437	Akaike info criterion		-4.213837
Sum squared resid	1.716633	Schwarz criterion		-4.207877
Log likelihood	3908.227	Hannan-Quinn criter.		-4.21164
Durbin-Watson stat	2.181142			



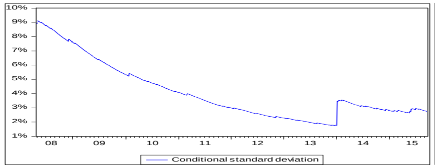


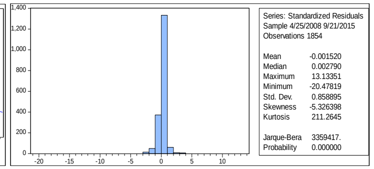


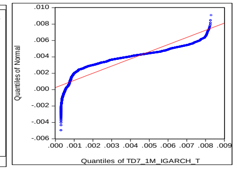
IGARCH (1,1)_T

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.0000827	0.000224	-0.369654	0.7116
	Variance Equation			
RESID(-1)^2	0.003426	0.000203	16.83864	0
GARCH(-1)	0.996574	0.000203	4897.62	0
T-DIST. DOF	2.034052	0.002212	919.7477	0
R-squared	-0.000008	Mean dependent var		-1.69E-04
Adjusted R-squarec	-0.000008	S.D. dependent var		0.029935
S.E. of regression	0.029936	Akaike info criterion		-5.820924
Sum squared resid	1.660549	Schwarz criterion		-5.811984
Log likelihood	5398.997	Hannan-Quinn criter.		-5.817629
Durbin-Watson stat	2.254808			



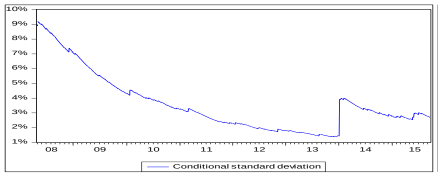


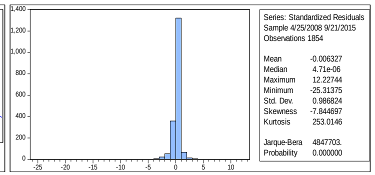


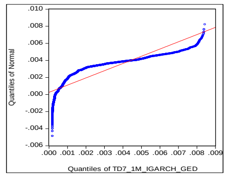
IGARCH (1,1)_GED

GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000000134	0.000293	-0.000457	0.9996
	Variance Equation			
RESID(-1)^2	5.14E-03	0.000512	10.02723	0
GARCH(-1)	0.994864	0.000512	1942.337	0
GED PARAMETER	0.395617	0.0084	47.099	0
R-squared	-0.000032	Mean dependent var		-1.69E-04
Adjusted R-squarec	-0.000032	S.D. dependent var		0.029935
S.E. of regression	0.029936	Akaike info criterion		-7.273264
Sum squared resid	1.660588	Schwarz criterion		-7.264324
Log likelihood	6745.316	Hannan-Quinn criter.		-7.269969
Durbin-Watson stat	2.254755			



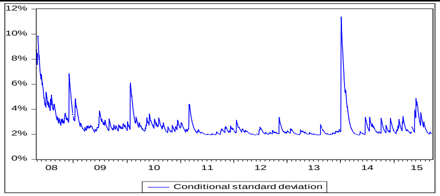


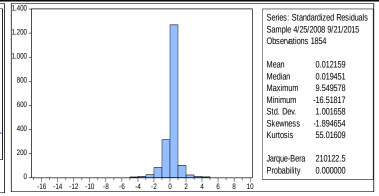


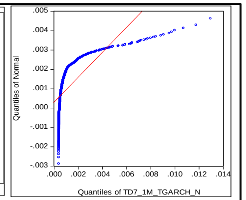
(GJR)TGARCH (1,1)_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000452	0.00055	-0.822493	0.4108
	Variance Equation			
C	3.51E-05	2.39E-06	14.6875	0
RESID(-1)^2	0.054747	0.004456	12.28479	0
RESID(-1)^2*(RESID	-0.009413	0.006245	-1.507473	0.1317
GARCH(-1)	0.904613	0.005475	165.2327	0
R-squared	-0.00009	Mean dependent var		-1.69E-04
Adjusted R-squarec	-0.00009	S.D. dependent var		0.029935
S.E. of regression	0.029937	Akaike info criterion		-4.449384
Sum squared resid	1.660684	Schwarz criterion		-4.434484
Log likelihood	4129.579	Hannan-Quinn criter.		-4.443892
Durbin-Watson stat	2.254625			



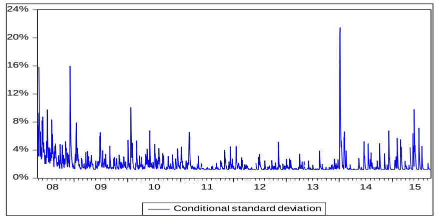


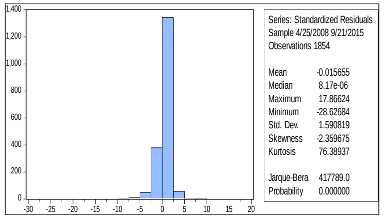


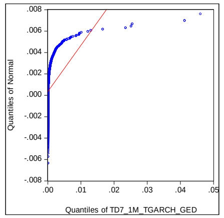
(GJR)TGARCH (1,1)_ged

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000000115	0.0000234	-0.00491	0.9961
	Variance Equation			
C	7.09E-05	1.02E-05	6.930581	0
RESID(-1)^2	1.92E-01	4.81E-02	3.996833	0.0001
RESID(-1)^2*(RESID	0.123811	0.069189	1.789461	0.0735
GARCH(-1)	0.507718	0.044314	11.45735	0
GED PARAMETER	0.39086	0.017438	22.41414	0
R-squared	-0.000032	Mean dependent var		-1.69E-04
Adjusted R-squarec	-0.000032	S.D. dependent var		0.029935
S.E. of regression	0.029936	Akaike info criterion		-7.581293
Sum squared resid	1.660588	Schwarz criterion		-7.563412
Log likelihood	7033.858	Hannan-Quinn criter.		-7.574702
Durbin-Watson stat	2.254755			



