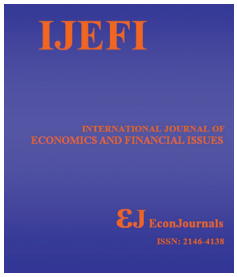

International Journal of Economics and Financial Issues

ISSN: 2146-4138

available at http: www.econjournals.com

International Journal of Economics and Financial Issues, 2017, 7(2), 714-722.

Long-run Trend and Determinants of Terms of Trade of Iran

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ABSTRACT

This paper examines the trend and determinants of terms of trade of Iran. Using a vector-error correction model (VECM), two models has been estimated for Iran's economy. Terms of trade in Model I is the net barter terms of trade; and in Model II is the ratio of export to import unit values. Annual data of 1966-2012 and seasonal data of 1991-2011 have been used for respectively, Model I and II. Four variables have been identified as main explanatory elements of variation in terms of trade over time; these variables are output, exchange rate, trade openness and oil prices. VECM is used to capture the long-run interaction among variables. In first part of the article, the trend in terms of trade is evaluated to investigate whether there is a negative trend exists among Terms of Trade (TOT) data as the Prebisch-Singer hypothesis suggests there would be such a tendency in a commodity exporting country like Iran. Results show that there is not a significant decreasing trend in TOT data. VECM results show short-run causality from all variables to the terms of trade in. Also variables converged to their equilibrium levels. The correlation of the terms of trade is negative with exchange rate and positive with output, oil prices and trade openness in long-run.

Keywords: Terms of Trade, Unit Root Test, Vector-Error Correction Model
JEL Classifications*:* F11, C8, C32

1. INTRODUCTION

Terms of trade is an important economic factor which is the purchasing power of a typical economy in context of trade, as it indicates the amount of foreign goods can be purchased by a given amount of domestic output. Its fluctuations can affect economic welfare and show how an open economy can benefit from trade. The most known concept of terms of trade (TOT) is the ratio of export to import price index of an open economy; defined as net barter terms of trade. When a country's export price index experiences an increase while import price index is fixed, it means TOT has improved; on the contrary, we say the TOT has deteriorated. But sometimes there are other indicators for TOT that are widely been used in different studies. Gross terms of trade is the ratio of value of import to export. Another more common proxy for TOT is the ratio of export unit value to import unit value. Export unit value is calculated by dividing of value of export to its weight or quantity.

Terms of trade and its trend has been one of the most challenging issues for many years. Some classical economists like Malthus and Ricardo believed that the terms of trade of primary products would increase over time when the limited availability of land and other natural resources made their marginal production costs and prices to rise (Tilton, 2013). Prebisch (1950) and Singer (1950) challenged the issue, mostly known as the Prebisch-Singer hypothesis, and believed terms of trade of developing countries which export primary commodities is decreasing over time. So a country which exports commodities like wheat, coffee or mineral products and instead imports manufactured and capital-intensive products would experience decreasing TOT. This phenomenon shows developing countries benefit less from external trade rather developed countries as their terms of trade has been deteriorating. This subject is been evaluated by lots of articles and for different economies (For example Tilton, 2013; Ghoshray, 2015; Gillitzer and Kearns, 2005; Wacker et al., 2014). Instead, these commodity exporting countries have benefited from the commodity price boom of the last decade, which helped

them to boost their economic fundamentals noticeably (Adler and Magud, 2015).

Discussion on trend in terms of trade has been continuing in international trade literature in decades. Some argues even if terms of trade is diminishing over time, in terms of price competitiveness, economy would be better off; but generally it is believed that the more TOT is, the more benefits from trade will be; because TOT mainly shows the export price over import price. One of the main goals in this article is to examine how the terms of trade of Iran has changed during last decades. We are going to test Prebisch-Singer hypothesis for economy of Iran as it is mostly considered as a developing country which exports somehow primary commodities. Iran's economy is adopting more and more to be involved in international trade although it is the largest economy outside the World Trade Organization and international trading system. Over the last three decades, developing countries has been opening up their economies to be more engaged in world trade and to be more involved in global financial system. Based on empirical literature, most of these countries are main exporter of primary commodities and face with more TOT fluctuations (Al-Abri, 2014; Hausmann et al., 2006). It has been well documented in different studies that many developing countries depend heavily on just a few commodities for a large proportion of their national income (Ghoshray, 2015). Iran as a developing country and main exporter of oil in international market has the same situation. We will consider this in deciding on determinants of Iran's TOT.

