

## Investigating the Impact of Macroeconomic Variables on the Container Trading in Iranian ports of the Persian Gulf

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### Abstract:

Nowadays, maritime trade plays an important role in the economy of some countries, including Iran. Especially, some of the ports in Iran that are located on the Persian Gulf border carry out container shipping operations. Therefore, in the present study, we investigate the impact of the most important macroeconomic factors on the container trading in Iranian ports in the Persian Gulf. For this purpose, we employed the autoregressive distributive lag (ARDL) approach for the estimating effect of oil price, gross national production, industrialization and exchange rate on the container trading volume. The used data are quarterly. Container business data is related to the ports of Shahid Rajaei, Bushehr, Imam Khomeini, Khorramshahr, Shahid Bahonar, which are obtained from the Ports and Maritime Organization. The results of this study show a negative impact of increasing oil price on Iran's container trading. Moreover, our empirical findings indicate that the effect of industrial indicator (INDS) on the container trading volume is positively. Also, one percent increases in gross national production (GNP) leads to %0.37 increase in container trading, and one percent increase in exchange rate (EXH) leads to % .17 decrease in container trading, respectively. Finally, coefficient of ECM is -0.54. It means that speed of adjustment in the function of container trading volume is relatively high, and in each period, 54 percent deviation from long run direction of container trading volume to be corrected by variables of model.

### 1. Introduction

Freight transport via sea still dominates on other transport modes at international and at intercontinental scale. Container trading plays an important role among the various methods of maritime transportation. In the past two decades the steady growth of seaborne trade has resulted in the increase of container ships, container ports and their terminals (Liu, 2010). Nowadays, ports around the globe are

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planning expansions to respond to the growth of containerized maritime trade and to the development needs of their hinterland economies (Brooks et al, 2014).. In many countries, development in ports effect on the developments in international trade and logistics infrastructure tied with huge investments. Movement of goods in a container is common today, but was only adopted half a century ago (Waal, 2014).. Asia contributes almost 46.5% of total container traffic (Jeevan, 2015). More than 900 kilometer of the Iran total land is exposed to maritime water of Persian Gulf and justifies the importance of the maritime industry and container trading via its ports to the nation. A large number of Iranian ports are located in the Persian Gulf. In some of these ports, container loading and unloading operations take place. The most important of these ports which have been studied in this study are Shahid Raja port, Bushehr port, Imam Khomeini port, Khorramshahr port and Shahid Bahonar port.

Shahid Rajae Port is the biggest container of Iran. This port plays vital role in Iran's trade. In 1983, with the opening of the first terminal container of Shahid Rajae Port, this port complex was officially opened and loading/unloading operations were started. Department of Container Affairs is in charge of the management of Container Terminal 1 and 2 and these container terminals operate under the supervision of this department ([shahidrajaeport.pmo.ir](http://shahidrajaeport.pmo.ir)).

Nominal capacity for Terminal 1 and Terminal 2 are 1500000 and 1800000 TEU<sup>1</sup> per year. From 20 March 2016 to 21 March 2017, 2,279,404 TEU containers were discharged and loaded at the port of Shahid Rajae. Second port for container trading operation is Bushehr port. Bushehr port features one container terminal with dedicated berths and container storage area (<http://bushehrport.pmo.ir>). In Bushehr port, 128746 TEU containers have been charged and discharged in the above period. The total container terminal capacity of Imam Khomeini port is 700,000 TEU (<http://bikport.pmo.ir>). But In the same period, 124119 TEU containers were discharged and loaded in this port. The fourth rank in terms of container traffic belongs to Khorramshahr port with 74474 containers in the period mentioned. Overall, from 20 March 2016 to 21 March 2017, 2658693 containers loaded and unloaded at the ports of Iran. So that, the share of Raja'i port, Bushehr port, Imam Khomeini port, Khorramshahr port and Shahid Bahonar port are %85.7, %4.8, %4.7, %2.8 and %0.2, respectively.

The main purpose of this research is the investigation the effect of macroeconomic variables on the volume of container trading in southern Iranian ports that located in the Persian Gulf. Oil is the major energy source for caring out martin trade and maritime transport is very dependent on oil.

