

An Econometrics Analysis of Oil Price Volatility

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Abstract The main objectives of this research are firstly, to determine the variables which may cause the oil volatility. Secondly, to analyze that how much these variables cause the oil volatility. Secondary data from 1973 to 2011 were used to estimate the coefficients. GARCH (1, 1) model is used to analyze the volatility among the variable. Oil price, Oil supply and oil demand are stationary at 1st Difference through ADF test. It is found through Generalized Autoregressive Conditional Heteroskedasticity (GARCH1, 1) that oil demand has a significant effect on the oil price. Government should make a proper plan and procedure according to economic growth and requirement which would help to maintain the equilibrium of oil demand and supply and decreased the impact of oil price volatility on the economic growth. Exploration the oil alternatives that steadily decrease the impact of the oil price volatility, will make potential of the economy stronger to face volatility crisis.

Keywords: *oil Price volatility, oil demand, oil supply, GARCH (1, 1)*

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1. Introduction

Oil is considered to be the most valuable commodity in the world. Oil is the life line (blood) for development of any economy, whether it is developing or developed. Oil is the product which is used in energy sectors, transportation etc, so it is a main product for our economies and societies, for a continued growth. Oil prices have constantly been volatile over the periods. The economists and observers point of view is that the volatility seen in last decades was never been before. In the era of industrialization, oil prices was the basic indicator of any financial activity. The oil demand and supply is increased dramatically due to financial expansion and energy development (Peter Voser, 2011) [16].

The effect of the oil price volatility impacts all the segments of the economy and influence standard of life and change the interests of the community. The oil price volatility is a very famous issue which makes the people very worried because it distresses their budget collectively and independently. Policy makers' and Economists point of views is that there is a considerable relationship between the macroeconomic variables, i.e oil price instability, development of the country and financial development (Nicola Armaroli and Vincenzo Balzani, 2006) [15].

Oil prices have been very volatile and considerably changing for previous some years, mainly WTI and Brent products prices, which is known as a main point of reference for considerable oils. The continuous changing in oil prices and its increasing trend indicating dangerous situation for the developed and developing economies for their future prospects (Jean-Marie Chevalier et al., 2010) [10].

2. Literature Review

Economists have many diverse opinions when they projecting future oil demand and supply. These divergences are due to anonymous future proceedings like supply interruption, geo-political issue, environmental tragedies and technological advancements. It is also due to the lack of information about aspects like the income elasticity of demand, long run price, the reaction of supply (non-OPEC) and above all, OPEC behavior. The oil demand modeled, as a function of income and price, the reservations about short and long run oil price and income elasticity's can produce an extensive range of demand curve shapes. On view of supply side, it is function of reserves, technology, reduction effect, lags and leads and structure of the market (Robert et al., 2005 and 2006) [2,3].

According to Khan and Ali (2000) [11] in Pakistan, there is not much oil to fulfill our requirement and we have to depend on imports in future. The oil prices also rise due to heavy taxation from government which is transmitted through increase in prices of daily products and services. The huge amount gain from taxation on oil price, results in slow productivity growth.

Economists interpret that the oil prices increases the products price, cause to increase the inflation and decrease the economic activities. Similar to other raw materials, the increases in oil price enhance oil-production and decrease the development of oil demand. This would cause oil prices to decrease which afterward would arouse demand and raise the oil price. This dissimilar point of views about the oil market noticeably a sign of divergent prospect about the future progression of oil prices (Stevens, 2005) [18].

The demand– supply framework is the most broadly used modeling structure for oil market prices (Bacon, 1991) [1]. It is describing the relation between demand and supply for oil that finally conclude the oil price. He also defined that the extraordinary features of the oil-market make the modeling implement relatively complex.

Oil price volatility has established significant importance in the empirical writing. Macro-economists have analyzed the revolutionize changes in the oil prices presented as vital resource of economic and financial fluctuations. The oil volatility of middle and delayed 1970s was indicating by low development of economy, elevated rate of unemployment and high inflation rate in the majority of the developed economies (Blanchard et al., 2007) [5].

