

# Energy Security and Economic Performance of the Caspian Region: How Vulnerable is the Region to the Falling Oil Price?

By Nathaniel Babajide

## INTRODUCTION

Given the prime position of oil in Caspian economy, change in oil prices has become a crucial issue with significant implications on the development of the economies in the region. The oil and gas producing states in the Caspian region have experienced meaningful economic growth under high energy prices in the last decade. Now with the recent sudden and precipitous drop in global crude oil prices, it is imperative to examine the degree of vulnerability of the Caspian states economy to oil shocks, together with the associated economic and environmental challenges. This paper attempts to achieve this aim.

## OVERVIEW OF CASPIAN REGION

With total surface area of about 371,000 km<sup>2</sup> (143,200 sq mi) (excluding Garabogazköl Aylagy) and volume of 78,200 km<sup>3</sup> (18,800 cu mi), the Caspian Sea is regarded as the world's biggest enclosed inland water body and the largest lake cum full-sized sea on the planet (EIA, 2013; Stratfor Global Intelligence, 2014). As an endorheic basin (without seepages), this landlocked sea sits at the border between Europe and Asia, bounded by Russia in the northwest, Azerbaijan in the west, Iran in the south, Turkmenistan in the southeast, and Kazakhstan in the northeast. These five major countries are accordingly considered in this study to constitute the Caspian region.

Apart from the rich biological diversity, the major economic importance of the Caspian region lies in its strategic position with massive energy and mineral resources endowment. According to 2015 British Petroleum (BP) statistics, the region holds about 17.6%, 46.4% and 21.4% of global proven reserves of oil, natural gas and coal, respectively (see table 1). This, accordingly, makes all Caspian littoral states a significant homeland of energy resources.

	Oil		Natural Gas		Coal	
	Billion Barrels	R/P Ratio	Trillion Cubic metres	R/P Ratio	Billion Tonnes	R/P Ratio
Azerbaijan	7.0	22.6	1.2	68.8	-	-
Iran	157.8	>100	34.0	>100	-	-
Kazakhstan	30.0	48.3	1.5	78.2	33600	309
Russia	103.2	26.1	32.6	56.4	157010	441
Turkmenistan	0.6	6.9	17.5	>100	-	-
<b>Region Total</b> (% of World)	298.6 (17.6%)		86.8 (46.4%)		190.6 (21.4%)	
World	1700.1	52.5	187.1	54.1	891.5	110

**Table 1: Fossil Energy Reserve of Caspian Region, 2014**

Source: BP, 2015

## OIL PRODUCTION, CONSUMPTION AND EXPORT

Estimates from BP revealed that the Caspian region produced a total of 17.24 million b/d of crude oil, around 19.4% of the total world supply of 88.7 million b/d in 2014. Oil production in Russia and Iran stood at 10.8 and 3.6million b/d (63% and 21% of region total), respectively in 2014. This shows that the recorded annual production ceiling of 1.7mb/d in Kazakhstan, 848 thousand in Azerbaijan plus 239,000b/d in Turkmenistan accounts for just 14% of the total volume of oil produced in the area. However, the total oil consumption in 2014 stood at 5.74 million b/d, reflecting a net export margin of 11.5 million b/d, implying 66.5% of total production. Exports grew in the Caspian by 0.9% in 2014 over a 2013 value of 11.4 million b/d, due mainly to increased production in Russia and Iran.

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See footnotes at end of text.

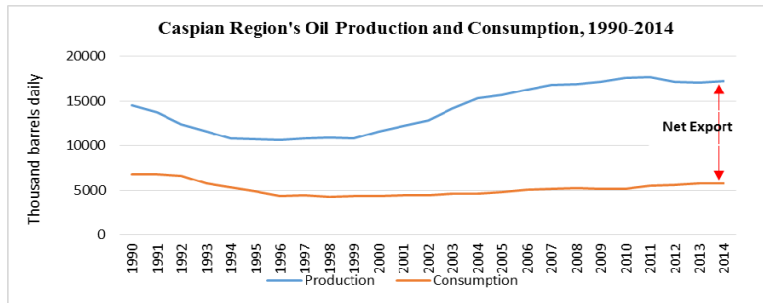


Figure 1: Caspian Region's Oil Production and Consumption, 1990-2014

Source: BP, 2015

In sum, the Caspian economies export between 40-80% of their total oil production. Russia is the biggest exporter supplying about 66.4 % of the region's export total in 2014, followed by Iran (13.8%), Kazakhstan (12.4%), Azerbaijan (6.50%) whereas Turkmenistan accounts for the remaining less than 1%. Nevertheless, Asia and European countries like Germany, The Netherlands and Poland are some of the leading destinations or importers of Caspian oil (IEA, 2013). Similarly, Caspian states export a substantial volume of natural gas, estimated at nearly 235 billion cubic meters (bcm), denoting about 18% of global

total exports in 2014. Of this total volume, Russia accounts for around a whopping 72.1%, followed by Turkmenistan 17.7%; while Kazakhstan, Azerbaijan and Iran jointly contribute the remaining modest 10.2% of total Caspian natural gas export volume in the same year.