Despite technological advances, there is still no substitute for energy costs. For shipping activities, not least container shipping, bunker fuel is a considerable expense. Bunker prices constantly fluctuate due to market forces and the cost of

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<sup>1</sup> - Twenty Equivalent Unit

crude oil (Notteboom et al., 2009). Also, gross national production is one of the variables affecting the volume of trade and container trade. The volume of container trade is expected to increase as the GDP grows. With the industrialization of the country, the volume of exports, imports and container shipping will also increase. The exchange rate is also another important economic variable affecting the volume of trade. With the increase in the exchange rate, exports will increase. Due to the expense of capital goods, imports are reduced. So, the impact of change rate on the volume of trade should be carefully examined.

In this section, we are reviewed some of the studies related to the topic of this research: Costas and Angels (2002) investigated the relationships of global macroeconomic factors and international shipping stock returns. They employed in the their analysis: (a) industrial production; (b) inflation; (c) oil prices; (d) fluctuations in exchange rates against the US dollar; and (e) laid up tonnage as macroeconomic factors. Several significant relationships are established between returns and macroeconomic factors. The results show that oil prices and laid up tonnage are negatively related to shipping stocks, whereas the exchange rate variable displays a positive relationship. UNCTAD (2010) in a study Realized that the price of oil is one of the most important costs of maritime trade. The results shows that estimated elasticity's are vary dependent on market sectors. Razmjooei and Hamoudi (2015) in a research have surveyed the relationship pattern of container trade and economic growth of Iran. In the first part of this research, a review of literature about world container trade growth and GDP is provided. Then in the second part, analysis and examination of two variables, Gross domestic product (GDP) as one of the main scales of economic growth and rate of container handling in Iran are clarified through calculation of correlation coefficient and regression analysis. The results of this paper indicated that the relationship between gross domestic product and loading and unloading of containers is positive and direct correlation type.

Chang Beom KIM (2016) in a study has explored the impact of exchange rate movements and global economics activity on loaded port cargo throughput in South Korea. The results indicate that increases in the nominal exchange rate and in global economy activity have (such as industrial production) a positive effect on the amount of sea freight.

Baghlani (2016) in his self master's thesis has determined the key factors influencing the transportation guide in the choice of a specific port. The results of this research show that the main factors influencing the development of container traffic to Bandar Imam Khomeini can be categorized into four broad factors: port connections, the cost and the productivity of the port, electronic information, logistics and management and operation of container at the port.

Darisavi-bahmanshir et al (2017) considered influential factors on Energy Demand in Iran Cargo Maritime Transportation of Port Khoramshaher with Econometrics Methods. Their findings show that the demand for maritime transport is related to

the increase in fuel prices, and gross domestic product (GDP) related to the sea freight rates.

As stated above, it is necessary to recognize several influential macroeconomic variables on the container trading volume, such as effecting of oil prices, gross national production, industrial indicator and exchange rate. As mentioned, the effect of increasing oil price on the container trading volume is ambiguous. Because, from one side, increasing the oil price causes that gross national production (GNP) rising, which follows, container trading volume will increase also. On the other hand, since that fuel prices are a major component of shipping costs, rising oil prices can reduce the volume of container trade. In this research, besides examining the effect of oil prices, the impact of variables such as GNP, industrialization index and the exchange rate on the container volume are examined. We expect that the effects of GNP and industrial indicator on the volume of container trade to be positively. Finally, the effect of exchange rate is ambiguous.

Following this Section 1, Section 2 reviews materials and methods. The empirical results have been discussed in Section 3, followed by the discussions and conclusions which are given in Section 4. The reference can be found at the end.