Thomas Helbling (2008) [9] described that Oil prices volatility can also increase uncertainty and discourage the investment which is much-needed in the oil region. Increased oil prices and stretched market circumstances have also increase uncertainties about oil shortage and raise concerns about energy security in many oil-importing countries. Some of the economist [1] argued that the market of oil has passing through different structural transformations due to increase in oil prices.

Charles (May, 2011) [7] acknowledged that unusual oil price concerns are the main reason of noticeable raise in oil price volatility. It is extensively believed that increase in oil prices can slow down the economic growth which also cause inflationary anxiety and generate inequality among the world economies.

Many economists recommended that the current increase in oil prices is due to the uncertainty in the oil market and the future contracts. “Oil volatility has not been infatuated by supply and demand.” Tang and Xiong (2011) proposed that an oil market uncertainty may be at the back the recent boom in prices of oil. This proposal has increased a continuing debate on striking extra rigid restrictions on futures dealing in oil (see Masters, 2008), creating the association between speculation and oil-prices applicability for strategy perspective.

2.1. Supply and Demand

Higher oil prices have also impact on the supply side. Increase in oil prices also increase the input expenses and decreasing earning for producers. Oil is also used in energy sector (electricity) and transport sector. Consequently, when oil price raise, it’s also increase the electricity bills and transport cost which may cause to increase inflation. The inflated prices decrease non oil demand and lower speculation in net oil-importing countries. Lower speculation spending will decrease the employment and productivity and decrease actual wealth and utilization spending. Moreover, tax revenues go down and the financial statement deficit goes up owing to the inflexibility in government expenses. Raised in budget shortfall would then induce interest rates in the upward way. If the government subsidize it, the oil prices are not liable as international prices grow, adding up to the weight on government budgets and growing political and social tensions (Barsky and Kilian 2004) [4].

Oil prices was instable in last few years. During world financial crises in 2008, oil prices are on its peak and reached at \$147 per container in month of July but after it

cut down stridently and reached at \$40 container in December 2008. Consequently, it rises next two year and reached \$90 at the beginning of 2011. Condition in Middle east (Iraq) and North Africa (Libya) also caused to increase oil prices because of increase in oil demand but decrease in oil supply. The increase in oil demand also effect as a slowing economic growth of developed and developing economies. (Leonardo Maugeri, 2012) [12].

CFR's Michael Levi says to anticipate instability in oil markets now in parts because there is no longer a big manufacturer in the oil market. He says "That means prices have to dangle far to equilibrium supply and demand". He also discuss that throughout previous time of oil market confusion, large producer like The United States and Saudi Arabia pay its role ,would increase manufacture and steady prices.

It is observed that economists and policy makers only highlighted the main factors of oil price volatility in their studies but not defined its altitude of these factors. Meanwhile, they also not linked the oil price volatility with these macro-economic variables and its aftershocks. So that study filled the research gap which is a main contribution in the field of oil sector and its effect on economy growth.

2.2. Problem Statement

Oil is major product for any economy. It is main asset of oil exporting economies but at the same time it is a major expense for oil importing economies. The oil price volatility has become a huge problem for the economies. It has a significant impact on balance of payment and economist pays special attention in future anticipation to minimize the loss due to oil price volatility. The aim of the present study is to analyze the main factors, which may cause the oil Price volatility.

3. Data and Methodology

3.1. Theoretical Framework

Different economics theories focus on the different aspect of oil price volatility. The demand and supply theory describe that in-equality between demand of oil and supply of oil make the oil price higher which make the oil price volatility.

The trade Economic theory proposed that oil volatility due to demand and supply shocks in the universal market have unusual effects or impacts on the non-oil trade balance and the oil trade balance of oil importers and exporters economies.

Peak oil theory which is also called Hubbert peak theory says that at some point oil production will decrease (supply) and prices will rise. When this happens it is going to have a dramatic effect on the global economy.

Oil price volatility refers toward short term increase and decrease in oil prices which effect the economies, whether developing or developed, for their future plan and targets. So it is very important for economies to anticipate the oil price volatility. My study is to analyze the determinants of oil price volatility and their impact on the economies which is also supported by demand and supply theory, economic trade theory and Hubbert peak theory (Peak oil theory).

