



## “Optimization Model for Balance of Trade (BOT) in Iran”

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### ABSTRACT

This study estimates Optimization Model for Balance of Trade (BOT) in Iran econometric model of Vector Autoregression (VAR) was employed for period of years (1981-2014). The results indicate that rising ratio of relative price to used cost in investment and wealth may worsen BOT while rise of real capital can lead to improvement of BOT, Shows that there was a need for implementation of economic reforms, further reduction in costs, and omission of investment controls and it requires strengthening infrastructures, encouraging for foreign investment, and increase in domestic savings to accelerate investment and accumulation of capital in Iran.

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### 1. Introduction

From the very beginning, human had some requirements for which s/he could not meet them and necessarily human should exchange with other individuals or other lands to provide for those needs. Thus, importance of exportation and importation and/ or in other words foreign trade was revealed in human life and following to clarification of that importance people took control of foreign trade. Optimization model for Balance of Trade (BOT) was popularized since early 1980s and these models could propose a solution for the prevalent non- optimized models. Trade deficit (surplus) in these models expressed reflected transfer of opportunity for consumption over the time instead of denotation of any economic imbalance according to non- optimal models. The optimization models emphasize in intertemporal considerations and balance in trade behavior (current account) as a function of domestic saving and decisions made for prospective investment by optimal broker. It is unlikely that the amount of importation is greater than exportation in a country (it uses lesser domestic products); therefore, this is led to trade surplus and accumulation of net foreign assets during current period so that it may cause use of this saved foreign wealth for more importation than exportation in the future. Alternately, a country may import further than exportation and this is possible by reducing net foreign wealth or rising foreign debts during current period provided that they were repaid with interest in forthcoming periods.

The estimated studies at these levels have paid no attention to unstable behaviors of series of model among the conducted studies before 1990s while dynamic models- based studies refuse any long-run balance among variables of this model. Many studies have been restricted to developed countries and only limited numbers of them dealt with analysis on balance of trade in developing nations. The present study develops an intertemporal optimization model and tests it empirically for Iran by means of Johansen Maximum Likelihood Procedure (1991). Initially, theoretical model is developed and tested without use of government and then by use of government.

### 2. Research literature

In an essay titled an optimization model for balance of payments, Tarlok Singh (2004) approximated intertemporal model of balance of payments for India. He primarily tested his model without use of government and then by use of government. Singh concluded that there were some strong evidences for long-run cointegration relationship between variables of the model at both modes but the model without government might seem better than a government- included model. He also found that the rise of prices might be biased relating to cost of using capital and real wealth while increase in accumulation of realcapital might lead to improvement of balance of trade. He suggests the Indian economy needs to some reforms, lower costs, and investment- related controls and also he recommends for further consolidation of infrastructures, encouraging foreign trade, and rise of domestic saving in order to accelerate investment and accumulation of capital.

In a study in which they used Autoregressive Distributed Lag (ARDL) model, Oskooei and Beik (2014) examined symmetric or asymmetric effect of exchange rate on balance of trade in South Korea. In this survey, they have utilized seasonal data (1989-2014) for 79 enterprises which were involved in bilateral trade with US and they estimated each of the given enterprises for model of balance of payments. They found some evidences based on presence of different modes for proving asymmetry in response to level of balance of trade in enterprises in respective of exchange rate variations. Initially, asymmetric adjustment was observed in different forms of accountability of balance of trades to reducing exchange value compared to increase in this level for 44 out of 79 industries. Secondly, asymmetry was seen in size of approximation among decrease and increase of value in 66 companies in short term. The long run asymmetric effects were also observed for 44 countries. Thus, there is asymmetry in non-linear model and exchange rate shows important role in transactions per se but linear models indicate symmetry.

The novel aspect of this study has caused no one can find a study approximately similar to our study. Thus, we will deal with studies which are slightly similar to the present survey.

