The Oil Export and the Growth Pattern of Iran

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Abstract

The growth pattern of Iran economy mainly depends on oil export. The oil export on the one hand constitutes main part of exports and on the other hand, it provides foreign exchange for imports. The government consumption and investment are also financed by oil export. In this paper, using Fojita and James (1991) method and regression analysis, the effect of volatility and stability in the oil export will be considered. The results indicate the growth pattern of Iran has influenced by volatility in oil export. The volatility in oil export has induced the growth pattern via import substitution. This effect is positive in short run and negative in long run.

Key Words: Oil Export, Volatility, Domestic Demand, Export Expansion, Import Substitution.

1- Introduction

In Iran economy, the oil export share in total export is 65-75 percent and its share in GDP is 13-15 percent. The oil export has also allowed Iran to finance its import. Moreover, a main part of government expenditures finance by oil export so that its share in government revenues is above 65 percent. Hence, the oil export has played important role in the growth pattern of Iran.

In this paper, the effects of stability and volatility in oil exports on the growth pattern of Iranian economy have been considered. The method of Fojita and James (1991) is used to decompose the growth factors in input-output model, and then behavioral equations are introduced and estimated for final demand components. These equations are included the stability and volatility in oil export. Since there is no data available for final demand components in the sectors level so, we will estimate an equation for each final demand component and then will use for each sector by its constant share.

2- Model

Consider the basic relationship in input-output table:

$$X=AX+Y \qquad (1)$$

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where X and Y are the vector of output and final demand respectively, and A is coefficients matrix.

Y can be written as follows:

$$Y=D+E-M \tag{2}$$

where *D* is domestic final demand, and *E* and *M* are vectors of export and import respectively.

The self-sufficiency ratio for sector *i* could be defined as follows:

$$u_i = \frac{x_{i0} + d_i - m_i}{x_{i0} + d_i} \tag{3}$$

where x_{i0} is intermediate demand for output sector *i*, d_i and m_i are domestic final demand and import. The equation (3) can be written as follows:

$$u_i = \frac{x_i - e_i}{z_i - e_i} \quad ; \quad x_i = x_{i0} + y_i \quad , \quad z_i = x_i + m_i \tag{4}$$

where z_i, x_i and e_i are supply, output and export respectively. It is clear from (4) the self-sufficiency ratio will be unit when there is no import.

Using (3) it is possible to write import as:

$$\begin{aligned} m_i &= (1-u_i)(x_{i0} + d_i) \\ &= (1-u_i)(\sum_{j=1}^{n} a_{ij} x_j + d_i) \end{aligned} \tag{5}$$

The matrix form of equation (5) is

$$M = (I - \hat{U})(AX + D) \tag{6}$$

where *U* is self-sufficiency ratio vector and $\wedge$ denote an operator to create a diagonal matrix from a vector. Substituting (6) in (2), the following solution can be derived:

$$X = B(\hat{U}D + E) \qquad ; \qquad B = (I - \hat{U}A)^{-1} \tag{7}$$

Using the equation (7) it is possible to solve the change of output in terms of changed in domestic and foreign demand (ΔD and ΔE) and changes in $\hat{U}$ and *A*, where the former shows change in self-sufficiency ratio and the latter shows technical changes. Now we can write (7) as follows:

$$\begin{aligned} \Delta X &= X_t - X_0 = B_t S_t - B_0 S_0 \quad ; \quad S = \hat{U}D + E \\ &= (B_t - B_0 + B_0)S_t - B_0 S_0 = (\Delta B)S_t - B_0(\Delta S) \end{aligned} \tag{8}$$

Since X_t is equal to $B_t S_t$, the first term on the right hand side of (8) can be written as follows:

$$(\Delta B)S_t = B_t S_t - B_0 B_t^{-1} B_t S_t = (I - B_0 B_t^{-1}) X_t = B_0 (B_0^{-1} - B_t^{-1}) X_t \quad (9)$$

and $B_0^{-1} - B_t^{-1}$ is equal to:

$$B_0^{-1} - B_t^{-1} = \hat{U}_t A_t - \hat{U}_0 A_0 = (\Delta \hat{U}) A_t + \hat{U}_0 (\Delta A) \quad (10)$$

