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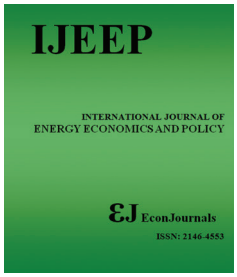

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Oil Price and Employment Nexus in Saudi Arabia

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ABSTRACT

Higher oil price is a signal of economic growth in Saudi Arabia due to her heavy dependence on oil revenues. This study has perused the relationship between oil price and employment in Saudi Arabia by using sample period of 1980-2015 and by utilizing the linear and non-linear autoregressive distributed lag (ARDL) models. We have found a positive influence of oil price on employment level in both linear and non-linear ARDL settings. Further, employment effects of increasing and decreasing oil price are found asymmetrical in the non-linear ARDL and we have also found that increasing oil price is positively affecting employment more than declining employment due to fall in oil price. Further, economic growth supports employment significantly. This study recommends the government of Saudi Arabia to save oil revenues in time of prosperity to support employment level in the oil price crisis period.

Keywords: Oil Price, Employment, Non-linear Autoregressive Distributed Lag
JEL Classifications: Q41, E24, C12

1. INTRODUCTION

Oil price may have positive role in oil exporting countries' and negative role in oil importing countries' employment level. Unemployment in an oil exporting country Saudi Arabia is rising due to heavy dependence on oil revenues and lesser on other industries. The recent oil price declines are becoming a reason for lower government revenues, lower employment level and lower income level in the country. OPEC oil basket price has been observed 109.45$, 105.87$, 96.29$, 49.49$ and 40.68$ per barrel in the years 2012, 2013, 2014, 2015 and 2016 respectively. It has fallen even more sharply in February 2016 as it is observed at 30.68$ per barrel. It has a slight rising trend as well afterwards and more recently, its price is observed at 50.81 $ per barrel in May, 2017 (SAMA, 2017).

Table 1 is showing an interest statistics of previous 5 years regarding the percentage of employment out of total labour force, oil price and oil-dependence. The contribution of oil sector to total gross domestic product (GDP) has been observed 50.84%, 50.02%, 46.24%, 42.36% and 27.46% in years 2011, 2012, 2013, 2014 and 2015 respectively. The proportion of oil sector is more than 50% of total GDP till year 2012 which is showing a high dependence of Saudi economy on the oil sector. In years 2013 and 2014, this proportion has been decline but it is still very high. This proportion is suddenly decline from 42.36% to 27.46% in the year 2014-2015. This sudden declined proportion is matching with a heavy decline in the oil price from 96.29$ to 40.68$ in the year 2014-2015. In the government dependence argument, the contribution of oil revenue to total government revenue has been observed as 92.53%, 91.78%, 89.51%, 87.45% and 72.48% in years 2011, 2012, 2013, 2014 and 2015 respectively. The oil dependence in government revenue is slightly decreasing from year 2011-2014 but a sharp decline from 87.45% to 72.48% in the years 2014-2015 is again in line with sharp decline in oil price from 42.36% to 27.46% in the year 2014-2015. The heavy reliance of government revenue and GDP on the oil revenue and price are showing that a declining oil price now-a-days could be proved very harmful for economic activities and employment in the Saudi Arabia.

In the relationship of employment and oil price in the reported 5 year data in Table 1, employment rate is increasing from 94.2%

Table 1: Oil and employment statistics

Years	Employment (%)	Oil price per barrel ($)	Oil sector to GDP (%)	Oil revenue to total government revenue (%)
2011	94.2	107.8	50.84	92.53
2012	94.5	109.45	50.02	91.78
2013	94.4	105.87	46.24	89.51
2014	94.3	96.29	42.36	87.45
2015	94.3	40.68	27.46	72.48

Source: SAMA (2017), GDP: Gross domestic product

to 94.5% with increasing oil price from 107.8$ to 109.45$ in year 2011-2012. After the year 2012, the declining employment rate is matching with the oil price declines. But, employment rate is observed stagnant from year 2014 to 2015 with a heavy decline in oil price from 96.29$ to 40.68$. These observations in years 2014 and 2015 are not seemed natural with the heavy dependence of Saudi economy on the oil sector discussed before. This relationship is showing the government support in the present oil price crisis which is heavy burden on government budget.

Oil price has a negative trend mostly since mid of year 2014 till now May, 2017. If oil price will not maintain its last position as it was in the year 2012 then it may have very adverse effects on employment. Therefore, this research is highly interested in exploring the linkages between oil price and employment in Saudi Arabia in log-log linear model to estimate the elasticity of employment with respect to oil price. For this purpose, we are utilizing the linear and non-linear autoregressive distributed lag (ARDL) model as motivation of our study is also to differentiate the influence of positive and negative movements of oil price on employment and to test a possible asymmetry in the relationships.

