Macroeconomic Effects of Oil Price Fluctuations in a Small Oil Exporting Economy

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Abstract: Trinidad and Tobago's energy sector accounts for on average 40% of the output, 49% of government revenues and 80% of exports in the economy. Consequently, fluctuations in the price of oil can impact the macroeconomic health of Trinidad and Tobago. This paper examined the effects of oil price and oil price volatility on several key macroeconomic variables for the Trinidad and Tobago economy, namely the real effective exchange rate, government revenue and current expenditure, the current account balance and output. The analysis was conducted using vector autoregressive (VAR) from which impulse response functions and short run Granger causality tests are generated. The main findings revealed that oil price shocks have a significant impact on all variables under investigation, whilst oil price volatility leads to random swings in the economy. Specifically, we find evidence of procyclical fiscal tendencies as well as an appreciation of the real effective exchange rate which could lead to the 'Dutch Disease'. The short run results highlights that oil prices Granger-causes Government revenue whilst oil price volatility Granger-causes government expenditure in the short run.

Keywords: Trinidad and Tobago; oil price; oil price volatility; EGARCH; VAR; Dutch Disease; procyclicality

JEL Classification: Q43, F41, C32, E30

1. Introduction

In mid 2014, oil prices plummeted and continued to languish, reaching all time lows in over ten years. This drastic unforeseen decline in prices had a myriad of effects of oil producing economies, more so, small highly open developing economies that depend significantly on the energy sector and thus suffer immensely from an undiversified export portfolios. Trinidad and Tobago (T&T), a small oil producing nation was one such casualty in recent times given its significant dependency on the petroleum sector, even though T&T has been in the petroleum arena ever since crude oil production began over a hundred years ago, in 1907[1].

Investigations into the effect of oil price fluctuations and macroeconomic performance were conducted by economists ever since the 1973 Israeli-Arab war. Following the embargo imposed on the USA in 1973, there were other notable oil price shocks that were induced by historical events. These include the Iranian revolution (1978–1979), the Gulf war (1990–1991), the Venezuelan crisis (2002–2003), the Iraq invasion of the U.S. commencing in 2003. The recent sources of the unforeseen and unexpected oil price plunge can be attributed to several factors: weak global demand especially from China and Europe; a supply glut following the boom in US shale oil production; relatively little supply disruptions despite geopolitical tensions and sanctions in the Middle East and Russia; and OPEC's decision in November 2014 to maintain its production level at 30 million barrels per day, (World Bank Group, 2015). These oil shocks can have damaging effects on the overall macroeconomy of small highly net oil exporters, such as Trinidad and Tobago, whereby a substantial amount of output, both direct and indirect are from the energy sector.

The energy sector accounts for a significant percentage of the country's Gross Domestic Product (GDP), as can be seen in Table 1. Consequently, fluctuations in the price of oil impact the macroeconomic health of T&T, which is further exacerbated by the fact that T&T has long avoided the calls to diversify its export base. Even though there exist a large breadth of literature that highlights the significant volatility and uncertainty surrounding the price of oil, to which this volatility ultimately transmits to the revenue streams of these economies, T&T has failed implement sufficient policies to move the economy away from its high dependence on the petroleum sector[2]. As such, following the decline in oil prices, along with a decline in production, the contribution of the Petroleum sector to T&T's overall GDP declined to 32.1% in 2015 after averaging 40.7% over the period 2010 to 2014. Energy sector revenues as a share of total government revenues also declined considerably to 33.5% in 2015, after averaging 52.4% over the period 2010 to 2014. This is reminiscent of the mid 1980's where oil prices also took a major hit resulting in severe economic uncertainty and instability for the Trinidad and Tobago economy.

[Insert Table 1 here]

Furthermore, the energy sector accounts for roughly 80% of T&T's merchandise exports, hence exogenous international shocks to the price of oil transmit directly to the T&T economy given its high level of openness. Consequently, fluctuations in the price of oil can impact the macroeconomic health of Trinidad and Tobago. To this effect this paper examined the effects of oil price shocks and oil price volatility on several key macroeconomic variables for the Trinidad and Tobago economy, namely the real effective exchange rate, government revenue and current expenditure, the current account balance and output. This investigation employs the use of Nelson's (1991) exponential Generalized Auto-Regressive Conditional Heteroscedasticity (EGARCH) model to derive a measure of oil price volatility. The impact of oil price shocks and oil price volatility on our key macroeconomic variables of interest is carried out using vector autoregressive (VAR) from which impulse response functions and short run Granger causality tests are generated.