Substituting (10) in (9) yields:

$$(\Delta B)S_t = B_0 (\Delta \hat{U}) A_t X_t + B_0 U_0 (\Delta A) X_t \quad (11)$$

Now we can write the second term on the right hand side of (8) by adding and subtracting $\hat{U} D_t$ to it as follows:

$$B_0 (\Delta S) = B_0 (\Delta \hat{U}) D_t + B_0 (\Delta E) \quad (12)$$

Therefore, substituting (11) and (12) in (8) yields:

$$\Delta X = B_0 \hat{U}_0 (\Delta D) + B_0 (\Delta E) + B_0 (\Delta \hat{U})(A_t X_t + D_t) + B_0 \hat{U}_0 (\Delta A) X_t \quad (13)$$

There are four terms in the right hand side of equation (7). The first and second terms indicate the effect of domestic final demand and the export expansion respectively. The third term denote to self-sufficiency ratios change, so that interprets the effect induced by import substitution. This shows the effect of change in composition of demand for domestic output and imported goods. Finally, the fourth term captures the effect change in input coefficients.

Now the behavioral equations are introduced for final demand to capture the oil export effects. These equations are function of volatility and stability in oil export. The following equation is estimated to compute volatility an stability parts of oil export:

$$\begin{aligned} EOIL_t &= a_0 + a_1 EOIL_{t-1} \\ h_t^2 &= \alpha + \beta_1 \varepsilon_t + \beta_2 h_{t-1}^2 \end{aligned} \quad (14)$$

where *EOIL* is oil export in constant prices, h_t^2 is variance of *EOIL* and ε_t is residuals of *EOIL*.

The model (14) is known as generalized autoregressive heteroscedasticity (GARCH). Here we use standard deviation (*h*) as criteria of volatility.

The variables to be used are

PIM: Private Investment in Machineries.

PIC: Private Investment in Constructions.

GIM: Government Investment in Machineries.

GIC: Government Investment in Constructions.

PI: Private Investment.

GI: Government Investment.

I: Total Investment.

GC: Government Consumption.

HC: Households' Consumption.

MG: Imported Goods.

MS: Imported Services.

M: Total Imports.

YNO: GDP without Oil Export.

R: Real Interest Rate.

ER: Exchange Rate (the price of dollar to domestic currency)

P_m: Price Index of Domestic Outputs.

P_d: Price index of Imported Goods.

The behavioral equations to be estimated are

$$PIM_t = f(\Delta YNO_t, R_t, h_t, EOILF_t, PIM_{t-1}) \quad (15)$$

$$PIC_t = f(\Delta YNO_t, R_t, h_t, EOILF_t, PIC_{t-1}) \quad (16)$$

$$GIM_t = f(\Delta YNO_t, R_t, h_t, EOILF_t, GIM_{t-1}) \quad (17)$$

$$GIC_t = f(\Delta YNO_t, R_t, h_t, EOILF_t, GIC_{t-1}) \quad (18)$$

$$PI = PIM + PIC \quad (19)$$

$$GI + GIM + GIC \quad (20)$$

$$I = PI + GI \quad (21)$$

$$GC_t = f(YNO_t, R_t, h_t, EOILF_t, GC_{t-1}) \quad (22)$$

$$HC_t = f(YNO_t, HC_{t-1}) \quad (23)$$

$$MG_t = f(YNO_t, \frac{P_m}{P_d}, ER_t, h_t, EOILF_t, MG_{t-1}) \quad (24)$$

$$MS_t = f(YNO_t, \frac{P_m}{P_d}, ER_t, h_t, EOILF_t, MS_{t-1}) \quad (25)$$

$$M = MG + MS \tag{26}$$

$$ER_t = f(h_t, EOILF_t, M, ER_{t-1}) \tag{27}$$

$$YNO = HC + GC + I + ENOIL - M \tag{28}$$

where *h* and *EOILF* are volatility and stability in oil export, and *ENOIL* is non-oil exports.

Since there is no data available in sectors level, we have to estimate equations (15) to (28) in macro level. Then the estimated equations are applied for each sector by its constant share.

