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Analysis the Asymmetric Effect of Oil's Price and Revenue on Unemployment Rate in Iran Application of Asymmetric Model (NARDL)

Zaroki, Sh.[1*], Yousefi Barfurushi, A.[2], Fathollahzadeh, A. H.[3]

Abstract

This paper studies the role of oil price and oil revenue in unemployment rate in a symmetrical (linear) and in an asymmetrical (nonlinear) model for Iran. For this purpose, seasonal data 2001:2 to 2017:4 and ARDL model in linear and nonlinear approach has been used. The results in the linear approach show that the oil price has inverse effect on unemployment rate and the oil revenue has no significant effect. Also, according to the nonlinear approach, in the short run, oil price and oil revenue have an asymmetric effect on the unemployment rate. So that, decreases in the oil prices has a negative effect on unemployment rate and the effect of increases in the oil price is not significant. In terms of oil revenue, the results show that increases and decreases have a reverse effect on the unemployment rate. So that, the first, the magnitude of the effect of increases in the oil income on unemployment is different from the effect of decreases in the oil income, and second, the effect of decreases in the oil income is greater than the effect of increases in the oil income. The results for oil price in long-run is similar to short-run, and only decreases in the oil price have a reverse effect on unemployment rate. In long-run, the impact of oil revenue is unlike to short-run and it's negative. So that the first, asymmetric effect of oil revenue on unemployment rate is confirmed, and second, unlike to short-run, in the long-run, the magnitude of the effect of increases in the oil revenue on unemployment is greater than the effect of decreases in the oil revenue. CPI in the linear and nonlinear approach has a negative effect on the unemployment rate in the short-run and long-run.

Keywords: Unemployment, Oil, NARDL, Iran.

JEL Classification: E24, C32, Q43, E31.

1. Introduction

While the oil price is falling, concerns about the consequences of this falling and its reasons increase. Because of the decrease in the oil price may show a decline in demand of total energy, which can affect economy performance and unemployment (Cuestas and Gil-Alana, 2017). On the other hand, in some oil-

1. Assistant Professor in Economics, Faculty of Economic, University of Mazandaran **Email:** Sh.zaroki@umz.ac.ir
2. Master of Science in Economics Science, University of Mazandaran **Email:** Arman.yousefi1372@gmail.com
3. Master of Science in Energy Economics, University of Mazandaran **Email:** Amirhossein300@yahoo.com

exporting countries, such as Iran, oil revenue is the main source of financing and social infrastructures. In such countries, where oil revenue belong to the government and regarding the effects that can have on government expenditure, money supply, inflation, real exchange rate and imports, it's said that, it has a significant effect on the macroeconomic variables (Emami and Adibpour, 2012). Oil revenue movements should also be considered for countries such as Iran, which in the recent period was subject to oil sanctions, rising in oil price do not have a significant effect on the economy, even when the oil price is rising due to the decline in the share of market or the lack of entry of foreign exchange to the country. Obviously, when the budget is more dependent on oil revenue, the economy will be more affected by oil price movements. On the other hand, unemployment is one of the main concerns of countries with young population. Increasing in unemployment in every country can cause irreparable damages. As Iran has a high percentage of the active population and the majority of this group consists of young people with high education; the problem of unemployment can create serious psychological and social harms. On the other hand, the education for each person since elementary to university is costly, but due to unemployment, the labor force will inevitably migrate to the other countries, and destination country will use this human capital freely to increase its production. The present study has tried to test the relationship between the oil price and oil revenue with unemployment rate in Iran. In Iran's economy, it is expected that increases and decreases in oil price have different effects on unemployment rate.

In such a way that at least with the increases in the oil price (or in the oil revenue), the unemployment rate is reduced, But with decreasing in the oil price (or in the oil revenue), unemployment will not rise with same coefficient or even doesn't rise at all. When the oil price decreases, budget deficit will happen because of the high dependence of economy on oil revenue and because in most cases this budget deficit is offset by a decrease in the development budget; it is expected that the rate of unemployment will increase as oil price goes down. This reversal relation between oil price and unemployment rate, at the time of rising oil price, is also justifiable. Thus, with rising oil price and, consequently, government revenues, it is likely that the level of infrastructure and development activities would increase, which cause reduce the unemployment rate. Of course, it should be considered that due to the inefficient allocation of oil revenues, the effect of increases in oil price on reducing in unemployment rate would not be as effective as decreases in oil price on rising in unemployment rate. This topic impulse the authors to focus on the asymmetric effects of oil price and oil revenue on unemployment rate; and examine the asymmetric effect of oil price and oil revenue on unemployment rate. To achieve such a processing, we need to use asymmetric models. Then, According Shin et al. (2014) Non-linear ARDL approach has been used to explain and describe asymmetric effect.