Considering the importance of TOT in a small open economy, some studies suggest adverse shocks to a country's TOT not only disrupt the economy's growth, but may also introduce some level of instability. For example, Mendoza (1995) and Kose (2002) find that TOT shocks account for at least half of the output volatility in developing countries (Al-Abri, 2014). Regarding this issue, in this paper we are trying to find out what are the most important elements determining TOT of Iran including trade openness. In light of this, we specify an econometric model to clarify if these elements have long-run effects on TOT or not. We will seek to answer to the question of is there any declining trend in terms of trade of Iran over last fifty years? This is the subject of the first part of this paper. Indeed the Prebisch-Singer hypothesis is been examined for long-run trend of Iran's TOT. After that, we try to find a long- run relation between TOT and its determinants; so in the second part, it should be recognized what are the most important variables that explain variation in TOT data.

2. OVERVIEW OF RELATED LITERATURE

Here we mention some studies on the issue of trend in terms of trade in different countries and make clear if developing countries TOT has fallen in long-run. In other words, is there a meaningful trend among TOT data over time? Other studies will be introduced to introduce an element or some factors that determine changes in TOT. The latter group would help us to do our model specification in the best manner to reach unbiased results.

The TOT debate on whether there is a negative tendency in TOT has not still been solved. Indeed the main question is should developing countries which export primary commodities diversify their export to benefit more from trade? There are lots of studies in this field. Gillitzer and Kearns (2005) has examined two important aspects of Australia's terms of trade using 135 years of annual data up to 2003/04. As they discussed, since Australia predominantly exports commodities and imports manufactures, the Prebisch-Singer hypothesis suggests that there should be a negative trend in the terms of trade. But the trend is no more than −0.1% per annum, less than the trend decline in world commodity prices relative to manufactured goods prices. It is because of diversification of export toward commodities with faster price growth.

Harvey et al. (2010) find a significant declining long-run trend in TOT of many of their 25 commodities sample covering the 17th to 21st centuries, using time-series techniques. Tilton (2013) discuss trend in TOT generally does exist but it should be analyzed in a way to consider production costs. Even if the terms of trade of primary products are falling, to suggest that countries should diversify away from their production, as Prebisch, Singer, and others over the years have done, makes little sense. Wacker et al. (2014) tried to explain the relationship between FDI and terms of trade in the case of South Asia. In this regard, it is mentioned that Singer clearly meant FDI and raised concerns that it would bring along a certain kind of foreign trade that held the FDI-importing developing country in an export-specialization poverty-trap through falling terms of trade. Ghoshray (2015) conducts a robust estimation of TOT between United Kingdom and British India over period 1858-1947. Using a unit root test in the data and robust estimation, he inferred that there is no obvious evidence whether the TOT improved for UK with India during the period.

Now we are considering some few studies to clarify what are the most determinants of TOT to be included in our model. There are lots of papers that discuss there is a strong correlation between TOT and exchange rate. For particular countries, the relationship between TOT and real exchange rate is generally observed to be very strong; for example, Karfakis and Phipps (1999) and Aruman and Dungey (2003) for Australia, and Amano and Van-Norden (1995) for Canada. Wider evidence of significant correlation between these variables is found in Habermeier and Mesquita (1999), Mendoza (1995) and Broda (2004) who examined the relationship in developing countries. The results are not always consistent. Dungey (2004) shows this relationship with annual data from six Asian countries. In this regard, Al-Abri (2013) using a panel of 53 primary-commodity exporting countries for 1980-2007, demonstrates greater international financial integration reduces the impact of terms-of-trade shocks on real exchange rate volatility. This reduction is more when we introduce financial integration as foreign direct investment.

For a country like Iran which its economy heavily depends on oil, it is necessary to be clear on the connection of oil prices and TOT through our model. Backus and Crucini (2000) suggest oil prices accounts for most of the variation in TOT over the last 25 years and its quantitative role varies significantly over time. They use simple average of US dollar prices in three major markets: Brent, Dubai, and West Texas. As they discuss, given the importance of oil as an internationally traded commodity and the volatility

of its price, oil shocks could potentially explain virtually all of the terms of trade variation from the early 1970's to mid-1980. On this subject, Fardmanesh (1991) and Tolonen (1989) analyze the relationship between oil prices and terms of trade, especially when a small open economy encounters an oil shock. Dauvin (2014) investigates the relationship between energy prices, the real effective exchange rate of commodity-exporting countries and their TOT, considering 10 energy-exporting and 23 commodity-exporting countries over the period 1980-2011. He finds oil prices as a channel of connection between TOT and exchange rate. There are some other studies mentioning this correlation like Zhang et al. (2016) and Kuboniwa (2014).

In basic international trade theories, when a country moves toward trade in products which has comparative advantage in them, the export price increases and import price decreases; then TOT will rise; so we expect a positive relationship between trade openness and terms of trade. Sometimes trade openness can appears as free trade agreement as it increases trade volume among its member states; for example Anderson and Yotov (2016), using panel data gravity methods in 2 digit manufacturing goods from 1990 to 2002 conclude global efficiency of manufactures' trade rises 0.9%. There are some studies like Lutz and Singer (1994), Razin et al. (2003) and Cardoso and Esteves (2008) exploring the relation between trade openness and TOT.