1 Oil was first discovered in 1857 by the American Merrimac Oil Company, Gelb (1988).
2 See Luciani (2011) which highlights that the volatility of oil prices is transmitted either directly or indirectly on government revenues.

In this regard, the rest of this paper is organized in the following way. Section 2 provides a review of the literature under three sub themes, whilst section 3 outlines the data sources along with the various methodologies utilized in the paper. Section 4 presents the results estimated along with the relevant analysis of these results, whilst section 5 discusses several policy initiative the government of T&T can look to in a bid to reducing or curbing the negative pass through effects of oil price volatility on the macroeconomic health of T&T, Finally section 6 concludes.

2. Literature Review:

2.1. Effect of Oil-Price on the Macro-Economy:

Many studies have examined the effects of oil price fluctuations on the macroeconomic health of several countries. These studies have focused on the responses of output, inflation, unemployment and the exchange rate, see studies by Loungani, (1986), Olomola and Adejumo (2006), Rafiq et al. (2009) and Omojolaibi and Egwaikhide (2013). There have been, however, varying results on the exact relationship. Oil price shocks affect the economies of oil exporting and oil importing countries differently. Net oil exporting countries usually benefit from an increase in fiscal revenues created by oil price shocks, while this acts as an additional strain on the net oil-importers' economies, see Berument et al. (2010). Positive oil price shocks see an increase in oil exporter's national income from larger exports earnings, the currency value rises and with it, purchasing power increases, Berument et al. (2010).

However, Husain et al. (2008) argues that the effect of the oil price shocks on the economy depends on the net oil-exporters fiscal policies and those of its trading partners. Abeysinghe (2001) states that even net oil-exporters eventually experience the negative effects of high oil prices indirectly through a trade matrix from trading partners in the long run, although, the direct impact is positive. Abeysinghe explains that although net exporters will reap immediate benefits from the increase, due to changes in the approach of trading partners, the immediate benefits are diminished over time and this is especially evident in smaller countries with open economies. This transmission effect, however, may not be important to large economies. Moreover, fiscal dependence on oil has a significant impact on fiscal management. Oil price shocks tend to remove the inclination for fiscal prudence. Thus seeing an increase in government spending as accumulating budgetary surpluses during oil booms is usually seen as unpopular, Talvi & Vegh (2005).

In oil-importing countries, an oil price shock leads to an increase in the cost of production which is likely to see a decrease in output. This results in a reduction in government revenue from taxes. Higher oil prices, also, decreases disposable income which leads to a fall in consumption. All of which may result in an increase in inflation and suppressed economic growth, see Burbidge and Harrison (1984), Gisser and Goodwin (1986), Korhonen and Juurikkala (2008), Bjornland (2009), Berument et al. (2010).

2.2. Oil Price Volatility

Prior to the twenty-first century, the crude-oil industry possessed the ability to adjust its supply to the meet and even exceed the demands of the market. Beginning in the early 2000s, production stabilized while the demand continued to increase leading to a more balanced environment. This equilibrium, according to Lynch (2002) means that there is much less ability to increase output during periods of market tightness. This lack of adaptability in the production of crude oil directly results in widely varying prices when demand is high versus when demand is low, prompting Fattouh (2005) to claim that an era of greater crude-oil volatility has begun. Today, oil prices fluctuate regularly, ranging from a US$105 per barrel in June 2014 to US$47 per barrel in January 2015 to even lower depths in February 2016 at US$30 per barrel. These fluctuations arise from a number of different factors including economic components, geopolitical tensions and uncertainty in supply and demand according to Schmidbauer and Rosch (2012).