In the second section, the econometric model has been presented in the form of the NARDL approach. The results of estimation in both symmetric and asymmetric formats have been presented in the third section. The conclusion is in the fourth section.

2. Data and Econometrics Model

The main aim of the present research is to analyze the asymmetric effects of oil price and oil revenue on unemployment rate. Therefore, focusing on the two research models is to separate the effect of increases in oil price and oil revenue with the effect of decreases in oil price and oil revenue. In the specification of the model, the study of Shin et al. (2014) has been used. Shin et al. (2014) introduce a new model using the Pesaran et al. (2001) study, which is called the nonlinear autoregressive distributed lag (NARDL) model. The variables in the econometric model are the unemployment rate (UR) and oil price (OilP), oil revenue (OilR) and consumer price index (CPI). Variables are considered logarithmically. Unemployment data from the Statistical Center of Iran, oil price from OPEC Internet Portal, and oil revenue and consumer price index from the Central Bank of the Islamic Republic of Iran have been extracted.

In the specification of the first model, oil price is imported and in the second model, oil revenue replaces it. The NARDL model base is Equation (1) in which UR, OilP and CPI is variables with first integration. The OilP in the form of $OilP_t = OilP_0 + OilP_t^+ + OilP_t^-$ has been decomposed in such a way that partial accumulation in the OilP changes is in the form of relation (2).

$$UR_{\ t} = \delta^+ OilP_t^+ + \delta^- OilP_t^- + \omega CPI_t + u_t \quad (1)$$

$$\begin{cases} OilP_t^+ = \sum_{j=1}^{t} \Delta OilP_j^+ = \sum_{j=1}^{t} \text{Max}(\Delta OilP_j\ , 0) \\ OilP_t^- = \sum_{j=1}^{t} \Delta OilP_j^- = \sum_{j=1}^{t} \text{Min}(\Delta OilP_j\ , 0) \end{cases} \quad (2)$$

Based on the above relations, the asymmetric model of ARDL (p, q, r, s) is designed in the form of relation (3). In this case, β is the autocorrelation coefficient, δ^+ and δ^- are asymmetric coefficients of OilP lags and ω is the coefficient of the CPI lags.

$$UR_t = \sum_{j=1}^{p} \beta_j UR_{t-j} + \sum_{j=0}^{q} \delta_j^{+\prime} OilP_{t-j}^+ + \sum_{j=0}^{r} \delta_j^{-\prime} OilP_{t-j}^- + \sum_{j=0}^{s} \omega_j CPI_{t-j} + \varepsilon_t \quad (3)$$

According to Shin et al. (2014), the first model is as follows:

$$\Delta UR_t = \beta UR_{t-1} + \delta^+ OilP_{t-1}^+ + \delta^- OilP_{t-1}^- + \omega CPI_{t-1} + \sum_{i=1}^{p-1} \beta_i \Delta UR_{t-i} + \sum_{i=0}^{q-1} \delta_i^+ \Delta OilP_{t-i}^+ + \sum_{i=0}^{r-1} \delta_i^- \Delta OilP_{t-i}^- + \sum_{i=0}^{s-1} \omega_i \Delta CPI_{t-i} + e_t \quad (4)$$

Where $\delta_i^+ \neq \delta_i^-$ means short-run asymmetry and $\delta^+ \neq \delta^-$ means long-run asymmetry. Based on the above model, we can test the asymmetric effect of oil price on unemployment rate in short-run (with estimation of parameters δ_i^+ and δ_i^-) and long- run (with estimation of δ^+ and δ^-). By analyzing the OilR in the form of $OilR_t = OilR_0 + OilR_t^+ + OilR_t^-$ and replacing it in place of oil price in

the form of relation (4), the second model in the form of the relation (5) is obtained:

$$\Delta UR_t = \beta UR_{t-1} + \mu^+ OilR^+_{t-1} + \mu^- OilR^-_{t-1} + \omega CPI_{t-1} + \sum_{i=1}^{p-1} \beta_i \Delta UR_{t-i} + \sum_{i=0}^{q-1} \mu_i^+ \Delta OilR^+_{t-i} + \sum_{i=0}^{r-1} \mu_i^- \Delta OilR^-_{t-i} + \sum_{i=0}^{s-1} \omega_i \Delta CPI_{t-i} + e_t \quad (5)$$