In light of the above, oil and gas revenue represents over 50% of federal budget revenues and about 70% of total exports in the region. It can, therefore, be inferred that the Caspian's thriving economic growth over the years has been driven primarily by commodity exports which consequently makes it extremely vulnerable to boom and bust cycles associated with volatile swings in global prices.

**ECONOMIC OUTLOOK OF CASPIAN REGION**

The Caspian region is historically one of the world's leading producers and exporters of oil and natural gas and its economy strongly depends on proceeds from hydrocarbons exports. Russia and Iran are the two largest economies of the region. Both countries constitute about 70.17% and 19.42% of region's total GDP (in constant 2005 US\$), respectively. On a purchasing power parity (PPP) basis, the economy of Russia was \$3.75 trillion in 2014 and accordingly ranks as the fifth largest economy globally after China, United States, India and Japan (World bank, 2016). As illustrated in Figure 2, the region's economic growth has been intermittent, averaging 7.3% from 2000-2014. The growth was, however, largely hampered by the 2008-09 global economic crisis during which oil prices sporadically dropped and the foreign credits relied upon by a majority of Caspian banks and firms dried up. The economy recuperated in subsequent years and recorded an average annual GDP growth of 3.0% and 4.3% in 2012 and 2014 respectively.

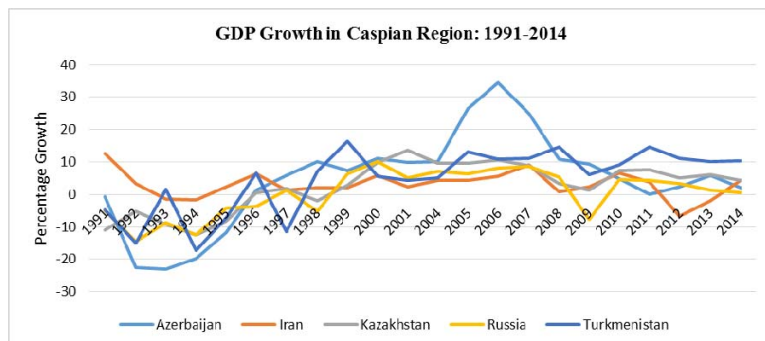


Figure 2: Caspian Region's Economic Outlook, 1991-2014

Source: Worldbank (2015)

This intermittent economic growth has over the years been driven primarily by commodity exports and makes the region extremely vulnerable to boom and bust cycles associated with volatile swings in global prices. This erratic fluctuation originates primarily from a combination of historical, geopolitical and economic factors among others. Of utmost concern is the recent downturn as crude oil prices dropped from an annual average of \$110.42 a barrel in 2013 to \$98.95 in 2014. This was exacerbated between June 2014 and January 2016 as the global crude price dropped dramatically from around \$110 to below \$50, indicating a whopping 60% fall within two years, thereby causing heavy revenue shortfalls for constituent oil exporting nations in the Caspian region.

**CASPIAN'S ENERGY RELATED CO2 EMISSIONS**

The major problem associated with huge fossil fuel utilization is the GHGs emissions arising from its combustion, specifically carbon dioxide (CO<sub>2</sub>), sulphur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>) and Methane (CH<sub>4</sub>) which are highly detrimental to human health and environment. Historical trends show a high volume of CO<sub>2</sub> emission in the Caspian region, as shown in Figure 3, which has fluctuated erratically from 1990 to 2014. In sum, Caspian states emitted 2607.7 million tonnes (Mt) of CO<sub>2</sub> (7.4% of global emission) in 2014. Of this, 1657.2 mt came from Russia, 650.4 mt from Iran, 188.6 mt from Kazakhstan, 78.1 mt from Turkmenistan and 33.5 mt from Azerbaijan. Russia and Iran were the major emitters of

CO<sub>2</sub> in the region, accounting for over 88% of the CO<sub>2</sub> emitted in 2014. This resulted principally from environmental pollution through large scale oil and gas production and consumption cum gas flaring in the region.