The second category of studies above, leads us to a model consisting the main explanatory elements of TOT; (to see more: Swift, 2004; Al-Abri, 2014; Dungey, 2004; Backus and Crucini, 2000;Dauvin, 2014, etc.); therefore, we will consider these four variables to explain variation in Iran's TOT (output, exchange rate, oil prices and trade openness).

3. TRENDS IN THE TERMS OF TRADE

Trend analysis of TOT is done here by using Iran's terms of trade in two ranges of data. Economists have long recognized that the simple barter terms of trade, given by the weighted prices of exports over imports, can be misleading (Tilton, 2013). So we utilize both net barter terms of trade, and the ratio of export unit value to import unit value as TOT. Figure 1 displays annual barter TOT over the period of 1966-2012 and Figure 2 displays the trend in annual TOT (unit values) of Iran for time-series of 1966-2015.

In both graphs, there is a positive trend in data until 1979; when revolution in Iran has happened. In period of 1980-1997, as graphs show, TOT has deteriorated. By some structural changes in 1997, TOT experienced a slow positive trend. This positive trend in Figure 2 is not considerable. These graphs don't suggest any meaningful negative trend among data; that is, there is no evidence of deteriorating TOT of Iran and rejection of the Prebisch-Singer hypothesis. However, we will make use of unit root test techniques to discuss the issue.

The following models are the basic models to analyze unit root test in TOT data:

$$\Delta TOT_t = \beta_2 TOT_{t-1} + \sum_{i=1}^{m} \alpha_i TOT_{t-i} + u_t$$

$$\Delta TOT_t = \beta_1 + \beta_2 TOT_{t-1} + \sum_{i=1}^{m} \alpha_i TOT_{t-i} + u_t$$

$$\Delta TOT_t = \beta_1 + \beta_2 TOT_{t-1} + \beta_3 t + \sum_{i=1}^{m} \alpha_i TOT_{t-i} + u_t$$

These three equations represent augmented dickey-fuller (ADF) test in three cases. These equations are estimated for our TOT data. Tables 1 and 2 show test results for both series of terms of trade of Iran. The first one is net barter TOT for the time series of 1966-2012 and the second one is TOT in terms of unit values for the period of 1992-2015. Results suggest there is a unit root in both data and TOTs are not stationary.

Table 2 shows the results for ADF test in first difference of the data.

Table 3 indicates the results of ADF test equations of Table 1. Results show there is unit root among both TOT data; but based on the results in Table 3 and what we see from Figures 1 and 2, the negative trend is not considerable. It means we can almost reject the Prebisch-Singer hypothesis for TOT in Iran.

Figure 3 is the monthly TOT data (unit values) of Iran, from 1992 to 2015. Graph has almost a zero-sloped shape and its fluctuations especially after 1995 are not considerable. Also the TOT has been smaller than one for most of the period showing that the import unit values were larger than the export unit values in this period.

We can say there is a small negative trend over time. In monthly data from 1992, there is no notable trend. Looking at these three graphs, we notice that TOT obviously experienced larger swings before 1992. When we separate annual data to three parts, at the breakpoint of 1992, again we can see a stable TOT until 2014. The Prebisch-Singer hypothesis, that a commodity exporter country will

Figure 1: The long-run trend in annual terms of trade of Iran (net barter terms of trade)

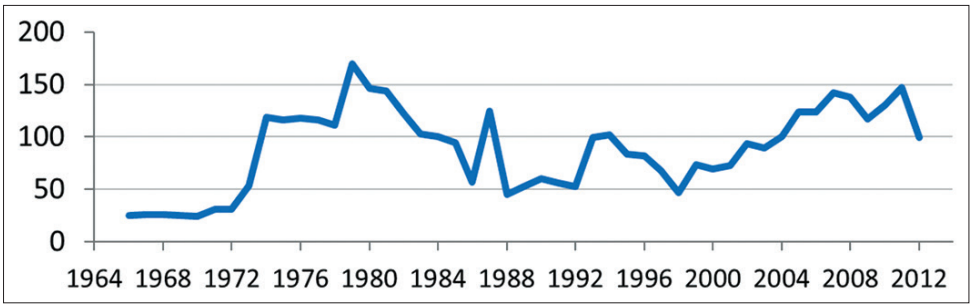


Figure 2: The long-run trend in annual terms of trade of Iran (unit values)