Where $\mu_i^+ \neq \mu_i^-$ means short-run asymmetry and $\mu^+ \neq \mu^-$ means long-run asymmetry. Based on the above model, we can test the asymmetric effect of oil revenue on unemployment rate in short-run condition (with estimation of μ_i^+ and μ_i^-) and long-run (with estimation of $\mu^+$and μ^-).

3. Results

The unit root test of the Augmented Dickey-Fuller (ADF) and Phillips-Peron (PP) has been used for all variables. ADF and PP tests show that all variables are I(1). With regard to the result of the unit root tests, ARDL and NARDL approach can be used.

3-1. Symmetric model based on the oil price

According to Table 1, the estimated coefficients of the symmetric model show that both oil price and CPI have a negative effect on the unemployment rate in the short-run. Therefore, with a one percent increase in the oil price, the unemployment rate is reduced by 0.061 percent, and with the one percent increase of the CPI, the unemployment rate is reduced by 0.342 percent.

Table 1: Estimation of Symmetric Model Based on the Oil Price in Short-run

Var.	Cof.	t Stat.		Prob.
UR_{t-1}	0.472	4.64		0.000
CPI	-0.342	-2.45		0.017
$OilP$	-0.061	-2.37		0.021
ECT	-0.527	-5.50		0.000
Bounds Test	F-Stat. Value	I(0)	I(1)	Signif.
	7.2	4.99	5.85	1%
Note: The selected model is based on the minimum of Schwarz criterion for ARDL (1, 0, 0). All variables are logarithmic. Dependent variable is the logarithm of unemployment rate.				

In order to clearly find that oil price and CPI effect on the unemployment rate, we will need to recognize the long-run relationship between these variables. Before calculating the long-run effect of explanatory variables on the dependent variable, the possibility of a long-run relationship between them should be investigated. To do this the Bounds Test has been used. The null hypothesis in the bounds test is the absence of a long-run relationship. The result of this test is shown in Table 1. The value of the test statistic is 7.2. Therefore, the null hypothesis is rejected and thus the possibility of establishing a long-run relationship between the oil price, CPI and the unemployment rate will exist. By ensuring that there is a long-run relationship, we can estimate the long-run effect of explanatory variables on the unemployment rate. The result of long-run

estimation has been shown in Table 2. Based on the symmetric model in the long-run, like the short-run, oil price and CPI have a negative effect on the unemployment rate, and with a one percent increase in oil price, the unemployment rate is reduced by 0.116 percent.

Table 2: Estimation of Symmetric Estimation based on the oil price in Long-run

Var.	Cof.	t Stat.	Prob.
L_{OilP}	-0.116	-2.396	0.019
L_{CPI}	-0.649	-2.509	0.014
Note: L_{OilP} and L_{CPI} denote natural logarithm of oil price and CPI. All variables are logarithmic. Dependent variable is the logarithm of unemployment rate.			

3-2. Asymmetric model based on the oil price

In linear estimation it has been shown that the effect of the oil price on unemployment rate is negative in short-run and long-run. The results of the nonlinear estimation in short-run are reported in Table 3. According to Table 3, the estimated coefficients of the asymmetric model show that increases in the oil price (the estimated coefficient of $OilP^+$) has a negative effect on unemployment rate in the current period, but after one season, it has a positive effect. For calculating of the final effect, Wald test has been used. Result of this test show that increases in the oil price (by 0.037) does not affect the unemployment rate. However, decreases in the oil price (the estimated coefficient of $OilP^-$) has a negative effect. Accordingly, it can be said that in short-run, the unemployment rate is affected inversely by the decreases in the oil price. Thus, asymmetric effect of the oil price on unemployment rate is confirmed in short-run. This results show difference between the estimation of the asymmetric and symmetric models in short-run. Another point is that, as same as the symmetric model in short-run, in the asymmetric model CPI has also a negative effect on unemployment rate.