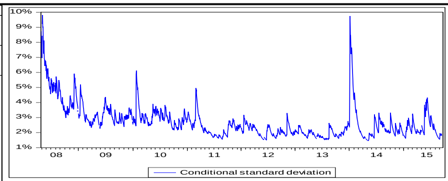


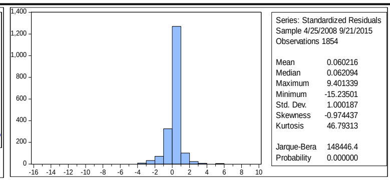


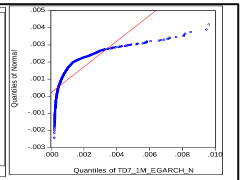
EGARCH (1,1)_N

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4) *RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.001417	0.000494	-2.865409	0.0042
	Variance Equation			
C(2)	-0.358351	0.020585	-17.40826	0
C(3)	0.154712	0.004529	34.16281	0
C(4)	0.039453	0.00455	8.670103	0
C(5)	0.961577	0.002848	337.6679	0
R-squared	-0.001738	Mean dependent var		-1.69E-04
Adjusted R-squarec	-0.001738	S.D. dependent var		0.029935
S.E. of regression	0.029961	Akaike info criterion		-4.485026
Sum squared resid	1.663421	Schwarz criterion		-4.470126
Log likelihood	4162.62	Hannan-Quinn criter.		-4.479534
Durbin-Watson stat	2.250915			



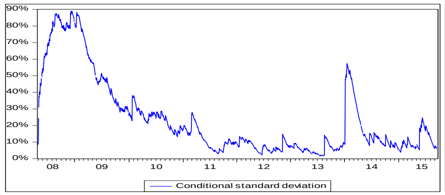


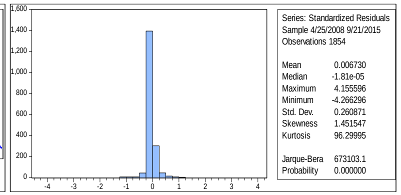


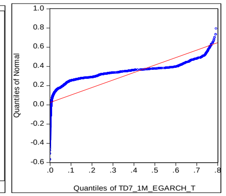
EGARCH (1,1)_T

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.00000174	0.000172	0.010102	0.9919
	Variance Equation			
C(2)	-0.018409	0.007241	-2.542221	0.011
C(3)	0.729683	0.222375	3.281319	0.001
C(4)	0.235515	0.079056	2.979075	0.0029
C(5)	1.011932	0.000545	1857.95	0
T-DIST. DOF	2.001311	0.000777	2575.275	0
R-squared	-0.000033	Mean dependent var		-1.69E-04
Adjusted R-squarec	-0.000033	S.D. dependent var		0.029935
S.E. of regression	0.029936	Akaike info criterion		-5.984521
Sum squared resid	1.66059	Schwarz criterion		-5.96664
Log likelihood	5553.651	Hannan-Quinn criter.		-5.97793
Durbin-Watson stat	2.254753			



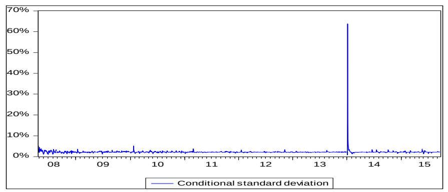


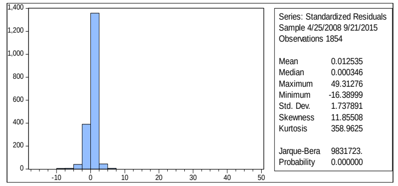


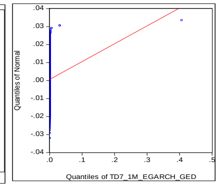
EGARCH (1,1)_GED

LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4) *RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.00000736	0.000255	-0.028891	0.977
	Variance Equation			
C(2)	-2.89814	0.32345	-8.960095	0
C(3)	0.016109	0.010132	1.589987	0.1118
C(4)	0.148824	0.008606	17.29208	0
C(5)	0.623855	0.042056	14.834	0
GED PARAMETER	0.862708	0.021676	39.79986	0
R-squared	-0.000029	Mean dependent var		-0.000169
Adjusted R-squarec	-0.000029	S.D. dependent var		0.029935
S.E. of regression	0.029936	Akaike info criterion		-5.496609
Sum squared resid	1.660584	Schwarz criterion		-5.478729
Log likelihood	5101.357	Hannan-Quinn criter.		-5.490019
Durbin-Watson stat	2.254761			



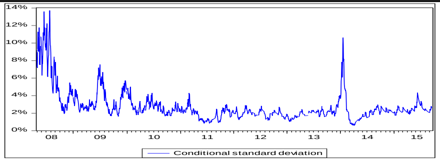


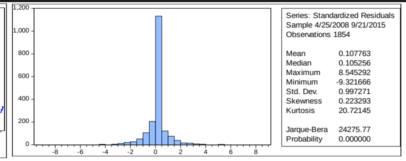


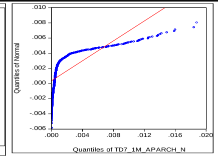
APARCH (1,1)_N

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.002316	0.00000819	-282.7187	0
	Variance Equation			
C(2)	-0.019089	2.73E-03	-6.99E+00	0
C(3)	0.064078	0.002722	23.53898	0
C(4)	-0.900408	0.006645	-135.5056	0
C(5)	0.955242	0.001512	6.32E+02	0
C(6)	0.001387	0.028561	0.048558	0.9613
R-squared	-0.005146	Mean dependent var		-1.69E-04
Adjusted R-squarec	-0.005146	S.D. dependent var		0.029935
S.E. of regression	0.030012	Akaike info criterion		-4.60312
Sum squared resid	1.669082	Schwarz criterion		-4.585239
Log likelihood	4273.092	Hannan-Quinn criter.		-4.596529
Durbin-Watson stat	2.243281			