3- The Effect of Oil Export on Sectoral Growth Pattern

To consider the effect of the oil export, at first the equation (14) is estimated by ML-ARCH for period 1965-2000. The exponential GARCH model is used here. The estimated equation is

$$\begin{aligned} EOIl_t &= 6214.85 + 0.8654 EOIL_{t-1} \qquad R^2 = 0.822 \\ &\quad (2.54) \quad (12.9) \\ Ln(h_t^2) &= -1.0578 - 0.133 \frac{|\varepsilon_{t-1}|}{h_{t-1}} + 0.3669 \frac{\varepsilon_{t-1}}{h_{t-1}} - 1.062 Ln(h_{t-1}^2) \\ &\quad (-16.6) \quad (-185.2) \qquad (2.5) \qquad (-152.9) \end{aligned} \tag{29}$$

By using (30) the stability and volatility in oil exports have been computed and shown in figure (1) and (2):

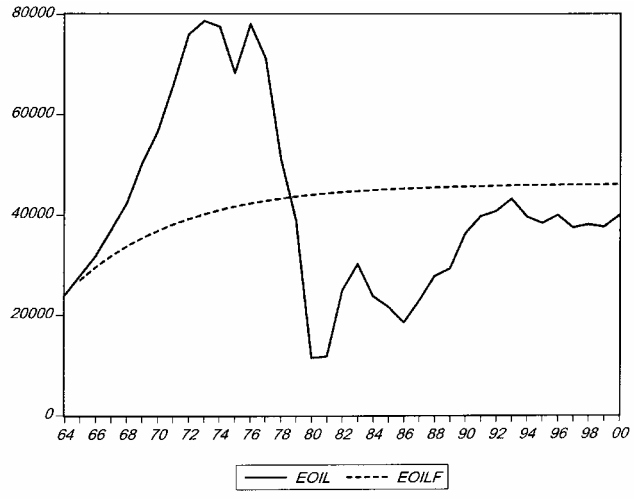

Figure (1): the actual oil export (EOIL) and forecasting oil export (EOILF)

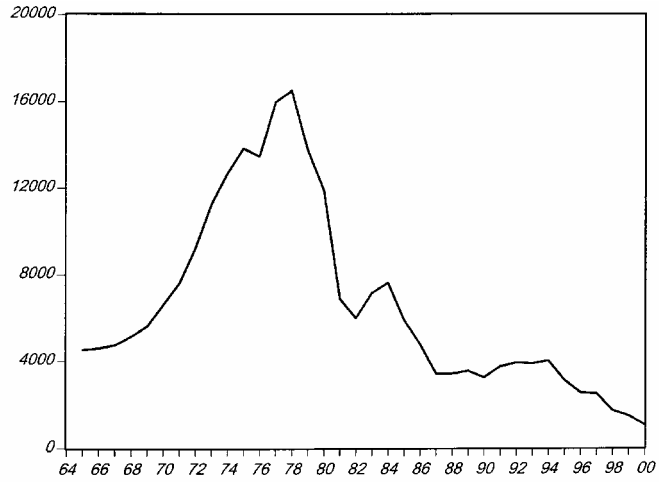

Figure (2): The volatility in oil export (h)

Now we use the h EOILF to consider the effect of the oil export on sectoral growth. The equations (15) to (28) have been estimated by 3SLS, and the results have been summarized in table (1).

Table (1): The estimated equation for final demand components

Dependent Variable	Intercept	ΔYNO	*YNO*	*R*	*ER*	*h*	*EOILF*	Lagged Dependent Variable	R^2
PIM	-24463 (-1.97)	0.562 (4.2)	_	_	_	-0.466 (-2.0)	0.781 (2.6)	0.852 (9.4)	0.677
PIC	_	0.292 (6.2)	_	-63.1 (-1.41)	_	0.545 (4.6)	_	0.793 (20.8)	0.831
GIM	_	_	_	_	_	0.157 (2.8)	0.040 (2.2)	0.726 (10.2)	0.655
GIC	_	_	_	_	_	0.255 (4.7)	0.076 (2.2)	0.690 (8.5)	0.601
MG	-86400 (-3.4)	_	0.503 (2.3)	_	-2.729 (-3.2)	1.668 (3.1)	2.560 (4.0)	0.380 (4.1)	0.783
ER	_	_	_	_	_	0.040 (5.6)	_	0.985 (124.3)	0.991

GC	-19063 (-2.1)	–	–	–	–	0.666 (4.3)	0.636 (2.6)	0.671 (9.2)	0.926
HC	4059 (2.2)	0.145 (3.6)	–	–	–	–	–	0.748 (11.1)	0.984

Note: the amounts of t are in parentheses.