Table 3: Estimation of Asymmetric Model Based on the Oil Price in Short-run

Var.	Cof.	t Stat.		Prob.
UR_{t-1}	0.429	4.25		0.000
CPI	-0.237	-3.41		0.001
$OilP^+$	-0.244	-1.89		0.064
$OilP^+_{t-1}$	0.282	2.16		0.035
$OilP^-$	-0.132	-3.71		0.000
ECT	-0.57	-6.06		0.000
Wald Test for $OilP^+$	Value of Cof.	F-Stat. Value		Prob.
	0.037	1.62		0.208
Bounds Test	F-Stat. Value	I(0)	I(1)	Signif.
	8.74	4.29	5.61	1%
Note: The selected model is based on the minimum of Schwarz criterion for ARDL (1, 0, 1, 0). All variables are logarithmic. Dependent variable is the logarithm of unemployment rate.				

Similar to the previous sub-section here, it is also necessary to use the bounds test to make ensure a long-run relationship. The value of the test statistic is 8.74. Therefore, the null hypothesis is rejected and thus the possibility of establishing a long-run relationship between increases and decreases in the oil price, CPI and the unemployment rate will exist. According to this result, the long-run effect of increases and decreases in the oil price on unemployment rate is estimated and reported in Table 4.

Table 4: Estimation of Asymmetric Model Based on the Oil Price in Long-run

Var.	Cof.	t Stat.	Prob.
L_{OilP^+}	0.065	1.28	0.204
L_{OilP^-}	-0.232	-3.86	0.000
L_{CPI}	-0.415	-3.57	0.000

Note: L_{CPI} denotes natural logarithm of CPI and L_{OilP^+} and L_{OilP^-} are natural logarithm of
increases and decreases in the oil price.
All variables are logarithmic. Dependent variable is the logarithm of unemployment rate.

According to Table 4, the effect of increases in the oil price on unemployment rate does not have a significant effect. However, decreases in the oil price on unemployment rate have a negative effect. The result is that in the long-run, unemployment rate is affected inversely by the decreases in the oil price, and increases in the oil price there will not be an increase in the unemployment rate. In other words, in long-run, asymmetric effect of the oil price on unemployment rate is confirmed. Therefore, it can be stated that in Iran's economy increases and decreases in the oil price don't have same effect on the unemployment rate in long-run and short-run.

3-3. Symmetric model based on the oil revenue

According to Table 5, the estimated coefficients of the symmetric model with regard to the oil revenue show that the oil revenue doesn't have a significant effect on the unemployment rate. But CPI has boundary a negative effect.

Table 5: Estimation of Asymmetric Model Based on the Oil Revenue in Short-run

Var.	Cof.	t Stat.		Prob.
UR_{t-1}	0.526	5.19		0.000
CPI	-0.221	-1.66		0.101
$OilR$	-0.021	-1.38		0.172
ECT	-0.473	-4.99		0.000
Bounds Test	F-Stat. Value	I(0)	I(1)	Signif.
	5.94	4.99	5.85	1%

Note: The selected model is based on the minimum of Schwarz criterion for ARDL (1, 0, 0).
All variables are logarithmic. Dependent variable is the logarithm of unemployment rate.

The value of the bounds test statistic is 5.94. Therefore, the null hypothesis is rejected and thus the possibility of establishing a long-run relationship between oil revenue, CPI and the unemployment rate will exist. According to this result, the long-run effect of oil revenue on unemployment rate is estimated and reported in Table 6.

Table 6: Estimation of Asymmetric Model Based on the Oil Revenue in Long-run

Var.	Cof.	t Stat.	Prob.
L_{OilR}	-0.045	-1.34	0.184
L_{CPI}	-0.467	-1.68	0.097
Note: L_{OilR} and L_{CPI} denote natural logarithm of oil revenue and CPI. All variables are logarithmic. Dependent variable is the logarithm of unemployment rate.			

According to Table 6, results in long-run are same to short-run. So that the oil revenue has no effect on the unemployment rate and CPI is associated with a positive effect.

3-4. Asymmetric model based on the oil revenue

Results of linear estimation show that the oil revenue does not have a significant effect on unemployment in short-run and long-run. In linear estimation it has been shown that the effect of the oil revenue on unemployment rate isn't significant in short-run and long-run.