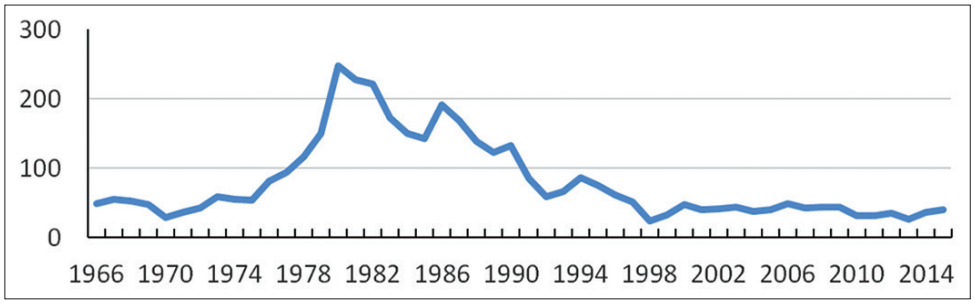


Figure 3: The long-run trend in monthly terms of trade of Iran

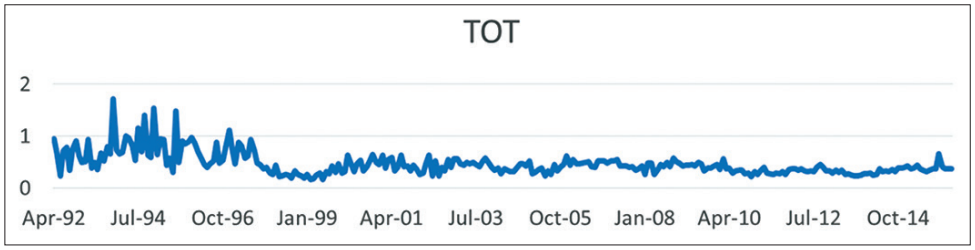


Table 1: TOT - Unit root test in level

Variable	Statistic	Without intercept and trend	Intercept	Intercept and Trend
Net barter TOT (Px/Pm)	ADF statistic	0.62	−2.26	−2.05
	P value	0.85	0.19	0.56
TOT - unit values (Ux/Um)	ADF statistic	−0.39	−2.49	−2.77
	P value	0.54	0.12	0.21

ADF: Augmented dickey-fuller

Table 2: TOT - Unit root test in first differences

Variable	Statistic	Without intercept and trend	Intercept	Intercept and trend
Net barter TOT (Px/Pm)	ADF statistic	−8.51	−8.53	−8.55
	P value	0.00	0.00	0.00
TOT - unit values (Ux/Um)	ADF statistic	−7.83	−7.75	−7.74
	P value	0.00	0.00	0.00

ADF: Augmented dickey-fuller

experience a declining TOT in long-run, applies to Iran but not too much. It means there is at most a weak negative trend in our case.

4. DETERMINANTS OF TERMS OF TRADE

Based on the literature we discussed and Iran's economy features, TOT model would be as follow:

$$TOT=\beta_0+\beta_1 Y_t+\beta_2 RER_t+\beta_3 TOP_t+\beta_4 PO_t+u_t$$

We will estimate this model for two types of TOT. The TOT in first model is the ratio of export price index to import price index. In Model I, we use annual data of 1966-2012. Y is real gross domestic product (GDP) and PO is OPEC average oil price. RER is real exchange rate computed as ratio of Iran's consumer price index to world's CPI multiplied by the official exchange rate in base year. TOP is a proxy for trade openness and it is the ratio of total amount of export and import to output.

In Model II we introduce TOT as the ratio of the export unit value index to the import unit value index, measured relative to the base year and the others are the same. In this model, quarterly data of 1991-2011 has been used. All variables in both models are transformed into logarithmic values.

First it should be examined if variables are stationary. It is very important for achieving unbiased results to test for stationary before estimation of the model. Table 4 indicates the unit root test results for variables included in Model I and Table 5 shows the same results for first differences of variables. Therefore, all variables in Model I have a unit root; so they are I(1).

ADF test results for Model II are shown in Tables 6 and 7. The results suggest all variables have a unit root; further tests show the first differences of them are stationary. Figures 4 and 5 show variation of logarithm of terms of trade, exchange rate, output, trade openness and oil prices in both models. We can see the pattern among variables.

5. VECTOR AUTOREGRESSIVE/VECTOR ERROR CORRECTION MODEL (VECM) ESTIMATION

Consider following model:

$$TOT_t=f(Y_t, TOP_t, PO_t, RER_t)$$

We want to examine the long-run and short-run relationship in this model for two sets of data; namely Models I and II. As all

Table 3: Augmented dickey-fuller test equation results

Variable	ADF statistic	TOT (−1)	C	At trend	R^2	Durbin-Watson stat
Net barter TOT (Px/Pm)	Without intercept and trend	−0.01 (0.54)	-	-	0.07	1.95
	Intercept	0.24 (0.02)	0.86 (0.36)	-	0.17	1.96
	Intercept and trend	−0.20 (0.05)	0.89 (0.39)	0.00 (0.00)	0.18	1.96
TOT unit values (Ux/Um)	Without intercept and trend	−0.01 (0.69)	-	-	0.19	1.33
	Intercept	−0.23 (0.02)	0.97 (0.02)	-	0.12	1.95
	Intercept and trend	−0.28 (0.10)	1.29 (0.47)	−0.01 (0.21)	0.15	1.94