Now we use the results of table (1) and equation (13) to evaluate the effect of the oil export between 1991 and 1999. It is assumed the oil exports have no effect on the input coefficients. Therefore, the fourth term on the right hand side of equation (13) do not change due to the oil export changes. Since there are lagged dependent variables in equations (15) to (28), it can be driven the results both in short run and long run.

During the period 1991-1999, *EOILF* has increased from 45723 to 46028 billion Rials and h has decreased from 3743 to 1468. Therefore, in this period, the stable part of oil exports has increased 305 and the volatility in the oil export has decreased by –2275 billion Rials at constant prices. The effect of the oil export changes has summarized in table (2). For simplicity and comparability, the changes in total outputs are assumed to equal 100. The results are only provided for the effects of *h* and *EOILF*, while it can be computed the effects of the rest of factors.

Table (2): the effect of stability and volatility in oil exports (short run)

Sectors	ΔX	Effect of *HC*	Effect of *GC*	Effect of *PI*	Effect of *GI*	Effect of *I*	Effect of *D*	Effect of *E*	Effect of *import substitution*	Total effect of *EOILF*
(a) **effect of *EOILF***										
1-Agriculture	100	1.53	0.02	0.31	0.05	0.30	1.84	0.01	-2.58	-0.73
2- Crude Petroleum and Natural Gas	100	0.93	0.01	0.04	0.01	0.05	0.99	28.6	-0.45	29.1
3- Mining	100	-0.02	-0.01	-0.04	-0.01	-0.04	-0.07	0.00	0.25	0.18
4- Industry	100	0.32	0.09	0.35	0.05	0.48	0.89	0.01	-4.02	-3.12
5- Water, Electricity and Gas	100	1.48	0.07	0.06	0.01	0.08	1.63	0.05	-0.58	1.10
6- Construction	100	0.12	0.05	1.77	0.26	1.21	1.38	0.03	-0.07	1.33
7- Trade, Restaurants and Hotels	100	-1.52	0.10	0.25	0.04	0.22	-1.21	0.01	-1.00	-2.20
8- Transportation and Communication	100	-0.15	0.06	0.07	0.01	0.17	0.07	0.01	-0.28	-0.20
9- Real Estates and Financial Services	100	0.32	0.01	0.03	0.00	0.02	0.36	0.01	-0.12	0.25
10- Other services	100	0.52	2.67	0.02	0.00	0.04	3.22	0.00	-0.20	3.02
Aggregate	100	0.28	0.25	0.31	0.05	0.33	0.87	0.31	-1.83	-0.66
(b) **effect of *h***										
1-Agriculture		-3.29	0.12	-0.24	-0.47	-0.58	-3.75	-0.05	15.16	11.35
2- Crude Petroleum and Natural Gas		-1.99	0.10	-0.03	-0.06	-0.11	-2.00	-227.6	2.58	-227.03
3- Mining		0.05	-0.05	0.03	0.06	0.08	0.09	0.01	-1.43	-1.33
4- Industry		-0.69	0.69	-0.27	-0.53	-0.94	-0.94	-0.07	22.86	21.84
5- Water, Electricity and Gas		-3.18	0.58	-0.05	-0.09	-0.15	-2.75	-0.43	3.32	0.14
6- Construction		-0.25	0.37	-1.33	-2.65	-2.38	-2.26	-0.24	0.43	-2.08
7- Trade, Restaurants and Hotels		3.28	0.75	-0.18	-0.37	-0.43	3.60	-0.10	5.72	9.22
8- Transportation and Communication		0.32	0.44	-0.05	-0.11	-0.33	0.43	-0.07	1.62	1.98
9- Real Estates and Financial Services		-0.69	0.10	-0.02	-0.04	-0.04	-0.64	-0.11	0.68	-0.07
10- Other services		-1.12	20.8	-0.02	-0.04	-0.07	19.6	-0.01	1.16	20.77
Aggregate		-0.61	1.94	-0.23	-0.46	-0.65	0.68	-2.48	10.49	8.69