2. LITERATURE REVIEW

Oil price and employment nexus has attracted the attention of empirical literature. For example, Altay et al. (2013) explore this nexus for Turkey by using data of a period 2000Q1 to 2012Q4. They find the one way relationship from oil price and income to the employment level in short run. Further, they find that oil price is also causing to income and employment in the long run. Burakov (2017) claims that oil price has direct effect on the economic activities if country is oil exporter and her income is majorly depending on the oil revenues. Further in the empirical testing of oil price and economic growth relationships, he finds cointegration and short run causality in the said variables in Russia by using a sample period of 1990-2015. Therefore, oil price could also have effect on the employment due to greater economic activities in case of rising oil price in oil exporting country and vice versa. Keane and Prasad (1996) explore this nexus using real wage model. They find that increasing oil price is responsible for declining real wage of unskilled worker but has pleasant effect on wage of skilled labour. Further, they find that increasing oil price has unfavourable effect on employment in short run and favourable in the long run.

Most of literature is available in the relationship of oil price and unemployment which is an indirect testing of effect of oil price on the employment. For example, Hooker (1996) investigates economic growth and unemployment effects of oil price in USA by exploring this relationship by using quarterly data for two subsets of 1948-1973 and 1973-1994. He finds a significant causality from oil price to economic growth and unemployment in the first subset and insignificant causal impact in the second subset. Carruth et al. (1998) investigate this relation in the efficiency wage model of USA economy. They find a significant contribution of these variables in determining the unemployment rate in the most of the years in the large sample. Gil-Alana (2001) investigates this dynamic relationship for Australia by using cointegration approach. He finds a highly significant cointegration and concludes that oil price is responsible for creating high unemployment. Ewing and Thompson (2007) investigate the cyclical components, by using monthly time series of USA, of oil price and unemployment. After running HP filter and including inflation, manufacturing output and stock market index in the analysis, they find that unemployment is influenced by oil price and it has a significant contribution in inflation and stock market index as well. Further, oil price is also playing a sensitive and significance role in determining the manufacturing output. Dogrul and Soytas (2010) investigate this issue by using monthly data of Turkey for a period of 2005-2009. They test the relationship among interest rate, oil price and unemployment by using Toda-Yamamoto causality test and find that oil price is significantly causing to unemployment. Using the same model and methodology, Ahmad (2013) investigates this issue for Pakistan by using monthly data of 1991-2010. He finds a significant contribution of oil price on unemployment by doing causality analysis but effect of interest rate remains insignificant. Further, he concludes that oil price would be helpful in forecasting future unemployment rates.

In the case of Saudi Arabia, there has been a little descriptive type of literature available that highlights the consequences of oil price on the local economy generally and there is no single study that discusses the oil price and employment nexus particularly. For example, Council of Saudi Chambers (2009) discusses the issue of oil price in descriptive way with reference to oil price crisis period of 2008. The study shows that oil price has started declining from the beginning of second half of the year 2008 and during the year 2009. Oil price has been found <40$ per barrel which has been observed more than 3 times before of that period. Oil price has been declined due to world financial crisis, fluctuations in exchange rate of US Dollar and strategic stock of main countries particularly U.S.A and China. This study discusses the result of declining oil price on investment level of petroleum sector in Saudi economy and reports a negative effect on the size of investments. Further, declining investment is found responsible for lower economic growth and employment levels. This study recommends adopting a rational economic policy based on economic diversification which could reduce the reliance upon the oil revenues and price.

From a literature review, we discover a significant influence of oil price on employment or unemployment in the most of reviewed studies and an insignificant result is also reported by Ewing and Thompson (2007). Therefore, it is empirical questions that oil price is significantly explaining to employment in an oil exporting country Saudi Arabia or not. Further, there is no single study on this

very important topic before in Saudi Arabia which is hypothesized by our present study.

3. MODEL AND ESTIMATION STRATEGY

Our goal is to test the influence of oil price on employment level in Saudi Arabia. This country is heavily depending on the oil revenue and oil price. Therefore, oil price is expected to contribute significantly on the employment level in the economy. For this purpose, we regress the influence of oil price and economic growth on employment by using log-log linear two factor model:

$$\log EM_t = \alpha+\gamma_1 \log OP_t+\gamma_2 \log YG_t+e_t \quad (1)$$

Here, $\log EM_t$ is log of employed labour force in millions and $\log OP_t$ is log of oil price in US dollar per barrel. $\log YG_t$ is log of GDP growth rate. The data on these variables is collected from SAMA (2017). Increasing oil price is likely to positively contribute to employment level in Saudi Arabia. Therefore, the sign of $\log OP_t$ is expected as positive. It means that employment level will increase with an increase in oil price and employment level will decrease with a decrease in oil price. Further, $\log YG_t$ is expected to positively contribute in employment level as economic growth means more economic activities and more of employment as well.