The numbers in parentheses are P values

Table 4: Model I: Augmented dickey-fuller test statistics

ADF statistic	TOT	Y	RER	TOP	PO
Without intercept and trend	0.62 (0.85)	1.04 (0.92)	3.49 (0.99)	−0.81 (0.63)	1.27 (0.95)
Intercept	−2.26 (0.19)	−1.81 (0.37)	1.59 (0.99)	−3.02 (0.09)	−1.37 (0.59)
Intercept and trend	−2.05 (0.56)	−2.81 (0.20)	−2.79 (0.21)	−2.98 (0.15)	−1.75 (0.51)

The numbers in parentheses are P values

Table 5: Model I: Augmented dickey-fuller in first difference

ADF statistic	TOT	Y	RER	TOP	PO
Without intercept and trend	−8.51 (0.00)	−3.71 (0.00)	−0.51 (0.00)	−4.67 (0.00)	1.27 (0.00)
Intercept	−8.53 (0.00)	−3.89 (0.00)	−2.19 (0.00)	−4.62 (0.00)	−1.37 (0.00)
Intercept and Trend	−8.55 (0.00)	−3.29 (0.00)	−4.09 (0.01)	−4.56 (0.00)	−1.75 (0.00)

The numbers in parentheses are P values

Table 6: Model II: Augmented dickey-fuller test statistics

ADF statistic	TOT	Y	RER	TOP	PO
Without intercept and trend	−1.04 (0.27)	3.90 (0.99)	4.27 (0.99)	−0.81 (0.36)	1.42 (0.96)
Intercept	−3.10 (0.10)	0.53 (0.99)	−0.05 (0.95)	−0.34 (0.91)	−0.05 (0.95)
Intercept and trend	−3.78 (0.09)	−1.80 (0.69)	−3.25 (0.08)	−1.90 (0.65)	−3.25 (0.08)

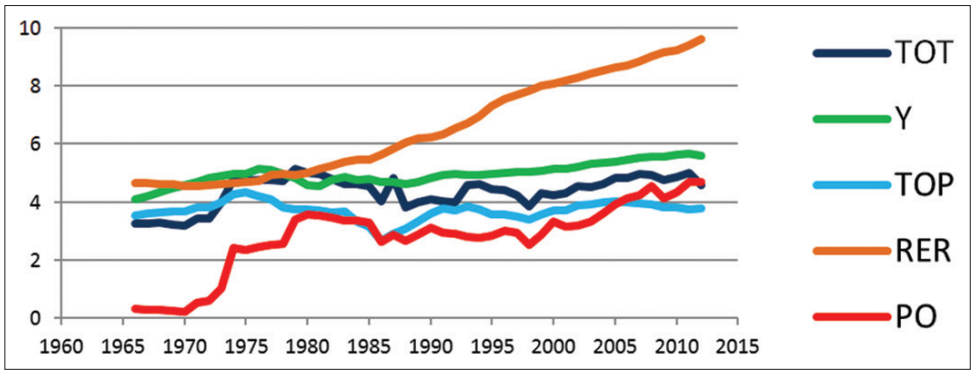
The numbers in parentheses are P values

Table 7: Model II: Augmented dickey-fuller in first differences

ADF statistic	TOT	Y	RER	TOP	PO
Without intercept and trend	−10.93 (0.00)	−0.69 (0.00)	−7.26 (0.00)	−9.12 (0.00)	7.26 (0.96)
Intercept	−10.89 (0.00)	−4.53 (0.00)	−7.46 (0.00)	−9.12 (0.00)	−7.46 (0.00)
Intercept and trend	−10.83 (0.00)	−4.58 (0.00)	−7.54 (0.00)	−9.29 (0.00)	−7.54 (0.00)

The numbers in parentheses are P values

Figure 4: Model I: Trend in variables



variables in the model are found to be I(1) and co-integrated, we make use of Johansson and Juselius (1990) co-integration test to see if there is a long-run relationship among variables. Co-integration means there is a linear, stable and long-run relationship among variables during that specific time. Also, this test would help us to make clear how many co-integration equations exist in model. Tables 8 and 9 indicate the results of trace and maximum eigenvalue co-integration tests for both models. In Model I, maximum eigenvalue test shows 3 and trace test shows 5 co-integrating vectors in the model. We decide to consider 3 co-integrating equations in our next step. In Model II, Maximum Eigenvalue test shows 1 and trace test shows 3 co-integrating vectors. Again, we consider eigenvalue test result and one vector in forthcoming estimation.