Regnier (2007) notes that it is commonly believed that since the 1973 oil crisis, oil prices have been more volatile than other commodity prices. Studies by Eifert et al. (2002), Regnier (2007) and Frankel (2010) highlight that oil price swings have been larger than those of other mineral resources. Results derived by Regnier (2007) show that oil prices are more volatile than prices for about 95% of products sold by domestic producers whilst in relation to crude commodities, oil prices are currently more volatile than about 65% of these other commodities.

According to El Anshasy and Bradley (2012), the history of oil price shocks since the first oil shock in the 1970's suggests that oil price cycles are unpredictable and that oil prices are volatile. Oil price volatility has a long and well documented history. Several authors point out that from 1973, oil price volatility has been triggered by several dramatic events, see Plourde and Watkins (1998) and Fleming and Ostdiek (1999). Events include the Organization of the Petroleum Exporting Countries (OPEC) oil price crises in 1973 following the Yom Kipuur war, the Iranian Revolution in 1979, the crude oil price collapse in 1986, the Gulf war in 1991, the Asian crisis of 1997–2000, the global financial crises of 2008, Shaxson (2005), Regnier (2007), and Kilian (2010)[3].

2.3. Dutch disease and the resource curse:

The oil boom of the 1970's saw oil exporting countries attain an extraordinary influx of income. Naturally, one would expect that this increase in income would lead directly to the country's economic development. However, this expected reaction was not observed. In fact, when compared with non-oil exporting countries, no noticeable improvement in the economy of the oil exporting countries has been noted. Furthermore, the export boom led to an appreciation of the exchange rate in these economies, which led to an overall reduction in the competitiveness of the manufacturing and industrial sectors in these economies. These contradictory responses prompted further analysis, with the literature outlining two theories to help explain these anomalies, namely the resource curse and Dutch Disease respectively.

The driving factor behind Dutch disease is well known, and is brought about, according to Usui (1997), by the spending of part of the boom revenues on non-tradable goods that in turn leads to appreciation of the real exchange rate and reallocates resources from the tradeable sector to the non-tradeable sector. More recent studies in this area suggest that this influx of revenue from oil can lead to another phenomenon other than Dutch disease, namely the resource curse which was coined by Auty (1993). The resource curse highlights the circumstance whereby countries that are poor in terms of natural resources tend to outperform those with greater resources, that is resource rich economies. Studies by Gelb (1988) and Ross (1999) highlight that natural resource abundant economies tend to grow slower or have lower growth rates than other countries that are not resource blessed or resource endowed.

There are opposing views on whether the Dutch disease and resource curse are inherent within any influx of revenue or if it is as a result of the policy reactions of the country itself to the news of acquired revenue. One example in support of the latter argument can be found when comparing the findings of Taniura (1989) and Usui (1997). Taniura shows that the Mexican oil boom from 1970-1980 was followed by the expected Dutch disease with the tradeable sectors contracting immediately afterwards. On the other hand, Usui (1997) performed a study on the reaction of Indonesia to the increased revenue from their oil boom and found that Indonesia's achievements were in sharp contrast to Mexico's. Indonesia's non-oil based export expanded rapidly and no signs of Dutch disease or resource curse were seen. Usui notes that a deliberate accumulation of budget surplus, a balanced approach to expenditure and a conservative borrowing strategy were some of the policies implemented by Indonesia to avoid falling prey to Dutch disease and resource curse. Sala-i-Martin & Subramanian (2013, p.610) outlines the Nigerian experience which has fallen prey to the resource curse whereby *"waste and poor institutional quality stemming from oil appear to have been responsible for its poor long-run economic performance"*.

3 The Yom Kippur War is also known as the 1973 Arab–Israeli War.

In summary, the review of the literature in the study has highlighted that oil prices are extremely volatile and prone to exogenous shocks which can have significant impacts on the overall macroeconomy of both net oil exporters and net oil importers. A major anomaly associated with net oil exporters is the Dutch disease and the resource curse which affects the competitiveness of the non-oil export sectors namely the manufacturing and agriculture sectors of the economy as well as the overall growth performance of the economy respectively.