To this end, the Caspian's heavy fossil fuel reliance portends enormous GHGs danger, principally CO<sub>2</sub> emissions, with possibly severe impacts upon global climate change. Also, the indiscriminate discharges of petrochemical and biological pollutants (transboundary contaminants) via enormous transport activities (principally through the Volga River) coupled with existing and planned massive oil and gas pipelines projects in the Caspian sea, further increase the region's ecological menace.

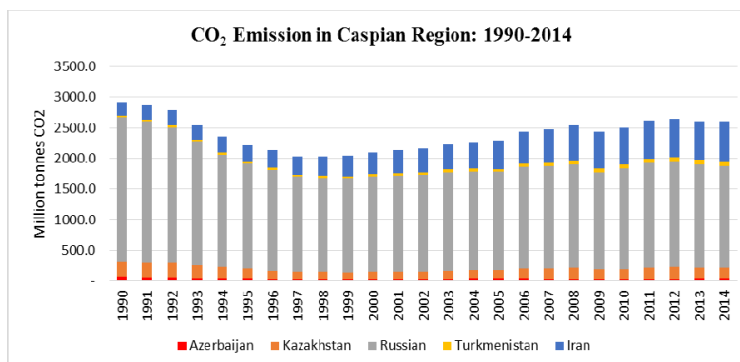


Figure 3: Caspian's Energy Stimulated CO<sub>2</sub> Emission: 1990-2014  
Source: BP, 2015

### VULNERABILITY OF CASPIAN REGION TO OIL PRICE SHOCKS

To investigate the vulnerability of the Caspian economy to oil price shocks, this study employs the Vulnerability Indicator (Ratio of Net Value of Oil Exports to GDP) as presented below.

$$\text{Vulnerability} = \frac{\text{Net Oil Exports (NOEX)}}{\text{GDP}}$$

$$\left(\frac{\text{NOEX}}{\text{GDP}}\right) = P * \left(\frac{\text{volume net oil exports}}{\text{Total oil use}}\right) * \left(\frac{\text{Total oil use}}{\text{Total energy use}}\right) * \left(\frac{\text{Total energy use}}{\text{GDP}}\right)$$

Where: NOEX is Net Oil Export, GDP is Gross Domestic Products and P is price of oil

$$\text{Vulnerability Impact} = \% \text{ price change} * (\text{Share of oil exports in GDP})$$

Ultimately, this indicator was adopted as a tool to gauge the Caspian economies' vulnerabilities to the recent fall in global oil prices and identify potential options for curtailing associated risks in future. Moreover, as the degree of vulnerability is a combination of different factors; the study further examines the region's Diversification of primary Energy Supply (DPES) and Carbon Free Energy Portfolio (CFEP)

### DIVERSIFICATION OF PRIMARY ENERGY SUPPLY (DPES)

This index is employed as it considers both the significance of diversification in terms of abundance and equitability of energy supply sources. This according to APEC (2007) is calculated as;

$$\text{DPES} = \beta / \text{Ln } \eta \quad \text{But } \beta = -\sum(Q_i \text{Ln} Q_i)$$

Where

$\beta$  is the Shannon's bio-diversity Index, Q is the share of energy source in TPES, Ln is the natural log, i is the sources of energy and  $\eta$  is the number of energy sources used.

The final estimate from this metric is normalised on a scale of 0-100. Values closer to zero depict a country's dependency on one energy source while that closer to 100 signifies even distribution among the main energy sources. Hence, the lower the DPES value, the higher the risk of energy supply security.

### CARBON FREE ENERGY PORTFOLIO (CFEP)

This evaluates the degree of carbon concentration in the region's energy mix thus highlighting the need for the switch away from a carbon intensive fuel mix. The measure considers the proportion of non-fossil sources like hydro, nuclear, solar, wind, geothermal, etc. in the nation's overall energy mix. The indicator is computed as follows:

$$\text{CFEP} = \frac{\text{PES}_{\text{hydro}} + \text{PES}_{\text{nuc}} + \text{PES}_{\text{renew}}}{\text{PES}_{\text{total energy}}}$$