Table(3): the effect of stability and volatility in oil exports (long run)

sectors	ΔX	Effect of *HC*	Effect of *GC*	Effect of *PI*	Effect of *GI*	Effect of *I*	Effect of *D*	Effect of *E*	Effect of *import substitution*	Total effect of *EOILF*
(c) **effect of *EOILF***										
1-Agriculture	100	12.35	0.05	0.75	0.16	0.74	13.14	0.01	-0.17	13.0
2- Crude Petroleum and Natural Gas	100	7.47	0.04	0.10	0.02	0.14	7.64	28.6	-0.19	36.0
3- Mining	100	-0.18	-0.02	-0.10	-0.02	-0.11	-0.31	0.00	0.11	-0.2
4- Industry	100	2.58	0.27	0.85	0.18	1.21	4.05	0.01	-1.71	2.4
5- Water, Electricity and Gas	100	11.91	0.23	0.15	0.03	0.19	12.33	0.05	-0.21	12.2
6- Construction	100	0.95	0.14	4.23	0.88	3.05	4.14	0.03	-0.03	4.1
7- Trade, Restaurants and Hotels	100	-12.29	0.29	0.59	0.12	0.55	-11.45	0.01	-0.41	-11.9
8- Transportation and Communication	100	-1.21	0.17	0.17	0.04	0.42	-0.61	0.01	-0.11	-0.7
9- Real Estates and Financial Services	100	2.60	0.04	0.07	0.01	0.05	2.69	0.01	-0.05	2.7
10- Other services	100	4.19	8.11	0.06	0.01	0.10	12.40	0.00	-0.08	12.3
Aggregate	100	2.30	0.76	0.74	0.15	.83	3.89	0.31	-0.67	3.5
(d) **effect of *h***										
1-Agriculture		12.96	0.37	-4.53	-1.71	-5.15	8.18	-0.05	-20.10	-12.0
2- Crude Petroleum and Natural Gas		7.83	0.29	-0.59	-0.22	-0.95	7.18	-227.6	-3.37	-223.8
3- Mining		-0.19	-0.14	0.60	0.23	0.75	0.42	0.01	1.86	2.3
4- Industry		2.71	2.09	-5.14	-1.94	-8.34	-3.54	-0.07	-29.9	-33.5
5- Water, Electricity and Gas		12.50	1.76	-0.90	-0.34	-1.33	12.93	-0.43	-4.35	8.1
6- Construction		1.00	1.12	-25.6	-9.69	-21.08	-18.96	-0.24	-0.56	-19.8
7- Trade, Restaurants and Hotels		-12.90	2.27	-3.55	-1.34	-3.75	-14.41	-0.10	-7.47	-22.0
8- Transportation and Communication		-1.26	1.33	-1.03	-0.39	-2.92	-2.86	-0.07	-2.12	-5.1
9- Real Estates and Financial Services		2.73	0.29	-0.41	-0.16	-0.38	2.64	-0.11	-0.89	1.6
10- Other services		4.39	63.27	-0.35	-0.13	-0.66	67.0	-0.01	-1.52	65.5
Aggregate		2.41	5.91	-4.47	-1.69	-5.77	2.55	-2.48	-13.75	-13.7

The table (2) indicates that the effect of *EOILF* is negative (-0.66) in short run. This is due to import substitution effects. Since increasing *EOILF* has induced to increase import, therefore has caused to decrease the growth. On the other hand, the effect of volatility in oil export has a positive effect on the growth in short run. Because, decreasing in h has induced to decrease import and thus the effect of import substitution has been positive. It must be noted that the effect of increase in h on exchange rate is very low in short run. However, the total effect of oil export is equal to 8 ($\approx$ 8.69-.66) and the effect of the rest factors is 92.

The table (3) shows the long run effects. The effect of stability in oil exports is positive in long run. This is due to low the effect of import substitution (-0.67), while the effect of domestic final demand is equal to 3.9. In the long run, when the volatility in oil exports decrease, it causes to decrease exchange rate and rises imports. On the other hands, the indirect effect of volatility on imports (via exchange rate) dominates over its direct effect on imports. Moreover the results have been shown for each sector in table (2) and (3).

4- Summary and Conclusion

The oil export plays an important role in Iranian economy, so that it has considerable effect on imports, government and private investment, households and government consumption and exchange rate. The results indicate the stability and volatility in oil exports are important factors for growth pattern, although the latter has more effect than the former. In addition, the oil exports has mainly influenced the growth via import substitution, because it is main source to finance imports.

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