3. Data and Methodology

3.1. Data

This study seeks to investigate the effect of oil price (OILP) shocks and oil price volatility (OILPVOL) on gross domestic product (Y), government revenue (REV), government current expenditure (CEXP), current account balance (CAB) and the real effect exchange rate (REER). These macroeconomic variables were taken into consideration due to the availability of lengthy series of data as well as the major impact of oil price shocks and oil price volatility on these respective variables. The data were obtained from the World Bank's website http://www.worldbank.org; under the World Development Indicators (WDI) and Central Bank of Trinidad and Tobago (CBTT) Handbook of Key Economic and Financial Statistics. Government revenue, government current expenditure, the current account balance and oil prices were obtained from the CBTT Handbook of Key Economic and Financial Statistics, whilst output and the real effective exchange rate were sourced from WDI. The variables OUTPUT, REV, CEXP and the CAB were deflated using the consumer price index (CPI) for the Trinidad and Tobago economy which was sourced from WDI in order to take into account the effects of inflation on the respective time series. The variable OILP on the other hand was deflated using the CPI for the United States of America which was also sourced from the WDI. The data spans the period 1966 to 2016 and all the variables were all logged with the exception of the current account balance.

3.*2. Empirical Methodology*

3.2.1. EGARCH model:

This sub section outlines the model employed to derive a measure of oil price volatility. The Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model was developed by Robert Engle in 1982. In summary, modelling data using this system entails 3 steps:

1. Estimation of the best-fit Autoregressive model.
2. Computation of the autocorrelations of the error term.
3. Testing for significance.

The GARCH model is useful for modelling time varying volatility financial assets and was the basis of dynamic volatility models, Alexander and Lazar (2006). The development of this type of model paved the way for easy estimation and also for diagnostic tests to be performed, Drakos et al (2010). However, GARCH(1,1) models only captured some of the skewness. Furthermore, Nelson et al (1996) discovered that if the observed conditional densities were not normal, it was beyond the forecasting scope of the model. Consequently, other researchers sought to produce other models that would yield a better explanation for the data. Another problem encountered prior to the development of the EGARCH model was the evidence of asymmetric properties as noted by Nelson (1991) and Christie (1992). However, Nelson (1991) postulated another model to account for the asymmetry associated with the GARCH(1,1) models, namely the Exponential GARCH or EGARCH model. The model is outlined as follows:

$$y_{t=}\,\omega + a_1 y_{t-1} + \varepsilon_t \qquad (1)$$

$$where\ the\ \varepsilon_t\ is\ normally\ distributed\ with\ mean = 0, and\ standard\ deviation = \sigma_t$$

$$\log(\sigma_t^2) = \bar{\omega} + \beta_1 \, log(\sigma_{t-1}^2) + \alpha_1 \left|\frac{\varepsilon_{t-1}}{\sigma_{t-1}}\right| + \gamma_1 \frac{\varepsilon_{t-1}}{\sigma_{t-1}}$$

Where y_t is m log-difference of oil prices. The EGARCH (1, 1) model is asymmetric if γ_1<0.

3.2.2. VAR model:

In contrast to static models, Vector Autoregression (VAR) models are very useful for explaining the dynamic behaviour of variables. Sims (1980) in his seminal paper proposed a multivariate system of regressions which could be used to capture rich dynamics of time series data. According to Murphy and Murphy (2012, p.357) *"the system proposes that a variable can be (at least partly) explained by its own lagged values and the lagged values of other variables in an interconnected multivariate system".* Sims (1980), contends that if there is true simultaneity among a set of variables they should all be treated on an equal basis; there shouldn't be any apriori peculiarities amongst exogenous and endogenous variables. The VAR model provides a coherent and credible approach to data description, forecasting, structural inference, and policy analysis. The popularity of analyzing time series data through the use of the VAR model is also enhanced by its use in generating impulse response functions and causality testing. A pth-order vector autoregression VAR (p) can be written in terms of a vector-valued AR (p) time-series as follows:

$$Z_t = A_0 + \sum_{j=1}^{p} A_j Z_{t-1} + \varepsilon_t \qquad (2)$$

where Z_t is a vector of stationary endogenous variables all in their logarithmic forms, A_0 is the intercept vector, A_j is the j^{th} matrix of autoregressive coefficients for j = 1, ..., p, and ε_t, is a vector containing the reduced-form residual.