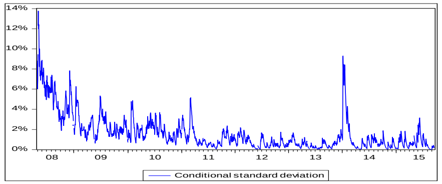


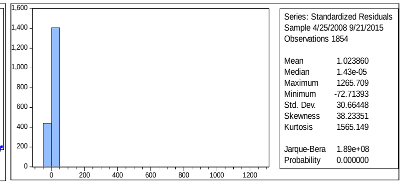


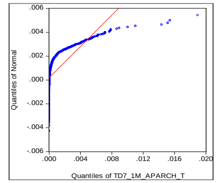
APARCH (1,1)_T

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000000113	0.0000246	-0.004596	0.9963
	Variance Equation			
C(2)	-0.000153	0.000288	-0.529327	0.5966
C(3)	0.169	0.009168	18.43359	0
C(4)	-0.094595	0.039464	-2.396992	0.0165
C(5)	0.886888	0.00399	222.2947	0
C(6)	0.718617	0.017556	40.93379	0
T-DIST. DOF	2.646265	0.060802	43.52262	0
R-squared	-0.000032	Mean dependent var		-1.69E-04
Adjusted R-squarec	-0.000032	S.D. dependent var		0.029935
S.E. of regression	0.029936	Akaike info criterion		-5.861278
Sum squared resid	1.660588	Schwarz criterion		-5.840418
Log likelihood	5440.405	Hannan-Quinn criter.		-5.853589
Durbin-Watson stat	2.254755			



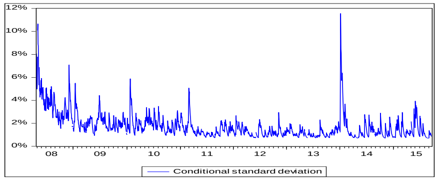


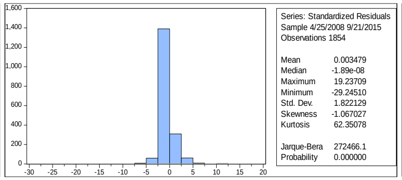


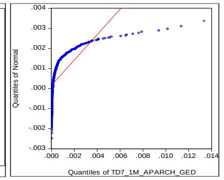
APARCH (1,1)_GED

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	2.3E-10	2.07E-08	0.01109	0.9912
	Variance Equation			
C(2)	0.001127	0.000579	1.946007	0.0517
C(3)	0.154837	0.020347	7.609911	0
C(4)	-0.089982	0.08292	-1.085164	0.2778
C(5)	0.809684	0.0199	40.68667	0
C(6)	1.031554	0.102704	10.04391	0
GED PARAMETER	0.389105	0.015985	24.34159	0
R-squared	-0.000032	Mean dependent var		-1.69E-04
Adjusted R-squarec	-0.000032	S.D. dependent var		0.029935
S.E. of regression	0.029936	Akaike info criterion		-7.773611
Sum squared resid	1.660589	Schwarz criterion		-7.752751
Log likelihood	7213.138	Hannan-Quinn criter.		-7.765922
Durbin-Watson stat	2.254754			



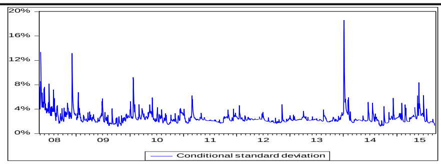


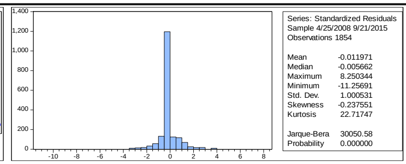


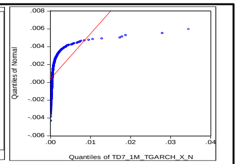
TARCH (1,1)_X_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1) + C(6)*SPREAD_TD7_S_TD7_3M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000127	0.00058	0.21953	0.8262
	Variance Equation			
C	2.17E-04	1.04E-05	20.78626	0
RESID(-1)^2	0.147427	0.01137	12.96669	0
RESID(-1)^2*(RESID	0.058965	0.030353	1.942672	0.0521
GARCH(-1)	0.531554	0.021675	24.52393	0
SPREAD_TD7_S_TD7	4.80E-04	2.37E-05	20.2387	0
R-squared	-0.000098	Mean dependent var		-1.69E-04
Adjusted R-squarec	-0.000098	S.D. dependent var		0.029935
S.E. of regression	0.029937	Akaike info criterion		-4.543898
Sum squared resid	1.660698	Schwarz criterion		-4.526018
Log likelihood	4218.194	Hannan-Quinn criter.		-4.537308
Durbin-Watson stat	2.254606			