## 2. Materials and Methods

To survey the impact of increasing macroeconomic variables on the container trading volume of Iranian ports in the Persian Gulf, a conventional demand function for it could be simplified as:

$$TEU = f(OILP, GNP, INDS, EXH) \quad (1)$$

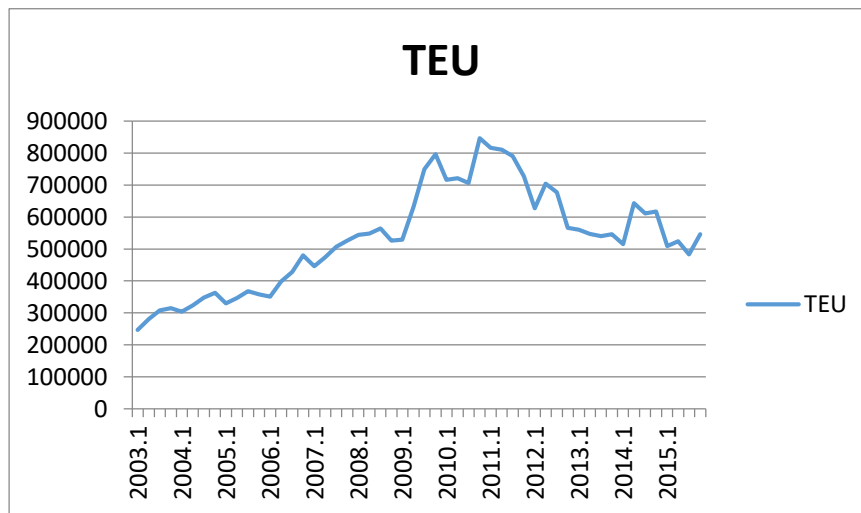
Where TEU denotes volume of container trading volume of Iranian ports in the Persian Gulf, OILP is oil price, GNP indicates gross national production, INDS denotes industrial index and EXH is exchange rate. Since that the main purpose of this study is to deliver statistically reliable evidence on the impact of macroeconomic variables on the container trading volume, we applied ARDL (Autoregressive Distributive Lags) method to determine effects of macroeconomic variables on the container trading volume of Iranian ports in the Persian Gulf. All variables in the model are logarithmic.

Therefore, according to Peseran et al (2001), function (1) rewrite by ARDL form:

$$TEU_t = C + \sum_{i=1}^p \theta_i TEU_{t-i} + \sum_{i=0}^{q1} \beta_i OILP_{t-i} + \sum_{i=0}^{q2} \gamma_i GNP_i + \sum_{i=0}^{q3} \lambda_i INDS_i + \sum_{i=0}^{q4} \phi_i EXH_i \quad (2)$$

As you see, in ARDL method, dependent variable (TEU) is a function of lags of itself and independent variables such as: oil price (OILP), gross national product (GNP), industrial index (INDS) and exchange rate (EXH). It is expected that an increase of oil price has a positive or negative effect on the container trading volume. Because increasing oil price will increase exports and imports of goods to

Iran and subsequently, the volume of container trade to Iran increases. On the other hand, rising oil prices will make fuel prices worse. And this, reduces maritime shipping which leads to a decline in container traffic. So, the effect of oil price on TEU volume of Iranian ports in the Persian Gulf is ambiguous. It is expected that an increase of GNP and INDS have to be a positive effect on container trading volume. It's worth knowing that in this research TEU is sum of container volume loaded/unloaded (export and import) of Iranian ports in the Persian Gulf including Shahid Raja port, Bushehr port, Imam Khomeini port, Khorramshahr port, Bandar Shahid Bahonar. Other Iranian ports in the Persian Gulf due to lack of data during the period under review and low volume of container traffic are not considered. It is noteworthy that study period length is from 2003 to 2015 and data is collected quarterly. The source for collecting container volume data (TEU volume) is Ports & Maritime Organization website. Data related to other variables, such as oil price (*OILP*), GNP (gross national product), exchange rate and INDS (industrial index) have been obtained from the Central Bank of the Islamic Republic of Iran and the Center for Statistics of Iran. Figure (1) shows trend of container trading volume of Iranian ports in the Persian Gulf during 2003:1 to 2015:4.