Impulse response functions trace out the dynamic effects of a unit shock (usually a one standard deviation shock) to one endogenous variable onto all other the other endogenous variables through the dynamic structure of the VAR. However, ambiguity can arise in interpreting the impulse response functions due to the fact that the errors are not correlated in the standard form of the VAR model. Sims (1980) argued that 'triangularising' the VAR was his method of orthogonalising the reduced form shocks, which he referred to as Cholesky decomposition. This triangularising achieves orthogonalisation but imposes a recursive structure on the contemporary relationships of the variables. Under a triangular scheme, the ordering of the variables in the VAR will determine which is affected by which in this recursive way, Ronayne (2011). Hence, according to how the variables are ordered in the VAR model, the impulse response functions can change drastically. Pesaran and Shin (1998) proposed a new method of estimating impulse response function, which essentially constructs an orthogonal set of innovations that are not dependent on the ordering of variables in the VAR model. As such this paper employs the generalized impulse response functions proposed by Pesaran and Shin (1998), where the ordering of the variables does not matter.

Additionally, Granger Causality tests were conducted to determine whether there are any short run relationships between oil prices and oil volatility and the chosen macroeconomic variables used in the study. According to Granger (1969), X is said to "Granger-cause" Y if and only if the forecast of Y is improved by using the past values of X together with the past values of Y, than by not doing so. Granger causality can be unidirectional (X causes Y alone) or it can be bi-directional (X causes Y and Y causes X simultaneously). In this study we are interested in the short run causality within the generalised VAR system; as such the Granger Causality/Block Exogeneity Test which is not sensitive to p lags is utilized. Enders (1995, p.306) notes that "*the concern is ascertaining whether lags of one variable Granger Causes any other variables in the system*".

4. Empirical Results and Analysis

4.1. Time Series Properties

Most macroeconomic time series tends to be upward trending and as a result they tend to be non-stationary. Therefore, the first step undertaken in the econometric analysis is to determine to order of integration of the variables using two unit root test. For this study, we employ the use of two standard unit root tests; namely the Augmented Dickey-Fuller (ADF) test developed by Dickey and Fuller (1979, 1981) and the Phillips-Perron (PP) developed by Phillips and Perron (1988). The results in Table 2 below highlights that all variables barring OILPVOL were found to possess a unit root, that is all variables with the exception of OILPVOL are I(1) according to both the ADF and PP unit root tests respectively. As such, the respective variables were differenced once to obtain stationarity, before running both the VAR models. A lag length of one is used to estimate both VAR models which is chosen based on both the Schwartz-Bayesian Information Criterion (SBIC) and Akaike Information Criterion (AIC) respectively. The following sub-sections outlines the results obtained from both the impulse responses functions and short run results via the use of the Granger-Causality tests.

[Insert Table 2 here]

4.2.Impulse Response Function (IRF's)

4.2.1. Innovation to Oil Price

In this sub-section, the dynamic effects of oil price fluctuations are analyzed over a 10- year forecast horizon through the use of impulse response functions. Figure 1 displays the impulse response of each variable to a unitary shock to the oil price. A shock to Oil prices leads to an appreciation of the real effective exchange rate in the first year by 1.2% immediately following the shock. The response declines to 0.9% by the second year, but the response slowly dissipates eventually dying off by the 6th year. This is a cause for concern, as an increase (appreciation) in the real effective exchange rate will ultimately lead to a reduction in Trinidad and Tobago's international competitiveness. In essence, an appreciation of the real effective exchange rate leads to exports becoming relatively more expensive to other country's exports whilst imports becomes relatively cheaper, leading to a reduction in net exports. This in turn can lead to a widening of the current account balance deficit. Additionally, an appreciation of the real effective exchange rate can allow for the 'Dutch Disease' effect to take effect in the Trinidad and Tobago economy, whereby the manufacturing sector becomes relatively less competitive on account of the appreciation.

[Insert Figure 1 here]

Examining the response of the Current account balance to a shock to oil prices, in the first year following the shock the balance is positive however by the second year the balance goes into deficit. This may be on account of the effects of oil price shock on the REER as well as on current expenditure. This finding is in line with the notion that an oil price hike can eventually lead to an appreciation in the real exchange rate of the net oil exporter, which in turn drives an increase in imports and a fall in exports of non-oil goods, see Devlin and Lewin (2005) and Jimenez-Rodriguez and Sanchez (2005).