At first, the variables of our model will be tested for unit root problem which is harmful for empirical estimations if ignored. Kwiatkowski et al. (1992) introduce the KPSS test to conclude the unit root test in series as follows:

$$W_t = k_t+(r_t+r_0)+\zeta_t \quad (2)$$

Here, W_t is series for test, t is time trend and r_t is procedure of random walk where r_0 can be consider as intercept/initial value of W_t. The null hypothesis of this test is a stationary series, W_t. Rejection of hypothesis can be evidence for non-stationary series. The KPSS statistic is defined as:

$$KPSS= \frac{1}{T^2}\sum_{t=1}^{T} SUM_t^2 \Big/ \hat{\sigma}^2 \quad (3)$$

Where, SUM_t^2 is sum of square of error term from equation 2 and $\hat{\sigma}^2$ is variance. After testing the unit root, we can proceed for cointegration. We are utilizing the ARDL test suggested by Pesaran et al. (2001). ARDL can be framed for equation 1 as:

$$\begin{aligned}\Delta \log EM_t &= \varphi + \delta_1 \log EM_{t-1} + \delta_2 \log OP_{t-1} + \delta_3 \log YG_{t-1} \\ &+ \sum_{i=1}^{p} \phi_{1i} \Delta \log EM_{t-i} + \sum_{i=0}^{q} \phi_{2i} \Delta \log OP_{t-i} \\ &+ \sum_{i=0}^{r} \phi_{3i} \Delta \log YG_{t-i} + \varepsilon_t \end{aligned} \quad (4)$$

To test the cointegration, we apply the wald test on H_0: $\delta_1=\delta_2=\delta_3=0$. After Wald test, if cointegration is proved then we can estimates the long run influence of oil price and economic growth on employment through δ_2/δ_1 and δ_3/δ_1. Further, short run relationships and effects can also be estimated through error correction model (ECM) in following way:

$$\begin{aligned}\Delta \log EM_t &= \sum_{i=1}^{p} \varpi_{1i} \Delta \log EM_{t-i} + \sum_{i=0}^{q} \varpi_{2i} \Delta \log OP_{t-i} \\ &+ \sum_{i=0}^{r} \varpi_{3i} \Delta \log YG_{t-i} + \vartheta ECT_{t-1} + \xi_t \end{aligned} \quad (5)$$

In equation 5, negative and significant parameter of ECT_{t-1} will be an indication of short run relationships in 5. Further, short run effects can be captured through parameters of differenced variables. Equations 4 and 5 signify that increasing oil price is increasing the employment and decreasing oil price is decreasing employment. But, this result can be claimed as biased. Because, it is possible that increasing oil price is good signals for economic activities and employment in Saudi Arabia as most of economic performance of Saudi Arabia is depending on oil price. But, it is also possible that a decreasing oil price could not harm employment level due to government support in times of oil price crisis. Therefore, a linear ARDL estimation can be claimed as biased and there is a need to test the effect of oil price in non-linear ARDL settings recommended by Shin et al. (2014). Then we can differentiate the effects of increasing and decreasing oil price separately on the employment level. We can differentiate these as:

$$\log OP_t^+ = \sum_{j=1}^{t} \Delta \log OP_j^+ = \sum_{j=1}^{t} \max\left(\Delta \log OP_j, 0\right) \quad (6)$$

$$\log OP_t^- = \sum_{j=1}^{t} \Delta \log OP_j^- = \sum_{j=1}^{t} \min\left(\Delta \log OP_j, 0\right) \quad (7)$$

Where, equations 6 and 7 are showing partial totality of increasing and decreasing variations in $\log OP_t$ variable respectively. We can adjust these variable $\log OP_t^+$ and $\log OP_t^-$ in equations 4 and 5 to test possible asymmetrical effects of oil price on employment level. Non-linear ARDL equation and its ECM by including $\log OP_t^+$ and $\log OP_t^-$ are as follows:

$$\begin{aligned}\Delta \log EM_t &= \chi + \nu_1 \log EM_{t-1} + \nu_2^+ \log OP_{t-1}^+ + \nu_2^- \log OP_{t-1}^- \\ &+ \nu_3 \log YG_{t-1} + \sum_{i=1}^{p} \iota_{1i} \Delta \log EM_{t-i} \\ &+ \sum_{i=0}^{r} \left(\iota_{2i}^+ \Delta OP_{t-i}^+ + \iota_{2i}^- \Delta OP_{t-i}^-\right) \\ &+ \sum_{i=0}^{p} \acute{e}_{3i} \Delta \log YG_{t-i} + \xi_t \end{aligned} \quad (8)$$

$$\begin{aligned}\Delta \log EM_t &= \sum_{i=1}^{p} \tau_{1i} \Delta \log EM_{t-i} + \sum_{i=0}^{r} \left(\tau_{2i}^+ \Delta OP_{t-i}^+ + \tau_{2i}^- \Delta OP_{t-i}^-\right) \\ &+ \sum_{i=0}^{q} \tau_{3i} \Delta \log YG_{t-i} + \upsilon ECT_{t-1} + \zeta_t \end{aligned} \quad (9)$$

We can test the cointegration with null hypothesis of $\nu_1=\nu_2^+=\nu_2^-=\nu_3=0$ in equation 8. Afterwards, long run effect of $\log OP_t^+$, $\log OP_t^-$ and $\log YG_t$ on employment can be captured through ν_2^+/ν_1, ν_2^-/ν_1 and ν_3/ν_1 respectively. Further, the possibility of asymmetry in effects of $\log OP_t^+$ and $\log OP_t^-$ can be confirmed through wald test on H_0: $\nu_2^+/\nu_1=\nu_2^-/\nu_1$.

4. DATA ANALYSES AND DISCUSSIONS

Table 2 shows KPSS results with H_0: Stationarity of series. The null hypothesis has been rejected in case of level of $\log EM_t$ and $\log OP_t$.

However, $LogYG_t$ is stationary at level with intercept and trend in analysis but it is non-stationary with only intercept in analysis. Further, all variables are stationary at their first differences as null hypothesis of stationarity could be rejected with calculated KPSS test statistic. Though. a mix order of integration is found in the unit root test analysis but it is sufficient to proceed for ARDL cointegration test.

Table 3 shows the long and short run estimates from selected linear and non-linear ARDL model through Akaike Information Criteria. At first, bound test shows the F-value = 6.2174 and the F-value = 11.5643 which are higher than upper critical F-value in the both linear and non-linear ARDL model respectively and we can claim for a strong cointegration in our proposed models. The diagnostic tests in both models are showing that our linear and non-linear ARDL models are out of any econometric problem. Further, oil price is showing a positive and significant impact on employment level in the linear ARDL model. It means that increasing oil price is increasing employment level and decreasing oil price is responsible for decreasing employment level in Saudi Arabia. But, this results is not reliable due to an argument that both increasing and decreasing oil price would not been have same effects. Therefore, we have done this analysis in non-linear ARDL settings. Again, the non-linear ARDL results show that both $logOP_t^+$ and $logOP_t^-$ variables have positive effects on employment. But, an evidence of asymmetry can be observed from the magnitudes of oil price positive and negative variables. The coefficient of $logOP_t^+$ is showing higher magnitude than coefficient of $logOP_t^-$. Therefore, we apply the Wald test on the null hypothesis of $\nu_2^+/\nu_1=\nu_2^-/\nu_1$ to ensure that the difference in magnitude is statistically significant or not. The F-value of Wald test is 37.4676 and it is significantly high at 1% level of significance. Therefore, we can claim the presence of asymmetry in the effects of $logOP_t^+$ and $logOP_t^-$ on employment. In comparison of the coefficients, the $logOP_t^+$ is showing the higher elasticity than $logOP_t^-$. This may be due a reason that Saudi economic activities are heavily depending on oil prices and increasing oil prices have good signal for economic activities and employment level. On the other hand, decreasing oil prices are reducing employment but with a minute magnitude due to the government support in time of oil price crisis. Further, economic growth is positive and significantly affecting the employment in the both models. It is showing that higher

Table 2: Unit root test (KPSS)

Variable	Intercept	Intercept and trend
$LogEM_t$	0.6007 (5)**	0.1837 (4)*
$LogOP_t$	0.4550 (5)*	0.1993 (4)**
$LogYG_t$	0.4047 (3)*	0.0743 (0)
$\Delta logEM_t$	0.0741 (0)	0.0665 (3)
$\Delta LogOP_t$	0.2564 (0)	0.1061 (6)
$\Delta LogYG_t$	0.2146 (12)	0.1876 (11)