**Fig. 1: volume of container trading in Iranian ports in the Persian Gulf, during 2003:1-2015:4**

Source: Ports & Maritime Organization website & Research Calculations

Table (1) shows descriptive statistics of model variables including, TEU, OIL, GNP, EXH and INDS:

**Table 1. Descriptive statistics of model variables for the period 2003:1 -2015:4**

	TEU	OILP	GNP	EXH	INDS
<b>Mean</b>	533451.2	981106.4	162145.6	16449.87	392.9423
<b>Median</b>	534253.0	777596.5	164137.0	10026.00	435.0000
<b>Maximum</b>	846160.0	2696967.	230973.0	35763.00	527.0000
<b>Minimum</b>	246618.0	187462.0	103656.0	8186.000	187.0000
<b>Std. Dev.</b>	159142.9	678242.3	28033.69	10481.51	99.93712
<b>Skewness</b>	0.132042	1.240731	-0.002971	0.939687	-0.502197
<b>Kurtosis</b>	2.132636	3.879575	2.707061	2.043212	1.863421

Source: research findings

### 3. Results

In this sector, results of estimation of macroeconomic variables effects on the container trading of Iranian ports in the Persian Gulf in short run and long run by ARDL method are presented. Also, error correction model (ECM) for to be or not to be co-integration between the variables of model is implemented.

#### 3.1. Estimating the effects of macroeconomic variables on the container trading of Iranian ports in the Persian Gulf by ARDL method in the short run

In the present study, we employ Autoregressive distributed lags method (ARDL). This method estimates coefficients of models better than another method such as Engle-Granger test. Because in this method, dynamic short run reactions between variables is considered. In ARDL method, for each variable can choose optimal lags by AIC, SBC, HQC criteria. We have presented an ARDL to investigate the impact of macroeconomic variables on the container trading volume according to the equation (2). Results of estimating in short run by ARDL method have been exhibited in the table (2):

**Table 2. Results of estimating the container trading of Iranian ports in the Persian Gulf in the short run by ARDL approach, ARDL (1, 0, 0, 0)**

Regresses	Coefficient	t- Ratio (probe)
TEU (-1)	.45022	4.2486[.000]
OILP	-.051230	-1.1707[.248]
GNP	.20573	1.9739[.055]
INDS	.64216	4.5494[.000]
EXH	-.096135	-1.8457[.072]
C	2.5524	1.8392[.073]

#### Diagnostic Tests

Test Statistics	LM Version, F Version
Serial Correlation	CHSQ (4) = 4.2807[.369]
Functional Form	CHSQ (1) = .97911[.322]
Normality	CHSQ (2) = 1.9403[.379]
Anisotropy variance	CHSQ (1) = 2.9024[.188]

Resource: research findings

Table (2) indicates that in estimated function of the container trading volume of Iranian ports in the Persian Gulf in short run by ARDL approach is selected one optimal lags for dependent variable (TEU), and zero lag for other variables. Results of diagnostic tests in the model are satisfactory, because all of them are significant in 5% level.

We use the below statistic to identify whether there is long run relationship among the variables or not:

$$\frac{0.45022 - 1}{0.10597} = -5.19 \quad (3)$$

Where, the numerator is sum of coefficients of dependent variable lags minus one, and denominator is standard deviation of them (Tashkini, 2008). Whereas absolute statistic (3) is greater than critical value of Banerjee, Dolado and Mestre's Table (-4.05), so there is a long run relationship between variables of equation (2). In the following, we estimate long run equation and Error Correction Model (ECM).

### 3.2. Estimating the effects of macroeconomic variables on the container trading of Iranian ports in the Persian Gulf by ARDL method in the long run

The results of estimating the long-term effect of macroeconomic variables on container traffic in Iranian ports of the Persian Gulf, using ARDL method, have been shown in table (3):

**Table 3. Results of estimating effect of macroeconomic variables on the container trading of Iranian ports in the Persian Gulf in the long run by ARDL approach**

Regresses	Coefficient	t- Ratio (probe)
OILP	-.093184	-1.0904[.281]
GNP	.37421	1.7915[.080]
INDS	1.1680	9.8255[000]
EXH	-.17486	-2.1742[.035]
C	4.6427	2.2601[.029]

Resource: research findings

Based on the table (3), long run equation is:

$$TEU = 4.6427 - .093184 * OILP + .37421 * GNP + 1.1680 * INDS - .17486 * EXH \quad (4)$$

According the table (3), all of the coefficients in equation (4) except price of oil are statistically significant at the 10% level and sign of all coefficients is conformably to expectations.