In Table 10, we can see the normalized co-integrating equations with standard errors in parentheses. These coefficients can be interpreted somehow as long run effects of the variables on the terms of trade. Output, oil prices and trade openness have positive correlation with terms of trade in long run. Exchange rate is negatively correlated with dependent variable.

When we found co-integrating vectors among variables, we can employ a VECM to identify the mutual effects of the variables. The VECM allows us to distinguish between the short-run and long-run relationships among variables (Sun et al., 2010). As Andrei and Andrei (2015) discuss, with co-integrating equations, the suitable technique is VECM to capture both short- and long-run effects.

General form of a VECM model is:

$$\Delta Y_t=\beta_0+\beta_1 EC_{t-1}+\beta_2\Delta Y_{t-1})+\beta_3\Delta X_{t-1}+u_t$$

The coefficient of EC_{t-1} (that is β_1) measures the speed of adjustment of dependent variable to its equilibrium level.

Table 8: Model I: Unrestricted co-integration rank test

Rank	Max-eigen statistic	0.05 critical value	Trace statistic	0.05 critical value
None	52.82	33.88	135.52	69.82
At most 1	32.41	27.58	82.70	47.86
At most 2	31.68	21.13	50.29	29.80
At most 3	13.99	14.26	18.61	15.49
At most 4	4.62	3.84	4.62	3.84

Table 9: Model II: Unrestricted co-integration rank test

Rank	Max-eigen statistic	0.05 critical value	Trace statistic	0.05 critical value
None	68.02	33.88	125.56	69.82
At most 1	24.08	27.58	57.53	47.86
At most 2	19.67	21.13	33.45	29.80
At most 3	13.61	14.26	13.77	15.49
At most 4	0.16	3.84	0.17	3.84

Table 10: The normalized co-integrating equation

Model	TOT	Y	PO	RER	TOP
Model I	1.00	−0.68 (0.20)	−0.18 (0.04)	0.03 (0.03)	−0.54 (0.13)
Model II	1.00	−15.01 (5.41)	−3.92 (1.01)	0.03 (1.18)	−4.99 (1.40)

Table 11: VECM main results

Model	Source of Causation: Short-run effects χ^2 statistics				
	ΔTOT	ΔY	ΔPO	ΔRER	ΔTOP
Model I					
ΔTOT	-	25.10**	6.75*	12.97**	5.28
ΔY	1.35	-	7.24*	7.41**	8.55**
ΔPO	2.73	8.63**	-	4.07	4.62
ΔRER	42.16**	16.77**	24.30**	-	10.35**
ΔTOP	5.18	27.87**	5.09	18.14**	-
Model II					
ΔTOT	-	20.96**	13.09**	6.64*	13.47**
ΔY	2.33	-	6.24	3.77	0.16
ΔPO	4.08	13.18**	-	2.55	6.78*
ΔRER	6.40*	103.09**	7.84**	-	26.90**
ΔTOP	1.28	26.57**	0.06	11.71**	-

**Denotes significance at 5%, *Denotes significance at 10%. VECM: Vector error correction model

A significant coefficient implies that past equilibrium errors play a role in determining the current outcomes. Table 11 reports the VECM main results for variables by considering all of them as endogenous. In the first block, we can see Granger causality test results. It should be noticed that this statistics, show short-run effects of the variables. ECM figures show that variables can correct a part of disequilibrium in each period.

In Model I, except trade openness, all variables are Granger cause of terms of trade. In Model II, there is significant causality from all variables to the terms of trade. It means, in short-run, all variable affect TOT. Also there are some bi-directional short-run effects among variables; namely between TOT and exchange rate, output and exchange rate, trade openness and output, and trade openness and exchange rate in Model I. In Model II, bi-directional causality exists between TOT and trade openness and between trade openness and exchange rate. What is important for us is the presence of unidirectional causality from variables to the terms of trade in both models. Table 12 indicates the VECM Wald test for coefficients of lagged variables in models. This table is the corresponding results for Table 11 that show two statistics and P values of these short-run coefficients.