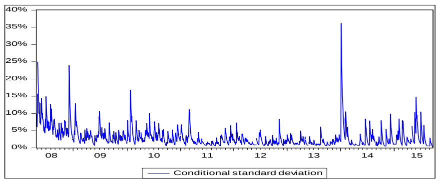


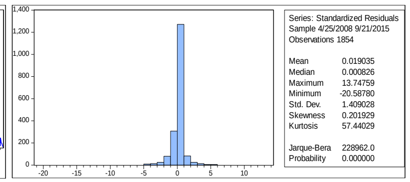


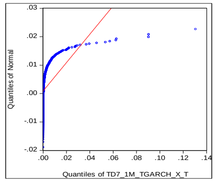
TARCH (1,1)_X_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1) + C(6)*SPREAD_TD7_S_TD7_3M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.0000163	0.000174	-0.093584	0.9254
	Variance Equation			
C	1.53E-05	1.23E-05	1.239852	0.215
RESID(-1)^2	0.522198	0.431008	1.211576	0.2257
RESID(-1)^2*(RESID	0.170063	0.160548	1.059266	0.2895
GARCH(-1)	0.691317	0.01348	51.28441	0
SPREAD_TD7_S_TD7	6.74E-05	5.42E-05	1.243092	0.2138
T-DIST. DOF	2.050992	0.044027	46.58486	0
R-squared	-0.000026	Mean dependent var		-1.69E-04
Adjusted R-squarec	-0.000026	S.D. dependent var		0.029935
S.E. of regression	0.029936	Akaike info criterion		-5.798362
Sum squared resid	1.660579	Schwarz criterion		-5.777501
Log likelihood	5382.081	Hannan-Quinn criter.		-5.790673
Durbin-Watson stat	2.254768			



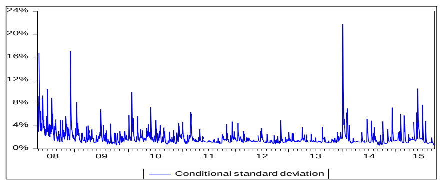


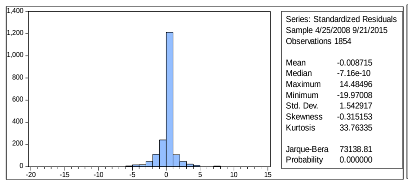


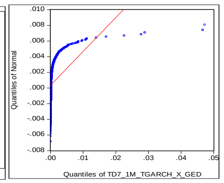
TARCH (1,1)_X_GED

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1) + C(6)*SPREAD_TD7_S_TD7_3M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	9.51E-12	1.5E-09	0.00632	0.995
	Variance Equation			
C	7.04E-05	9.99E-06	7.047545	0
RESID(-1)^2	0.182695	0.04683	3.901242	0.0001
RESID(-1)^2*(RESID	0.177501	0.074405	2.385606	0.0171
GARCH(-1)	4.81E-01	0.042826	11.22438	0
SPREAD_TD7_S_TD7	1.71E-04	3.25E-05	5.243972	0
GED PARAMETER	0.349272	0.016045	21.76882	0
R-squared	-0.000032	Mean dependent var		-1.69E-04
Adjusted R-squarec	-0.000032	S.D. dependent var		0.029935
S.E. of regression	0.029936	Akaike info criterion		-8.064081
Sum squared resid	1.660589	Schwarz criterion		-8.04322
Log likelihood	7482.403	Hannan-Quinn criter.		-8.056392
Durbin-Watson stat	2.254754			





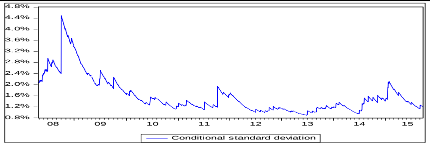


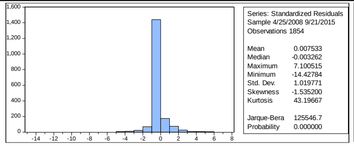
TD7 3Month

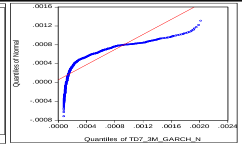
GARCH (1,1)_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	4.22E-05	0.000298	0.141523	0.8875
	Variance Equation			
C	8.82E-07	6.59E-08	13.38635	0
RESID(-1)^2	0.012106	0.000771	15.7011	0
GARCH(-1)	0.983824	0.000913	1077.941	0
R-squared	-0.00003	Mean dependent var		-5.40E-05
Adjusted R-squarec	-0.00003	S.D. dependent var		0.017544
S.E. of regression	0.017544	Akaike info criterion		-5.533011
Sum squared resid	0.570331	Schwarz criterion		-5.521091
Log likelihood	5133.101	Hannan-Quinn criter.		-5.528618
Durbin-Watson stat	2.184579			



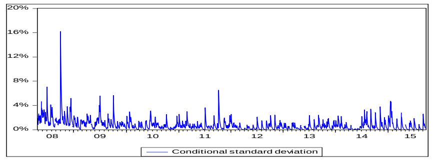


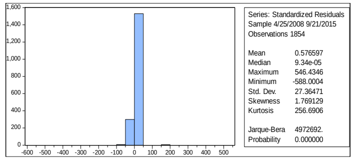


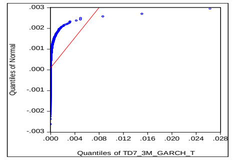
GARCH (1,1)_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-3.84E-07	0.000116	-0.003307	0.9974
	Variance Equation			
C	6.38E-09	1.67E-09	3.812317	0.0001
RESID(-1)^2	0.218974	0.018526	11.82005	0
GARCH(-1)	0.572287	0.006487	88.21964	0
T-DIST. DOF	2.429434	0.04359	55.73436	0
R-squared	-0.000009	Mean dependent var		-5.40E-05
Adjusted R-squarec	-0.000009	S.D. dependent var		0.017544
S.E. of regression	0.017544	Akaike info criterion		-7.504283
Sum squared resid	0.570319	Schwarz criterion		-7.489383
Log likelihood	6961.47	Hannan-Quinn criter.		-7.498791
Durbin-Watson stat	2.184624			