A shock to oil prices leads to an immediate fiscal response in the first year for both government expenditure and government revenue. The magnitude of the response of government revenue is larger than that of government expenditure; however the response is not as long lived as compared to the response to expenditure. Following an innovation to oil prices, government revenue spikes in the first year reaching 14%, before declining rapidly in the following year to 6% percent. Government expenditure on the other hand increases to 3.3% in the first year, slowly declining in each subsequent period, with the effect of the shock having long lasting effects on government expenditure as the response eventually dies of by the 5th year following the shock. This is somewhat indicative of a procyclical fiscal stance adopted by the government of T&T in relation to oil prices, which is in line with the

findings of Hosein et al. (2017) which found empirical evidence that the conduct of fiscal policy in T&T is in fact procyclical. Furthermore, studies by Fasano and Wang (2002) and Husain et al. (2008) have indicated that developing oil producing economies usually adopt a procyclical fiscal stance in relation to oil prices. This sub optimal fiscal stance can impact severely on T&T's business cycle during periods of declined or suppressed oil prices; whereby the amplitude of the contraction phase can be significantly exacerbated[4]. As Ilzetzki and Vegh (2008) and Chian (2016) points out, the adoption of procyclical fiscal policies has negative effects on the business cycle of a country; in that it exacerbates and amplifies the business cycle.

Lastly as expected, due to the heavy reliance on the energy sector for the T&T economy, following a positive innovation to oil prices, output increases to 8% in the first year. The response to output is short lived as by the second year the response falls to 2.6% before dying off in the 3rd year following the innovation to oil prices.

4.2.2. Innovation to Oil Price Volatility

In this sub-section, the dynamic effects of oil price volatility are analyzed over a 10- year forecast horizon through the use of impulse response functions. Figure 2 displays the impulse response of each variable to a unitary shock to oil price volatility. A positive shock to oil price volatility, leads to severe random swings in the T&T economy. This is not surprising given the economy's heavy reliance on the energy sector. Random swings are particularly experienced in the economies real effective exchange rate, current expenditure, its current account balance and output. As is the case with an innovation to oil prices, an innovation to oil volatility also leads to an appreciation of the real effective exchange rate initially, albeit a marginal effect, which has confounding effects on the external competitiveness of the economy. This places added pressures to the other sectors of the economy, mainly manufacturing which can have severe consequences on the growth path of the economy.

[Insert Figure 2 here]

An innovation to oil price volatility brings about random swings in government current expenditure. This can be welfare reducing given the governments large size in the T&T economy. This volatility in expenditure persists up to the 6th year or thereabouts following the positive shock to oil price volatility, highlighting the lingering effect or impact volatility in oil prices has government expenditure. Following an innovation to oil price volatility, the response of revenues is positive in the first year but by the second year the response becomes negative, with revenues contracting by 2%.

A major finding is that volatility in oil prices leads to a contraction in output in the second year following the innovation to oil price volatility. Specifically, economic activity contracts by 0.7% in the second year. This may not be only on account of the fact that volatility affects the T&T economy directly, but also indirectly through its trading partners as well. In addition, this can be indicative of the effects of suboptimal fiscal spending adopted by the government of Trinidad and Tobago, which affects the business cycle during downturns or increased volatility in oil prices as expenditure follows oil prices, i.e. procyclical fiscal stance.

4.2.Short-run Results:

To determine whether any short run relationships exist between oil prices and the macro-economic variables investigated in the study, a Granger-Causality test is undertaken and results are reported in Table 3. The results highlight that oil prices only Granger-causes government revenue.

[Insert Table 3 here]

4 This has already taken effect, as T&T recorded growth rates of 1%, -6% and -2.3 provisionally in the years 2015 to 2017 respectively.

We also examine whether any short run relationships exist between oil price volatility and the macro-economic variables investigated in the study and results are reported in Table 4. The results show that oil price volatility only Granger-causes government current expenditure. This is a substantial finding, as volatility to oil prices is transmitted to government current expenditures in the short run in the T&T economy.