Based on estimates in Tables 11-14, there is negative relationship between TOT and real exchange rate in long-run. When the ratio of

Table 12: VECM Wald test: Short-run coefficients

Model	Y	PO	RER	TOP
Model I				
F-statistic	8.37 (0.00)	8.37 (0.09)	4.32 (0.01)	1.76 (0.18)
Chi-square	25.10 (0.00)	25.10 (0.08)	12.97 (0.00)	5.28 (0.15)
Model II				
F-statistic	6.98 (0.00)	4.36 (0.00)	2.21 (0.09)	4.49 (0.00)
Chi-square	20.96 (0.00)	13.09 (0.00)	6.64 (0.08)	13.47 (0.00)

VECM: Vector error correction model

Table 13: Model I: VEC estimates coefficients of TOT equation

Co-integrating Eq	Coint Eq1	Coint Eq2	Coint Eq3	
LNBTOT(−1)	1.00	0.00	0.00	
LY(−1)	0.00	1.00	0.00	
LPO(−1)	0.00	0.00	1.00	
LRER(−1)	−0.23	−0.20	−0.73	
LTOP(−1)	1.41	0.35	3.57	
C	−8.10	−4.98	−11.30	
ECM	**D (LTOT)**	**D (LY)**	**D (LPO)**	**D (LER)**	**D (LTOP)**
CointEq1	−1.45	0.18	0.20	−0.26	−0.06
CointEq2	−1.51	−0.18	1.73	0.08	0.64
CointEq3	−0.37	−0.10	−0.38	0.12	−0.19
D (LTOT(−1))	0.81	−0.06	0.22	0.32	0.16
D (LY(−1))	3.54	0.46	−2.79	0.15	−1.14
D (LPO(−1))	0.18	0.01	−0.22	−0.16	0.16
D (LRER(−1))	−2.50	0.04	−2.21	0.65	−0.23
D (LTOP(−1))	−0.71	0.06	0.31	−0.16	0.05
R^2	0.75	0.73	0.56	0.88	0.83
Sum sq. resids	1.07	0.08	2.00	0.03	0.18
F-statistic	4.07	3.68	1.73	9.64	6.69
Log likelihood	18.39	73.60	4.93	92.74	56.38

VEC: Vector-error correction, ECM: Error correction model

Figure 5: Model II: Trend in variables

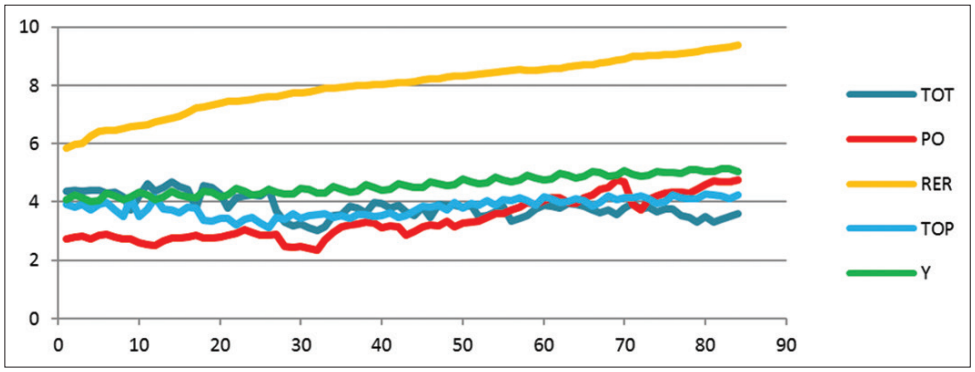


Table 14: Model II: VEC estimates coefficients of TOT equation

Co-integrating Eq	Coint Eq1				
LNBTOT(−1)	1.00				
LY(−1)	−24.20				
LPO(−1)	2.52				
LRER(−1)	6.13				
LTOP(−1)	5.66				
C	225.28				
ECM	**D (LTOT)**	**D (LY)**	**D (LPO)**	**D (LER)**	**D (LTOP)**
CointEq1	−0.37	0.01	0.04	−0.12	−0.03
CointEq2	−1.11	0.14	0.88	3.63	0.17
CointEq3	0.23	−0.05	−0.45	−0.33	−0.02
CointEq4	−0.01	−0.01	0.04	−0.95	−0.01
D (LTOT(−1))	−0.02	−0.01	0.11	0.11	−0.01
D (LY(−1))	0.84	0.99	−1.17	−2.77	0.10
D (LPO(−1))	0.13	0.06	0.48	0.21	0.02
D (LRER(−1))	−0.09	−0.02	−0.02	0.01	−0.09
D (LTOP(−-1))	−0.30	−0.01	−0.32	0.60	−0.66
R^2	0.56	0.92	0.44	0.95	0.66
Sum sq. resids	2.15	0.09	1.08	0.73	0.94
F-statistic	4.03	35.09	2.51	56.45	6.22
Log likelihood	31.22	158.98	58.53	74.43	64.27

VEC: Vector-error correction, ECM: Error correction model

Iran's CPI to world's CPI (RER) increase, Iran's imports decrease and export increase as well; then TOT in both models decrease, as RER coefficient is significant and negative. In fact, one definition of TOT is gross terms of trade which is the ratio of import to export values. GDP has positive correlation with both import and export (Khan, 1974; Boylan et al., 1980; Hothaker and Magee, 1969; Kanjilal and Ghosh, 2014; Kompas and Che, 2016; for export and import of Iran, see also, Goodarz and Sabuori, 2014; Kalbasi and Jalaee; 2002). When output strengthens, both export and import unit values lessen; but the negative and significant coefficient for output in Model II shows the decline in numerator of TOT is more. It will bring us to this fact that the output elasticity of export is larger than the same elasticity for import.