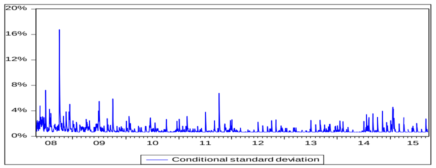


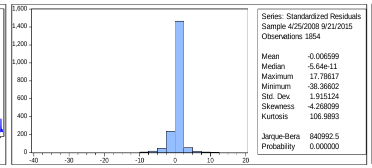


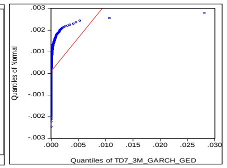
GARCH (1,1)_GED

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	3.95E-13	6.99E-11	0.005652	0.9955
	Variance Equation			
C	2.76E-05	3.78E-06	7.30431	0
RESID(-1)^2	0.234284	0.052594	4.45E+00	0
GARCH(-1)	0.378452	0.046813	8.084328	0
GED PARAMETER	0.307571	0.014718	20.89821	0
R-squared	-0.000009	Mean dependent var		-5.40E-05
Adjusted R-squarec	-0.000009	S.D. dependent var		0.017544
S.E. of regression	0.017544	Akaike info criterion		-10.82187
Sum squared resid	0.570319	Schwarz criterion		-10.80697
Log likelihood	10036.87	Hannan-Quinn criter.		-10.81638
Durbin-Watson stat	2.184624			



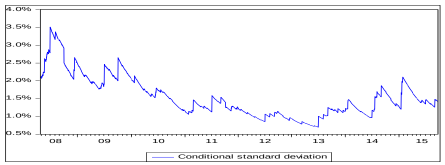


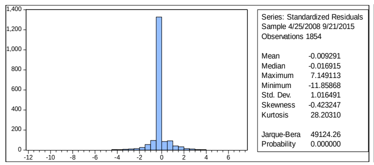


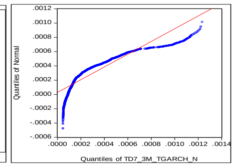
(GJR)TGARCH (1,1)_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	2.18E-04	0.000301	0.724153	0.469
	Variance Equation			
C	2.84E-07	3.46E-08	8.208423	0
RESID(-1)^2	0.021165	0.001	21.15598	0
RESID(-1)^2*(RESID	-0.023011	0.001009	-22.80369	0
GARCH(-1)	0.989412	0.00059	1678.295	0
R-squared	-0.000241	Mean dependent var		-5.40E-05
Adjusted R-squarec	-0.000241	S.D. dependent var		0.017544
S.E. of regression	0.017546	Akaike info criterion		-5.602945
Sum squared resid	0.570451	Schwarz criterion		-5.588045
Log likelihood	5198.93	Hannan-Quinn criter.		-5.597453
Durbin-Watson stat	2.184118			



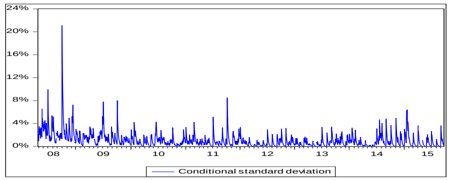


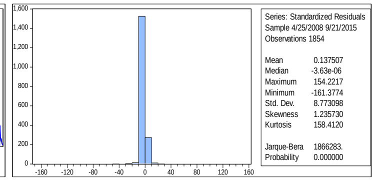


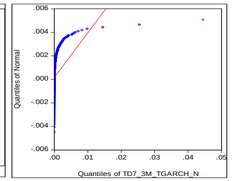
(GJR)TGARCH (1,1)_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	1.96E-08	0.00011	0.000178	0.9999
	Variance Equation			
C	1.05E-07	6.20E-08	1.700414	0.0891
RESID(-1)^2	0.436442	0.273108	1.598056	0.11
RESID(-1)^2*(RESID	-0.065967	0.059144	-1.115356	0.2647
GARCH(-1)	0.570213	0.008295	68.74263	0
T-DIST. DOF	2.044539	0.029257	69.88185	0
R-squared	-0.000009	Mean dependent var		-5.40E-05
Adjusted R-squarec	-0.000009	S.D. dependent var		0.017544
S.E. of regression	0.017544	Akaike info criterion		-7.876861
Sum squared resid	0.570319	Schwarz criterion		-7.85898
Log likelihood	7307.85	Hannan-Quinn criter.		-7.87027
Durbin-Watson stat	2.184624			



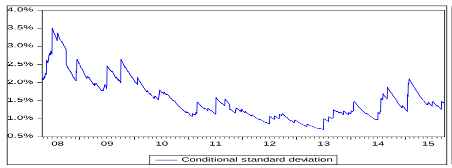


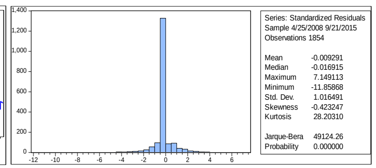


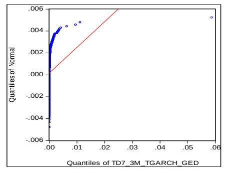
(GJR)TGARCH (1,1)_ged

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1)