Results show when oil price (OILP) to be increased one percent causes container trading volume of Iranian ports in the Persian Gulf decreases 0.09 percent. However, this coefficient is not statistically significant. Also, one percent increase in industrial indicator (INDS) leads to 1.168 percent increase in container trading volume and one percent increase in gross national production (GNP) leads to .374 percent increase in container trading volume. Finally, one percent increase in

exchange rate (EXH) leads to .174 percent decreases in container trading volume of Iranian ports in the Persian Gulf.

### 3.3. Estimation of ECM for container trading of Iranian ports in the Persian Gulf

Main reason of using ECM (Error Correction Model) is co-integration between the numbers of model variables. This indicator connected short run fluctuations of variables to the values of long run. In the ECM model, lag of residuals of long run equation  $U_{t-1}$  considered as error correction coefficient, Therefore ECM model takes following form:

$$\Delta Y_t = C + a\Delta X_t + bU_{t-1} + e_t \quad (5)$$

Where ( $Y_t$ ) is dependent variable and ( $X_t$ ) is all regressors in long run equation. It is expected that coefficient's sing of  $U_{t-1}$  to be negative. This coefficient exhibits that in each period, what percentage of disequilibrium of dependent variable to be adjusted toward its long run value.

In equation (6), ECM format of ARDL method for model of container trading volume of Iranian ports in the Persian Gulf is presented:

$$\Delta TEU_t = 2.55 - .051 * \Delta OIL_t - .205 * \Delta GNP_t + .642 * \Delta INDS_t - .096 * \Delta EXH_t - .54 * ECM(-1) \quad (6)$$

In table (4), results of ECM test using ARDL method for container trading volume of Iranian ports in the Persian Gulf is exhibited.

**Table 4. Results of estimating ECM for container trading, ARDL (1, 0, 0, 0, 0)**

Regressor	Coefficient	t- Ratio(prob)
dOIL	-.051230	-1.1707[.248]
dGNP	.20573	1.9739[.055]
dINDS	.64216	4.5494[.000]
dEXH	-.096135	-1.8457[.072]
dC	2.5524	1.8392[.073]
ECM (-1)	-.54978	-5.1881[.000]

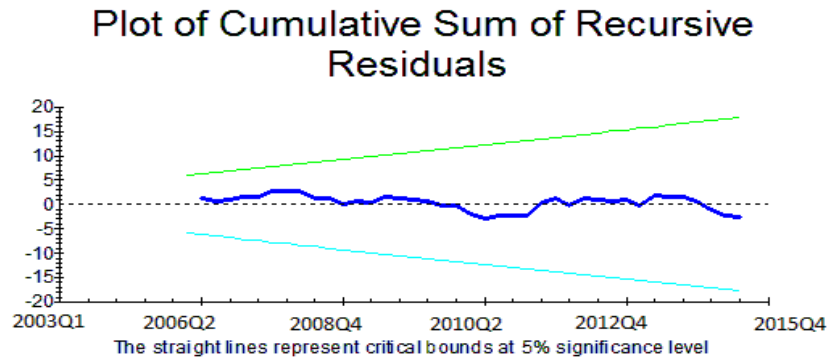
Resource: research findings

As seen in Table (4), coefficient of ECM for container trading volume of Iranian ports in the Persian Gulf is statistically significant at the 5% level and its sing is conformably to expectation because it is negative. So, it confirms that a long run relationship exists between variables of investigation function. According to table (4), coefficient of ECM for container trading is -0.54, so in each period (one season), 0.54 percent deviation from long run direction of container trading volume to be corrected by variables of model. Therefore, speed of adjustment is high.