[Insert Table 4 here]

5. Addressing Volatility in the macro economy.

The volatile nature of oil prices significantly affects the overall macroeconomic health of the Trinidad and Tobago economy. In particular, as highlighted in the results above, an innovation to oil price volatility brings about random swings in government current expenditure and leads to a contraction in output in the second year following the innovation to oil price volatility. Furthermore, volatility to oil prices is transmitted to government current expenditures in the short run in the T&T economy according to results obtained from the Granger causality test. As noted by Landon and Smith (2013), volatile revenues on account of the volatility in oil prices may induce volatile movements in government expenditures, leading to stop-go pro-cyclical fiscal policies that accentuate the magnitude of economic cycles. Pieschacon (2012) finds systematic evidence that resource revenue volatility can undermine economic stability through the fiscal policy channel. Therefore, fiscal discipline is a valuable tool in regulating the impact of oil price shocks, as welfare analysis conducted in the study by Pieschacon (2012) indicates that fiscal policies that insulate the country from exogenous oil price shocks seem to be welfare improving over those that are procyclical. As such, this section specifically seeks to outline some possible antidotes to aid in limiting or curbing the negative effects of oil price volatility on the macroeconomic health of T&T.

El Anshasy and Bradley (2012, p.606) notes that "*rising oil prices tends to alleviate the immediate pressure on the fiscal authority to adjust fiscal policy and reduces the urge for fiscal prudence*". The authors further highlights that these features can have important implications on the macroeconomic performance and stability of these economies, and in order to deal with such challenges, most oil producers have sovereign wealth funds (SWF's). The main purpose of these funds according to El Anshasy and Bradley (2012) is to guard against the volatility of oil prices and the eventual depletion of the resource in the future. It should be noted that T&T has a SWF in place effectively from the year 2000, but by law from 2007 where the Heritage and Stabilization Fund (HSF) replaced the then Interim Revenue Stabilization Fund (IRSF) in 2007[5]. Even though the SWF had been in place during the commodity super cycle boom, it has not effectively shielded the economy from the fluctuations and volatility in oil prices. Therefore, it is essential that the rules governing the HSF be addressed, as government current expenditure was allowed to follow oil prices due to its current limitations.

It is therefore pivotal that the current rules outlining the SWF be amended to allow for a larger proportion of the petroleum revenues to be saved in the HSF in a bid to decouple a larger proportion of the volatile oil revenues from its budgetary allocations. As Chian (2016, p.92) rightly notes, *"policymakers need to devise explicit fiscal rules and better integrate the oil reserve fund into the budgetary framework to decouple government spending from volatile oil revenues to prevent boom and bust cycles"*. In addition, larger savings of the resource revenues will also curb or limit the Dutch disease effects whereby large revenue windfalls can result in an appreciation of the real exchange under the current deposit rules of the funds[6]. Furthermore, the SWF on its own as highlighted has not been successful; as such the implementation of fiscal rules may be necessary to enact fiscal restraint with the overall aim of smoothing government expenditure. To limit pass through effects of oil price volatility onto the macroeconomy, the state should also look to diversifying its exports base.

5 The Interim Revenue Stabilization Fund (IRSF) covered the period 2000 to 2007.
6 See the Heritage and Stabilisation Fund Act, 2007 for rules outlining the fund.

6. Conclusions

This paper examined the impact of oil price shocks and oil price volatility on several key macroeconomic variables for the Trinidad and Tobago economy, namely the real effective exchange rate, the current account balance, government revenue and current expenditure and output. The volatile nature of oil prices has serious ramifications on the Trinidad and Tobago economy given its heavy reliance on the sector, whilst fluctuations to oil prices can have a myriad of effects on the macroeconomy of a small open oil exporter like Trinidad and Tobago. Consequently, this paper employed an EGARCH (1, 1) model to extract a proxy for oil price volatility. The econometric analysis is carried out using a VAR model from which impulse response functions and short run Granger causality tests are generated. The main findings highlights that oil prices have a significant effect on all variables under investigation, whilst oil price volatility leads to random swings in the economy. The short run results highlight that oil price Granger-causes government revenue, whilst oil prices volatility Granger-causes government current expenditure in the T&T economy.