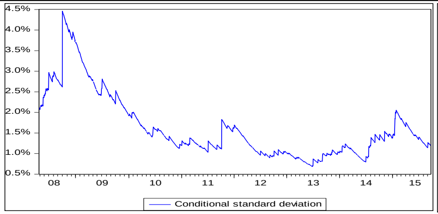
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	2.18E-04	0.000301	0.724153	0.469
	Variance Equation			
C	2.84E-07	3.46E-08	8.208423	0
RESID(-1)^2	2.12E-02	1.00E-03	21.15598	0
RESID(-1)^2*(RESID	-0.023011	0.001009	-22.80369	0
GARCH(-1)	0.989412	0.00059	1678.295	0
R-squared	-0.000241	Mean dependent var		-5.40E-05
Adjusted R-squarec	-0.000241	S.D. dependent var		0.017544
S.E. of regression	0.017546	Akaike info criterion		-5.60E+00
Sum squared resid	0.570451	Schwarz criterion		-5.588045
Log likelihood	5198.93	Hannan-Quinn criter.		-5.597453
Durbin-Watson stat	2.184118			

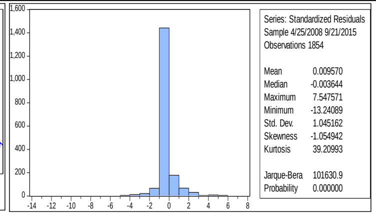


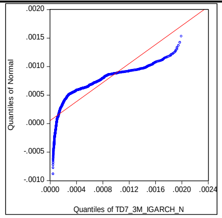




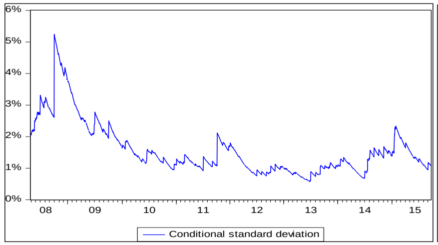
IGARCH (1,1)_N				
GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	4.65E-05	0.000224	0.20727	0.8358
	Variance Equation			
RESID(-1)^2	0.010961	0.000279	39.32883	0
GARCH(-1)	0.989039	0.000279	3548.79	0
R-squared	-0.000033	Mean dependent var		-5.40E-05
Adjusted R-squarec	-0.000033	S.D. dependent var		0.017544
S.E. of regression	0.017544	Akaike info criterion		-5.506686
Sum squared resid	0.570333	Schwarz criterion		-5.500726
Log likelihood	5106.698	Hannan-Quinn criter.		-5.504489
Durbin-Watson stat	2.184573			

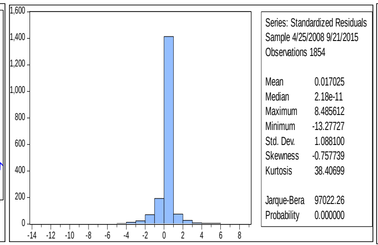


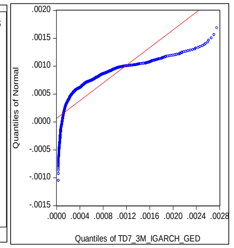




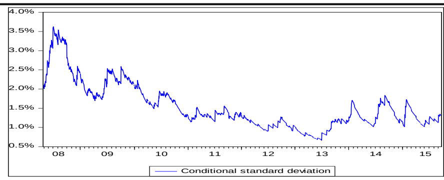
IGARCH (1,1)_GED				
GARCH = C(2)*RESID(-1)^2 + (1 - C(2))*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-2.67E-13	2.46E-11	-0.010844	0.9913
	Variance Equation			
RESID(-1)^2	1.74E-02	0.002145	8.093878	0
GARCH(-1)	0.98264	0.002145	458.1352	0
GED PARAMETER	0.265375	0.007041	37.68795	0
R-squared	-0.000009	Mean dependent var		-5.40E-05
Adjusted R-squarec	-0.000009	S.D. dependent var		0.017544
S.E. of regression	0.017544	Akaike info criterion		-11.44969
Sum squared resid	0.570319	Schwarz criterion		-11.44075
Log likelihood	10616.86	Hannan-Quinn criter.		-11.44639
Durbin-Watson stat	2.184624			

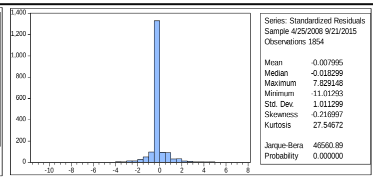


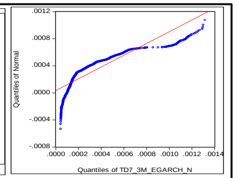




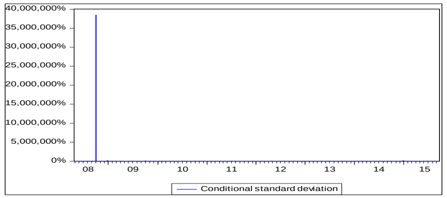
EGARCH (1,1)_N				
LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4) *RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	2.29E-04	0.000304	0.752614	0.4517
	Variance Equation			
C(2)	-0.04488	0.003307	-13.57272	0
C(3)	0.025467	0.001724	14.77058	0
C(4)	0.044818	0.001797	24.9372	0
C(5)	0.99598	0.000355	2806.704	0
R-squared	-0.00026	Mean dependent var		-5.40E-05
Adjusted R-squarec	-0.00026	S.D. dependent var		0.017544
S.E. of regression	0.017546	Akaike info criterion		-5.618605
Sum squared resid	0.570462	Schwarz criterion		-5.603705
Log likelihood	5213.447	Hannan-Quinn criter.		-5.613113
Durbin-Watson stat	2.184076			