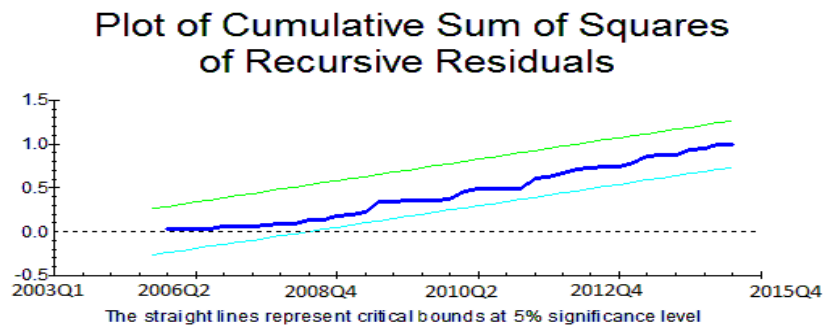


### 3.4. Stability testes: CUSUM and CUSUM Q

If estimated model to be unstable, it is determined using CUSUM and CUSUM Q testes. In figure (2) and figure (3) the straight lines represent critical bounds at 5% significance level. Because of CUSUM graph in figure (2) and CUSUM Q graph in figure (3) don't intercept critical bounds, so the model of container trading volume has structural stability.



**Fig. 2: Cumulative Sum of Recursive Residuals**



**Fig. 3: Cumulative Sum of Squares Recursive Residuals**

## 4. Discussion

In this paper, we have investigated the possible effect of macroeconomic variables on the container trading of Iranian ports in the Persian Gulf. To examine this issue, we applied Autoregressive Distributive Lags (ARDL) model. The empirical results show that increasing of the oil price (OILP) has negative effect on the container trading volume of Iranian ports in the Persian Gulf, although its coefficient is not

statistically significant in 5% level. The effect of industrial indicator (INDS) on the container trading volume is positively and its amount is noticeable. One percent increase in gross national production (GNP) leads to 0.37 percent increase in TEU volume of Iranian ports in the Persian Gulf. Finally, one percent increase in exchange rate (EXH) leads to .17 percent decrease in container trading of Iranian ports in the Persian Gulf. Moreover, the survey of our empirical findings shows that coefficient of ECM is -0.54. It means that speed of adjustment in the function of container trading of Iranian ports in the Persian Gulf is relatively high, and in each period (one season), %57 deviation from long run direction of container trading to be corrected by variables of model. Finally, the stability testes such as CUSUM and CUSUM Q show that the reviewed model for container trading has structural stability.

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## بررسی تأثیر متغیرهای اقتصاد کلان روی تجارت کانتینری در بنادر ایرانی حاشیه خلیج فارس

### چکیده

امروزه تجارت دریایی نقش مهمی را در اقتصاد کشورها از جمله ایران، ایفا می‌کند؛ به ویژه در تعدادی از بنادر ایرانی که در حاشیه خلیج فارس قرار دارند که در آنها عملیات حمل و نقل کانتینری انجام می‌گیرد. از این رو این مقاله، به بررسی تأثیر مهمترین متغیرهای اقتصادی بر روی تجارت کانتینری در این بنادر می‌پردازد. روش استفاده شده، رهیافت خود بازگشتی با وقفه‌های توزیع شده (ARDL) می‌باشد. متغیر وابسته مدل حجم تجارت کانتینری بوده و متغیرهای توضیحی نیز قیمت نفت، تولید ناخالص داخلی، صنعتی شدن و نرخ ارز می‌باشد. داده‌های بصورت فصلی بوده و مربوط به بنادر شهیدرجایی، بوشهر، امام خمینی، خرمشهر، شهید باهنر می‌باشد. نتایج گویای آنست که تأثیر شاخص صنعتی شدن روی تجارت کانتینری معنادار و مثبت است. همچنین ۱٪ افزایش در GNP منجر به ۰٫۳۷ درصد افزایش در تجارت کانتینری شده و ۱٪ افزایش در نرخ ارز منجر به ۰٫۱۷ درصد کاهش ترافیک کانتینری می‌شود. ضریب ECM برابر ۰٫۵۴- بوده و این بدان معنی است که سرعت تعدیل نسبتاً بالاست و هر دوره ۵۴ درصد انحراف از تعادل بلندمدت تصحیح می‌گردد.

**کلمات کلیدی:** تجارت کانتینری، بنادر ایرانی حاشیه خلیج فارس، متغیرهای کلان اقتصادی، رهیافت ARDL

طبقه بندی JEL: F12, F18, C32