*And** are showing stationary at 10% and 5%. Contains Bandwidth

Table 3: Regression results

Variable	Linear ARDL			Non-linear ARDL		
	Coefficient	t-value	P value	Coefficient	t-value	P value
Long run results						
$logOP_t$	0.1988	8.3822	0.0000	-	-	-
$logPOP_t$	-	-	-	0.1644	13.6661	0.0000
$logNOP_t$	-	-	-	0.0544	2.4569	0.0267
$logYG_t$	0.0046	2.0345	0.0588	0.0023	2.9839	0.0093
Intercept	6.0545	181.7601	0.0000	6.0653	446.5005	0.0000
Wald test	-	-	-	F value=37.4676		0.0000
Short run results						
$\Delta logEM_{t-1}$	0.2813	1.1875	0.2523	0.5018	3.0509	0.0081
$\Delta logEM_{t-2}$	0.6725	3.0105	0.0083	0.7906	5.8829	0.0000
$\Delta logEM_{t-3}$	0.0231	0.0877	0.9311	0.6008	3.2266	0.0056
$\Delta logEM_{t-4}$	0.7432	2.8546	0.0115	1.2387	6.7973	0.0000
$\Delta logOP_t$	0.1358	3.1487	0.0062	-	-	-
$\Delta logOP_{t-1}$	−0.1445	−2.3839	0.0299	-	-	-
$\Delta logOP_{t-2}$	0.0767	1.5037	0.1521	-	-	-
$\Delta logPOP_t$				−0.0220	−0.3104	0.7605
$\Delta logPOP_{t-1}$				−0.1640	−1.7908	0.0935
$\Delta logPOP_{t-2}$				0.0786	1.0050	0.3308
$\Delta logPOP_{t-3}$				−0.1086	−1.9018	0.0766
$\Delta logNOP_t$				0.1135	2.4462	0.0272
$\Delta logNOP_{t-1}$				−0.0798	−1.3432	0.1992
$\Delta logYG_t$	0.00274	2.0261	0.0598	0.0027	3.0481	0.0081
$\Delta logYG_{t-1}$	−0.0005	−0.5233	0.6079			
$\Delta logYG_{t-2}$	0.0022	2.0845	0.0535			
ECT_{t-1}	−0.7916	−4.1629	0.0007	−1.1890	−8.6031	0.0000
Bound test (F value)	6.2174	Upper critical F value at 1%=6.13		11.5643	Upper critical F-value at 1%=5.61	
Heteroskedasticity	1.3086	0.3013		0.8904	0.5834	
Serial correlation	0.7388	0.4954		1.3284	0.2986	
Jarque-Bera	2.0141	0.3652		0.5574	0.7567	
Ramsey reset	0.5238	0.4804		2.1673	0.1631	

ARDL: Auto-Regressive distributive lag

economic growth hence higher economic activities are promoting employment level in the long run.

Coefficients of ECT_{t-1} in both linear and non-linear ARDL models are negative and significant. Therefore, short run relationships are existing in both models. Optimum lag has been initially put as 5 in both models as all explanatory variables could have long lag effects. The coefficients of lag employment variables have strong positive effects on current employment in both models due to aggregate demand effects as higher employment in any period in symbol of higher aggregate demand in the current and proceeding years. In the linear ARDL model, the first lag variable of oil price is positive impact on employment level but its second lag is showing insignificant impact. It means that 1 year lag oil prices are also determining the employment in the short run. Further, the economic growth and its lags are also showing positive contribution in generation of employment mostly.

In the non-linear ARDL, positive oil variable has mostly insignificant and negative effects on the employment level. It means that rising oil price does not support employment in the short run mostly. But, coefficient of negative oil price movements is showing a positive and significant effect. It means that oil price declines are even decreasing employment in the short run but its lag is not affecting the employment. Further, economic growth is also positively impacting employment.

5. CONCLUSIONS

Saudi Arabia heavily depends on the oil price and oil revenues. Therefore, the employment levels may be influenced by change in oil price. This research has been investigated this issue in linear and non-linear ARDL settings. In the unit root analysis, we have found a mix order of integration. Further, we have found the strong cointegration in both linear and non-linear ARDL models. In the linear ARDL model, we have found positive effects of economic growth and oil price on the employment in long and short runs. In the non-linear ARDL model, both $logOP_t^+$ and $logOP_t^-$ are contributing positively in employment but these effects are found asymmetrical. The positive oil price movement has greater impact on employment in the long run because of heavy dependence of Saudi economy on the oil prices. However, the negative oil price movement has adverse effect on employment but its adverse effects is observed very minute which is may be due to government support to economy in the time of oil price crisis.

Further, economic growth has positive influence on employment in the short and long runs in both models. Our study recommends the government of Saudi Arabia to save more oil revenue in the oil price rising period to finance the economy in times of crisis.

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