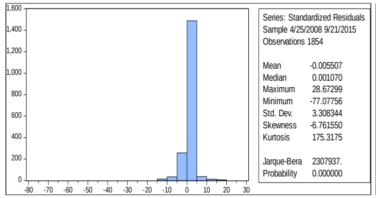


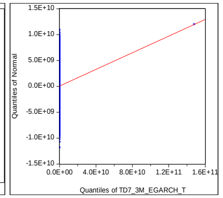




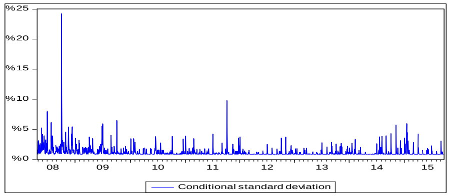
EGARCH (1,1)_T				
LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4) *RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-4.51E-06	0.000103	-0.043639	0.9652
	Variance Equation			
C(2)	-8.431116	0.794729	-10.6088	0
C(3)	0.667505	0.343362	1.944026	0.0519
C(4)	0.191733	0.099722	1.922666	0.0545
C(5)	0.233064	0.015147	15.38681	0
T-DIST. DOF	2.029024	0.031242	64.9463	0
R-squared	-0.000008	Mean dependent var		-5.40E-05
Adjusted R-squarec	-0.000008	S.D. dependent var		0.017544
S.E. of regression	0.017544	Akaike info criterion		-7.431486
Sum squared resid	0.570319	Schwarz criterion		-7.413605
Log likelihood	6894.987	Hannan-Quinn criter.		-7.424895
Durbin-Watson stat	2.184627			

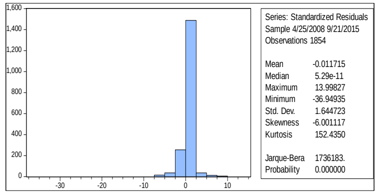


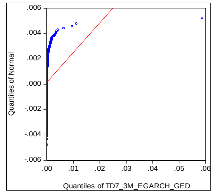




EGARCH (1,1)_GED				
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-4.60E-13	5.33E-11	-0.008633	0.9931
	Variance Equation			
C	6.02E-05	8.10E-06	7.425535	0
RESID(-1)^2	0.282117	0.087048	3.24093	0.0012
RESID(-1)^2*(RESID	0.207009	0.121247	1.707332	0.0878
GARCH(-1)	0.188426	0.046326	4.06739	0
GED PARAMETER	0.302899	0.015853	19.10729	0
R-squared	-0.000009	Mean dependent var		-5.40E-05
Adjusted R-squarec	-0.000009	S.D. dependent var		0.017544
S.E. of regression	0.017544	Akaike info criterion		-10.75398
Sum squared resid	0.570319	Schwarz criterion		-10.7361
Log likelihood	9974.943	Hannan-Quinn criter.		-10.74739
Durbin-Watson stat	2.184624			



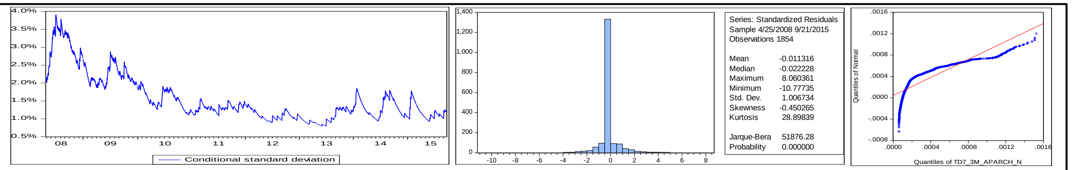




APARCH (1,1)_N

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

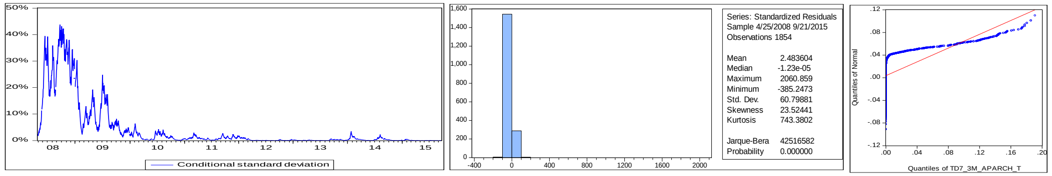
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	2.77E-04	0.000292	0.949486	0.3424
	Variance Equation			
C(2)	0.000181	3.73E-05	4.86548	0
C(3)	0.023593	0.001234	19.12513	0
C(4)	-1	0.012018	-8.32E+01	0
C(5)	0.982798	0.001061	926.1705	0
C(6)	0.905322	0.033384	27.1185	0
R-squared	-0.000356	Mean dependent var		-5.40E-05
Adjusted R-squarec	-0.000356	S.D. dependent var		0.017544
S.E. of regression	0.017547	Akaike info criterion		-5.619205
Sum squared resid	0.570517	Schwarz criterion		-5.601325
Log likelihood	5215.003	Hannan-Quinn criter.		-5.612615
Durbin-Watson stat	2.183867			



APARCH (1,1)_T

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

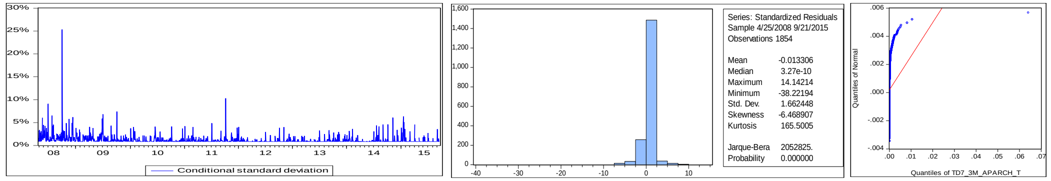
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	3.50E-08	0.000000197	0.177692	0.859
	Variance Equation			
C(2)	-0.000552	0.001682	-0.328475	0.7426
C(3)	0.092763	0.006748	13.74649	0
C(4)	-0.604345	0.055089	-10.97026	0
C(5)	0.965792	0.000923	1046.027	0
C(6)	0.240802	0.008399	28.67136	0
T-DIST. DOF	2.005981	0.002405	834.061	0
R-squared	-0.000009	Mean dependent var		-5.40E-05
Adjusted R-squarec	-0.000009	S.D. dependent var		0.017544
S.E. of regression	0.017544	Akaike info criterion		-9.130894
Sum squared resid	0.570319	Schwarz criterion		-9.110033
Log likelihood	8471.339	Hannan-Quinn criter.		-9.123205
Durbin-Watson stat	2.184624			