The results of the nonlinear estimation in short-run are reported in Table 7. According to Table 7, the estimated coefficients of the asymmetric model show that increases in the oil revenue (by -0.032) and decreases in the oil revenue (by -0.082), with a seasonal lag, have a negative effect on the unemployment rate. Hence, according asymmetric model, it can be said that the unemployment is negatively affected by the increases and decreases in the oil revenue in short-run. To investigate whether the effect of increases in the oil revenue are statistically equal to the effect of decreases in the oil revenue, the Wald test has been used. The results of this test show that the coefficients are not statistically equal. So there is a significant difference between the effects of increases and decreases in the oil revenue. Also statistically, the effect of decrease in the oil revenue on the unemployment rate is more than the effect of increases in the oil revenue. Accordingly, in the short term, the asymmetric effects of oil revenue on the unemployment rate are confirmed. Another point is that, as same as the symmetric model in short-run, in the asymmetric model CPI has also a negative effect on unemployment rate.

Table 7: Estimation of Asymmetric Model Based on the Oil Revenue in Short-run

Var.	Cof.	t Stat.		Prob.
UR_{t-1}	0.331	3.07		0.003
CPI	-0.662	-3.50		0.000
$OilR^{+}$	-0.029	-0.241		0.811
$OilR^{+}_{t-1}$	-0.032	-1.95		0.055
$OilR^{-}$	0.019	0.887		0.378
$OilR^{-}_{t-1}$	-0.082	-2.35		0.022
ECT	-0.668	-6.67		0.000
Wald Test for Equality $OilR^{+}_{t-1}$ and $OilR^{-}_{t-1}$	Value of Cof.	F-Stat. Value		Prob.
	0.050	1.79		0.186
Bounds Test	F-Stat. Value	I(0)	I(1)	Signif.
	8.32	4.32	5.23	1%

Note: The selected model is based on the minimum of Schwarz criterion for ARDL (1, 0, 1, 1).
All variables are logarithmic. Dependent variable is the logarithm of unemployment rate.

The value of the bounds test statistic is 8.32. Therefore, the possibility of establishing a long-run relationship between increases in the oil revenue, decreases in the oil revenue, CPI and the unemployment rate will exist. According to this result, the long-run effects of increases and decreases in the oil revenue on unemployment rate is estimated and reported in Table 8. According to Table 8, the effect of increases and decreases in the oil revenue on the unemployment rate is negative. So that, in long-run like the short-run, increases and decreases in the oil revenue have a reverse effect on the unemployment rate. Thus, in the long-run, first, it can be said that asymmetry impact of the oil revenue on unemployment rate is confirmed. The CPI in long-run, like short-run, has a negative effect on unemployment rate.

Table 8: Estimation of Asymmetric Model Based on the Oil Revenue in Long-run

Var.	Cof.	t Stat.	Prob.
$L_{OilR^{+}}$	-0.149	-3.65	0.000
$L_{OilR^{-}}$	-0.094	-2.32	0.023
L_{CPI}	-0.991	-3.945	0.000

Note: L_{CPI} denotes natural logarithm of CPI and $L_{OilR^{+}}$ and $L_{OilR^{-}}$ are natural logarithm of increases and decreases in the oil revenue.
All variables are logarithmic. Dependent variable is the logarithm of unemployment rate.

4. Conclusion

In this paper, we study the asymmetric effect of oil price and oil income on unemployment rate in Iran. For this purpose, using the linear and nonlinear ARDL model and seasonal data from 2001: 2 to 2017: 4, the survey was conducted. The results show that consumer price index in linear and nonlinear

model in short-run and long-run has a negative effect on unemployment rate. Also, in the linear model in the short-run and long-run, only oil price is inversely effective on the unemployment rate and oil revenue has no effect on unemployment rate. According to the nonlinear model, oil price and oil revenue have an asymmetric effect on the unemployment in short-run. So that effect of decreases in the oil price is negative and significant. But in the case of oil revenues, the increases and decreases have a reversely effect on the unemployment rate. In the long-run, results are same to short-run period and magnitude the effect of increases in the oil revenue on the unemployment rate is larger than the effect of decreases in the oil revenue. Overall, regardless of whether wealth such as oil for Iran's economy has been accompanied by increases in welfare, the results show that in the short-run and long-run, when oil revenue enter the cycle of the economy, employment increase and when it goes down, unemployment rate will increase. Also, although the magnitude of the effect of increases in the oil revenue on unemployment rate is larger than the effect of decreases in the oil revenue, but in short-run which is more tangible, decreases in the oil revenue have a greater impact on the unemployment rate and leads to its increase.

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