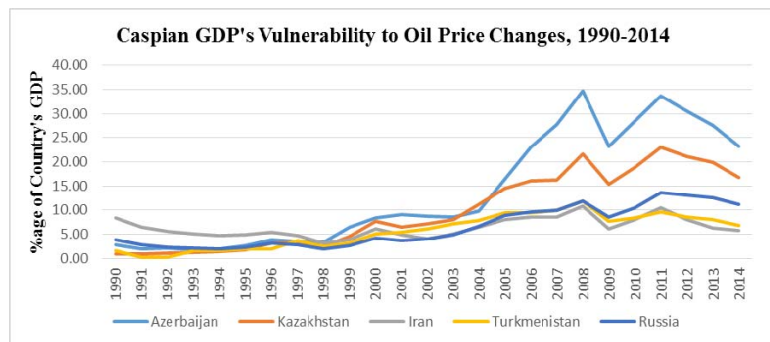
The final result obtained from this metric is expressed in percentage. Higher percentages denote greater potential offset against likely environmental degradation to the nation's energy supply security.

**RESULT AND DISCUSSION**

This section presents the results obtained from the calculation of three energy security indicators discussed above:

**VULNERABILITY OF CASPIAN ECONOMIES TO OIL PRICE SHOCKS**

From a macroeconomic viewpoint, the vulnerability of a net oil exporting country can be determined by the ratio of the value of net oil exports to GDP. The higher this ratio, the larger the fall in GDP that is required to offset a fall in oil prices. The impact of the oil price shock is calculated as the index of vulnerability multiplied by the percentage change in oil prices. Based on this, the vulnerability of the Caspian economies to oil price changes is calculated using historical data of GDP, oil consumption, exports and prices from 1980-2015<sup>1</sup> and the result is presented in figure 4.



**Figure 4: Caspian GDP's Vulnerability to Oil Price Changes, 1990-2014**

Source: the study

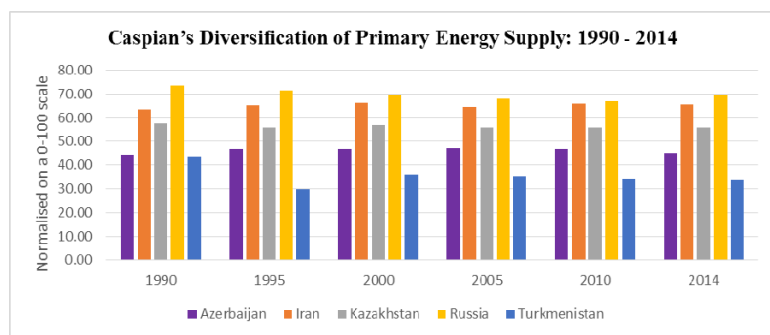
The result reveals that the Caspian economy is much more vulnerable to oil price changes as the oil export share of GDP moves in the direction of variation in global oil market. During periods of high oil prices, notably 2008 and 2011, when the average annual price of oil was respectively \$107 and \$117 a barrel, oil export revenue share of GDP was significantly high in the region; while under plummeting oil price regimes (for instance 2009 and 2014 when average oil price dropped to \$68 and \$98 respectively (see figure 2), the contribution of oil exports to GDP was greatly submerged. Among the five member countries, however, the vulnerability impact is seen to be more pronounced in Azerbaijan and Kazakhstan owing to their high contribution of oil export revenue to their GDP. Moreover, the downward trend of prices observed from 2011 to below \$50 as of April 2016, suggests an increasing vulnerability of the Caspian Region's economy.

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**DIVERSIFICATION OF PRIMARY ENERGY SUPPLY (DPES)<sup>2</sup>**

As earlier stated, DPES measures the degree of diversification within the Caspian economies' primary energy supply. The DPES values presented in Figure 5 are normalised on a scale of 0-100, with values closer to 100 reflecting an even distribution among the main energy sources in the economy.



**Figure 5: Caspian's Diversification of Primary Energy Supply (DPES) from 1990 - 2014**

Source: the study

As evident in Figure 5, three economies, Russia, Iran and Kazakhstan had DPES value higher than 50, ranging from 58 (in Kazakhstan) to 70 (in Russia) between 1990-2014. These values signify that these economies are moderately diversifying their supply portfolios and owing to availability of sizeable energy supply sources, these economies are less prone to energy supply security risk.

Nevertheless, the constancy of growth as well as intermittent DPES values obtained within the considered period suggests significant attention. As for the Azerbaijan and Turkmenistan economies, on the other hand, the DPES values below

50 suggest that they are primarily dependent on few sources of energy to meet their rising energy demand. These lower DPES values signal that the two economies have a higher level of energy supply security risk because they are highly prone to any changes occurring in the variable energy markets surrounding these sources.