Another interesting fact about estimation outcomes is the almost large and strongly significant correlation between oil prices and terms of trade. As we expect from studies on relation between oil prices and TOT (Backus and Crucini, 2000; Fardmanesh, 1991; Tolonen, 1989; Zhang et al., 2016; etc.), it should be such a meaningful connection in an oil exporting economy. But for trade openness, there is an adverse relationship in short-run. It should be revealed if export does not move toward products with comparative advantage; or at least this transformation has not been enough in short-run. Also TOP is not Granger cause of TOT in Model I.

ECM terms indicate the speed of adjustment of variables to the equilibrium. As they are negative and significant, variables will correct to the equilibrium level. Since data are annual in Model I, each ECM term shows the adjustment per year. For example, about 18% of disequilibrium corrected each year by changes in output in Model I. This numbers are much smaller in Model II. In Model II, about 1%, 4%, 12% and 3% of disequilibrium corrected each season by changes in respectively output, oil price, exchange rate and trade openness.

5.1. Validity of the Model

We applied some tests on residuals to be ensured about validity of the model. VEC residual serial correlation LM test is done and no serial correlation is detected up to lag 12. Normality test of models are done by VEC residual normality test, Orthogonalization: Cholesky (Lutkepohl), and we conclude that both models are jointly normal distributed. Also the results of stability tests drives us to this conclusion that models are stable and can be used in forecasting.

6. CONCLUSION AND POLICY IMPLICATIONS

This paper significantly contributes to the literature on the trend and determinants of terms of trade of Iran. In this paper, we survey the Prebisch-Singer hypothesis for Iran's TOT as it is a developing country which most of its exports are commodities rather to be manufacturers. It has been argued that Iran's TOT possibly would experience a negative trend in long-run. It has been long recognized that commodity exporting and manufactured importing countries (like Iran) will suffer a deteriorating TOT over time and benefit less from international trade. Recommendation for these types of countries to perpetuate this situation was to diversify their exports to more capital-intensive products. Based on relative studies in this field and using unit root techniques, we scrutinized Iran's TOT in this paper. We have used two types of TOT; the ratio of export to import price indices and the ratio of export to import unit values. The results illustrate Iran's TOT has not been stationary in our time framework and there was a negative direction

among the data; but this negative trend was slight and negligible. Indeed, if we separate data to three parts and exclude the middle sector, that is 1979-1991, we will see a zero-sloped trend for TOT. After all, we admit that the Prebisch-Singer hypothesis applies for Iran's TOT, but the negative trend is infirm. To get deeper insights into the reasons, it should be scanned if commodity prices boost. Actually this is true that commodity prices in world market have gone up in recent years; and maybe this is why Iran's TOT did not deteriorate like some countries mentioned in related literature.

In second part, we tried to explore what are the most components of TOT variation. In this regard, considering the related literature and some studies which point to variables concerning TOT in different economies, a model has been accorded to Iran's economy to explain the variation of TOT in long-run. Four variables were detected to enter to the model: Output, real exchange rate, trade openness and oil prices. We applied a VEC model for two sets of data. Model I consists of annual data of 1966-2015 and Model II has seasonal data of 1991-2011. Before that, with adequate unit root tests, it revealed that order of integration of all variables is one.

It was expected to be a downward correlation between exchange rate and TOT. Our findings imply there is such a significant and negative relation between exchange rate and TOT. The effect of output depends on the effect of this variable on both export and import; that is when the output elasticity of import is more than the same for export, the aggregate effect on TOT is negative. Here, in our findings, the coefficient for output is positive. The coefficient for trade openness was insignificant and negative in short-run. As basic international economic theories say, when a country moves toward a more open economy and export goods which it has comparative advantage in producing them, the relative prices of export to import, TOT, will improve. Also the results show a strong significant and positive correlation between oil prices and TOT, in both short- and long-run. It was declared that the share of oil prices is larger than the others. In Model I, we can see the presence of causality of all variables but trade openness to TOT. In Model II, short-run causality exists from all variables to TOT. In addition, ECM terms show.

There are some implications for policy makers. Iran is the largest economy outside the WTO. Opening up the economy will help Iran to benefit more from international trading system and will improve its terms of trade as well. This process should start by moving toward a more capital and technology intensive export. Second, the effect of output on export and import should be examined more in details; this subject remains for further studies. Finally due to the huge effect of oil prices and its common fluctuations, and especially decrease in oil prices in last few years, the dependence of economy on oil should lessen to minimize the adverse impact of oil price swings on the TOT.

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