A shock to oil prices leads to an appreciation of the real effective exchange rate in the first year by 1.2% immediately following the shock. The current account balance is positive in the first year following the shock oil prices; however by the second year the balance goes into deficit. Furthermore, a shock to oil prices led to an immediate fiscal response in the first year for both government expenditure and government revenue. The magnitude of the response of government revenue is larger than that of government expenditure; however the response is not as long lived as compared to the response to expenditure. Lastly as expected, due to the heavy reliance on the energy sector for the T&T economy, following a positive innovation to oil prices, output increases to 8% in the first year. The response to output is short lived however, as by the second year the response falls to 2.6% before dying off in the 3rd year following the innovation to oil prices.

In relation to the effects of volatility on the macroeconomy of Trinidad and Tobago, the overall finding indicates that a positive shock to oil price volatility, leads to severe random swings in the T&T economy. This is not surprising given the economy's heavy reliance on the energy sector. Random swings according to the results are particularly experienced in the economies real effective exchange rate, current expenditure, its current account balance and output. Hence, it is pivotal that the government of Trinidad and Tobago implement strong fiscal buffers to guard against negative oil price and volatility shocks. Therefore, it is essential that the rules governing the HSF be addressed, as government current expenditure was allowed to follow oil prices due to its current limitations. It is pivotal that the current rules be amended to allow for a larger proportion of the petroleum revenues to be saved in the HSF in a bid to decouple a larger proportion of the volatile oil revenues from its budgetary allocations.

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Table 1. The percentage contributions of the Energy Sector to GDP, total government fiscal revenues and merchandise exports for the Trinidad and Tobago economy for the period 2010 to 2015.

Year	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Energy Sector Share of GDP	42.0	44.8	41.4	38.3	37.2	32.1
Energy Sector Share of Government Revenue	51.8	57.6	54	50.4	48.2	33.5
Energy Sector Share of Merchandise Exports Receipts	82.9	84.3	75.7	81	83	77.9

Source: Central Bank of Trinidad and Tobago Annual Economic Survey for 2014 and 2015.

Table 2. Results generated by both the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) Unit Root Tests.

	ADF Test				*PP Test*			
	Level		*First Difference*		*Level*		*First Difference*	
Variables	*I*	*I&T*	*I*	*I&T*	*I*	*I&T*	*I*	*I&T*
LREER	-1.62	-1.93	-4.78***	-4.86***	-1.09	-1.47	-4.79***	-4.88***
CAB	-2.76*	-3.08	-9.96***	-9.89***	-2.78*	-3.12	-9.90***	-9.84***
LCEXP	-2.10	-2.47	-5.24***	-5.38***	-2.04	-1.86	-5.55***	-5.69***
LREV	-1.95	-1.38	-6.19***	-6.36***	-1.99	-1.71	-6.38***	-6.52***
LY	-1.88	-1.20	-5.60***	-5.70***	-1.95	-1.75	-5.77***	-5.88***
LOILP	-1.60	-1.54	-6.54***	-6.54***	-1.70	-1.80	-6.53***	-6.53***
OILPVOL	-9.29**	-9.67***	-	-	-9.05***	-9.35***	-	-

***, **, *** denotes levels of significance at 10%, 5% and 1% respectively**

Note: I denotes the unit root test with only an intercept term. I&T denote the unit root test with both an intercept term and trend.

Table 3. Granger-Causality results for oil price and the macroeconomic variables employed in study.

Null Hypothesis: Oil Price does not Granger-cause:	**Chi-square**	**p-value**
Real Effect of Exchange Rate	0.422806	0.5155
Current Account Balance	0.663044	0.4155
Government Current Expenditure	0.010648	0.9178
Government Revenue	5.344796	0.0208
Output	1.836818	0.1753

Table 4. Granger-Causality results for oil price volatility and the macroeconomic variables employed in study.

Null Hypothesis: Oil Price does not Granger-cause:	**Chi-square**	**p-value**
Real Effect of Exchange Rate	1.062289	0.3027
Current Account Balance	0.362245	0.5473
Government Current Expenditure	4.317796	0.0377
Government Revenue	0.486670	0.4854
Output	0.313328	0.5756