APARCH (1,1)_GED

@SQRT(GARCH)^C(6) = C(2) + C(3)*(ABS(RESID(-1)) - C(4)*RESID(-1))^C(6) + C(5)*@SQRT(GARCH(-1))^C(6)

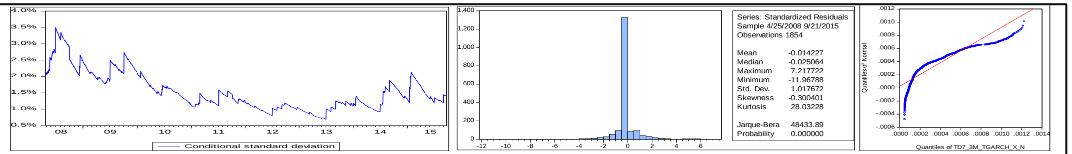
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-2.80E-12	1.58E-10	-0.017761	0.9858
	Variance Equation			
C(2)	0.000431	0.000687	0.626389	0.5311
C(3)	0.519533	0.127548	4.073234	0
C(4)	0.098146	0.078022	1.257925	0.2084
C(5)	0.125661	0.052517	2.392761	0.0167
C(6)	1.598414	0.348237	4.590021	0
GED PARAMETER	0.271521	0.015051	18.04008	0
R-squared	-0.000009	Mean dependent var		-5.40E-05
Adjusted R-squarec	-0.000009	S.D. dependent var		0.017544
S.E. of regression	0.017544	Akaike info criterion		-11.43447
Sum squared resid	0.570319	Schwarz criterion		-11.41361
Log likelihood	10606.75	Hannan-Quinn criter.		-11.42678
Durbin-Watson stat	2.184624			



TARCH (1,1)_X_N

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1) + C(6)*SPREAD_TD7_S_TD7_3M

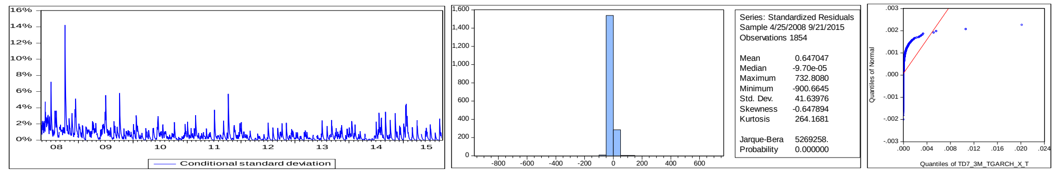
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	3.18E-04	0.000336	0.948522	0.3429
	Variance Equation			
C	3.51E-07	4.02E-08	8.736322	0
RESID(-1)^2	0.022073	0.001025	21.52468	0
RESID(-1)^2*(RESID	-0.023683	0.001019	-23.24912	0
GARCH(-1)	0.988807	0.000619	1597.239	0
SPREAD_TD7_S_TD7	-2.64E-06	4.91E-07	-5.373304	0
R-squared	-0.00045	Mean dependent var		-5.40E-05
Adjusted R-squarec	-0.00045	S.D. dependent var		0.017544
S.E. of regression	0.017548	Akaike info criterion		-5.603761
Sum squared resid	0.570571	Schwarz criterion		-5.58588
Log likelihood	5200.686	Hannan-Quinn criter.		-5.59717
Durbin-Watson stat	2.183661			



TARCH (1,1)_X_T

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1) + C(6)*SPREAD_TD7_S_TD7_3M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	4.11E-07	0.000115	0.003578	0.9971
	Variance Equation			
C	6.78E-09	1.20E-09	5.637747	0
RESID(-1)^2	0.230242	0.016967	13.57002	0
RESID(-1)^2*(RESID	-0.062272	0.018699	-3.330247	0.0009
GARCH(-1)	0.525154	0.006187	84.87599	0
SPREAD_TD7_S_TD7	3.80E-08	8.14E-09	4.666877	0
T-DIST. DOF	2.78467	0.04569	60.94655	0
R-squared	-0.00001	Mean dependent var		-5.40E-05
Adjusted R-squarec	-0.00001	S.D. dependent var		0.017544
S.E. of regression	0.017544	Akaike info criterion		-7.38628
Sum squared resid	0.570319	Schwarz criterion		-7.365419
Log likelihood	6854.081	Hannan-Quinn criter.		-7.378591
Durbin-Watson stat	2.184623			



TARCH (1,1)_X_GED

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1)<0) + C(5)*GARCH(-1) + C(6)*SPREAD_TD7_S_TD7_3M

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	1.67E-12	2.85E-10	0.005841	0.9953
	Variance Equation			
C	1.68E-04	2.34E-05	7.187674	0
RESID(-1)^2	0.067361	0.038085	1.768699	0.0769
RESID(-1)^2*(RESID	0.099056	0.071708	1.381377	0.1672
GARCH(-1)	-7.42E-03	0.002924	-2.538964	0.0111
SPREAD_TD7_S_TD7	2.04E-04	5.94E-05	3.427275	0.0006
GED PARAMETER	0.315891	0.017998	17.55121	0
R-squared	-0.000009	Mean dependent var		-5.40E-05
Adjusted R-squarec	-0.000009	S.D. dependent var		0.017544
S.E. of regression	0.017544	Akaike info criterion		-10.23999
Sum squared resid	0.570319	Schwarz criterion		-10.21913
Log likelihood	9499.472	Hannan-Quinn criter.		-10.2323