In terms of average Caspian diversification efforts, a slightly decreasing DPES value from 53 to 52 was obtained within the considered period. This indicates that few economies in the region remain relatively low in terms of diversification, while those that exhibit high diversification tendencies like Russia

and Iran also need great strides towards more diversification of their demand portfolios. Overall, this metric also reveals the potential for increasing energy supply risk within the Caspian as the economies are principally dependent on oil and gas proceeds. Moreover, high oil and gas export dependency is detrimental to the region's economic growth because of the unpredictability in the current and future prices of its main energy source in the global market, thus underlining the need for more diversity in the region's energy portfolio.

### CARBON FREE ENERGY PORTFOLIO (CFEP)

This study also analyses Caspian's vulnerability in terms of non-carbon energies in the region's overall energy portfolio; which includes hydro, nuclear and renewable energies. Although a high carbon-free percentage reveals a greater potential for curbing potential environmental degradation, the share of this vital indicator amidst Caspian economies is seen to be very low, less than 4% throughout the considered period. Figure 6 reveals great variation in the CFEP values in the selected years. In 1990, Russia's CFEP share was 3.0%, this improved to 3.7% (the highest) in 1995 and thereafter declined over the years reaching a low figure of 2.9% in 2014.

As for Azerbaijan, its CFEP value rose from 0.7% in 1990 to reach 3.3% in 2010 and eventually dropped to about 1.9% in 2014, while this same metric in Kazakhstan rose from 1% in 1990 to 2% in 2000 and stood below 1% in 2014. In the case of Iran and Turkmenistan, CFEP values stood at approximately 1% and 0.2% respectively in 2014. The low yet fluctuating historical CFEP trend highlights the absence of any concerted effort amidst the Caspian states to develop carbon free energy sources. Moreover, the clearly low proportion of non-carbon based fuel in the Caspian economies' energy portfolio highlights the need for these

economies to seriously pursue options to curb energy stimulated GHGs emissions and facilitate future CFEP growth in the region. The index, however, discloses the region's high vulnerability to possible environmental degradation associated with huge fossil energy production and export.

### CONCLUSION

This study reveals that the Caspian as an important net oil exporting region is highly vulnerable to oil shocks and that the recent downward trend in the global oil price is further exacerbating the situation, thus placing a crucial burden on economic growth and competitiveness of member economies. Based on the findings of this study, energy supply cum foreign earning sources diversification is very essential for meaningful economic and energy security amongst the member economies. In addition, huge investment in renewable energy technologies (wind, solar, hydro and biomass) is required to reduce Caspian's heavy dependence and high vulnerability to oil price changes as the prices of renewable solutions are independent of the global oil price.

To further strengthen the region's energy security efforts, it is vital to encourage research and development (R&D) initiatives as this will promote technological improvement in the region. Finally, regional cooperation among member states is also recommended to facilitate investment, project funding, capacity building and technology transfer. The general conclusion of this research is that the Caspian economy faces a serious problem of adjusting to the present and potential future low oil price shocks. Nevertheless, few policy measures are available to member states. This paper hence calls for thorough research (on country basis) into the gravity of the implication these would have on the different sectors of the economy; this will perhaps offer invaluable insights for relevant policy formulation to curb this situation at sectoral levels instead of a broad approach.

### Footnotes

<sup>1</sup> Historical data for this indicator was acquired from World Bank and BP Statistics, 2015.

<sup>2</sup> Historical data from 1990 is acquired from the International Energy Agency (IEA) database, and therefore includes major primary energy supply sources in the region, both renewable and non-renewable.

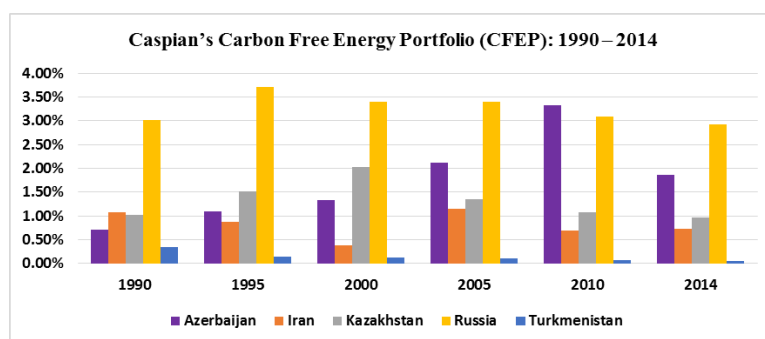


Figure 6: Caspian's Carbon Free Energy Portfolio (CFEP): 1990 – 2014  
Source: the study



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