3.2. Data collection procedure

Annual data are collected from IEA, IFS and World Bank from 1973 to 2011 for estimation of coefficient.

4. Results and Discussion

4.1. Unit Roots Results

Unit root test is used to check the stationary of the data. The ADF test contains three type of situation for every time series. First, random selection process includes intercept (c) and trend (t). Second, random selection process includes intercept (c) but no trend (0). Third, random selection process includes lag length. There is a trend in oil demand, oil supply and oil price.

Table 1. Augmented Dickey-Fuller Test Results

Variables	ADF test Statistics	Probability	Results
Oil Demand	-1.699589	0.7319	I(0)
Δ Oil Demand	-3.596155	0.0439	I(1)
Oil Supply	-2.074755	0.5428	I(0)
Δ Oil Supply	-5.183937	0.0008	I(1)
Oil price	-2.125841	0.5155	I(0)
Δ Oil price	-7.802852	0.0000	I(1)

The test result indicates that the all variables Oil demand, Oil supply and Oil price have a unit root in their levels and are stationary in their first differences as Table 1 demonstrate the results.

4.2. GARCH (1,1)

To run the Generalized Autoregressive Conditional Heteroskedasticity (GARCH1, 1) test it is compulsory to make all variable data stationary. So for that aspect, make Oil Price, Oil demand and Oil supply stationary at 1st difference and represent Oil price as DOP, Oil demand as DOD and Oil supply as DOS.

After making these variable stationary, run the Generalized Autoregressive Conditional Heteroskedasticity (GARCH1, 1). The following result revealed:

Estimation Equation of GARCH (1, 1) Model:

$$DOP = C(1) * @SQRT(GARCH) + C(2) * DOD + C(3) * DOS$$

$$GARCH = C(4) + C(5) * RESID(-1) \wedge 2 + C(6) * GARCH(-1)$$

The estimation equation of GARCH (1, 1) model described that dependent variable has auto-regress by its constant value which also include the GARCH value aspect and after that it is also auto-regress by its independent variables oil demand and oil supply.

Substituted Coefficients of GARCH (1, 1) Model:

$$DOP = 2.4023 * @SQRT(GARCH) + 0.5089 * DOD + 0.1035 * DOS$$

$$GARCH = 0.0030 + 0.3215 * RESID(-1) \wedge 2 + 0.7275 * GARCH(-1)$$

The substituted coefficients describe that the coefficient of GARCH value is 2.4023 which impact as positive on oil price, meanwhile the oil demand also impact positively on oil price and its coefficient is 0.5089 but in contrast the oil supply impact negatively on oil price and its coefficient value is 0.1035.

Table 2. GARCH (1, 1)

	Coefficient	Std. Error	z-Statistic	Prob.
GARCH (1, 1)	2.402303	0.279931	8.581755	0.0000
DOD	0.508929	0.147653	3.446797	0.0006
DOS	-0.103517	0.148786	-0.695745	0.4866

According to GARCH (1, 1) table the impact of GARCH coefficient and oil demand is significant at 1% of significance level but on the other hand the oil supply is not significant at even 10% of significance level. The R square value is 0.6328 which describe that the 63.28% oil price volatility is due to oil demand and oil supply and the remaining portion of oil price volatility is due to other factors and variables.

5. Conclusion & Policy Recommendation

5.1. Conclusion

It is observed that the time series data of independent variable and dependant variable (Oil price , Oil supply and oil demand) have a trend and also not stationary. After using unit root test (ADF) it is found that all variables are stationary at first difference and no variable is found stationary at level.

It is anticipated through Generalized Autoregressive Conditional Heteroskedasticity (GARCH1, 1) that oil demand has a significant effect on the oil price and oil supply has insignificant impact even at the 10% level of significance which is also same as the theoretical frame work described. In developing economies, the variation of demand may more effect on the price substitution then supply.

5.2. Recommendation

As described prior, the directly impact of elevated oil prices on the economies (in the emerging economies) is anticipated through the deterioration of balance of payments and consequential contraction of the economies. So that's why there is a requirement to explore the oil alternatives that steadily decrease the impact of the oil price volatility and will make potential of the economy more stronger to face volatility crisis.

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