Mehrara and Abdi (2007) examined determinant factors in balance of trade in Iranian economy using Johansen, Engel-Granger, and Philips- Hansen cointegration And ARDL technique (Pesaran and Shin). Their findings indicate that the formal effective exchange rate could not interpret satisfactorily balance of trade based on tests of cointegration, size and statistical importance of coefficients, diagnostic statistics, and stability of parameters but by using real exchange rate of parallel market in model of balance of trade it is capable to explain favorably long- term and short term behaviors of balance of trade in Iranian economy based on cointegration tests and diagnostic statistics. In fact, they concluded that what it might influence in trading decisions was the cost of real opportunity of exchange rate based the given value in parallel market. Rasekhi et al (2014) examined nonlinear asymmetric reaction by balance of trade to variance of real exchange rate for Iran during years 1973- 2009 by means of Logistic Smooth Transition Autoregressive (LSTAR) model. They came to the result that the negative (positive) effect of real exchange rate has been obtained on Iranian balance of trade at lower (higher) levels of threshold real exchange rate (Rls.5'705). Based on the given results from this investigation, firstly the real exchange rate has asymmetric (nonlinear) effect on Iranian balance of trade; secondly, overvaluation for Rial currency might negatively impact on balance of trade. It should be totally implied that the policymakers should pay special attention to other behavioral effective factors on exportation and importation and production conditions and domestic demand before execution of balancing policy. Accordingly, taking policy of reducing money value will not be necessarily led to improvement of balance of trade in the long run.

### 3. Model

This study adjusts intertemporal model for trade of balance (Burda and Gerlach, 1992). They distinguished among trade of balance for durable and delicate commodities and they proposed an optimization model by assuming bi- commodity production function similar to Sachs (1982) so that to enable them for showing profit- maximization technology in enterprises and also to indicate bi- commodity utility function for preferences of optimizer consumer as well. After solving the problem of consumer's utility maximization problem, they achieved separate models of balance of trade for durable and delicate commodities. The real balance of trade for delicate commodities was obtained as a function of price of delicate commodities compare to durable goods and variable of wealth while real balance of trade is characterized for durable commodities as a function of the aforesaid factors and individual capital cost and accumulation of real capital. The classified data have not been presented for durable and delicate commodities in Iran and therefore one model will be proposed for all of commodities without separation of balance of trade for both durable and delicate commodities.

### 4. Model assertion

This essay has been focused on four variables based on empirical analyses. The variables used during period (1981-2014) are given in a linear model as follows:

$$\ln RXM_t = \beta_1 + \ln K_t + \beta_2 \ln RPUK_t + \beta_3 WR_t + U_t \quad (1)$$

$\ln RXM$  = log of the ratio of real exports to real imports

$\ln K$  = log capital stock

$\ln RPUK$  = log ratio of prices to user cost of capital

$WR$  = Real wealth

The tests are used in this study include test of unit root, cointegration test, and also Vector Error Correction Model

(VECM). The unit root test is employed for determination of stationary of series at level and first- order difference by means of Augmented Dickey-Fuller (ADF) test and also Akaike Information Criteria (AIC).

### 4-1. Results of description of data

#### 4-1-1- Review of stationary of model variables

Before estimation of autoregressive model in order to determine stationary of times- series for variables in this study, stationary test was utilized for all time-series. If the studied time-series are not stationary, it is impossible to use autoregressive models because of problem of false regression. Unit root tests have been used for conducting stationary test. The Augmented Dickey-Fuller (ADF) test is one of the most prevalent tests for diagnosis of unit root where the given test has been utilized in this study.

If the value of calculated statistic is smaller than critical F- values, the null hypothesis is accepted according to autocorrelated statistic in residues. In other words, it is applicable if we accept that the residues are autocorrelated. Namely, if we accept the residues are autocorrelated this means the model will be optimally cable for self-explanation. If stationary test is significant this means the variables of time-series are stationary without unit root therefore null hypothesis is rejected and the opposite hypothesis is accepted. As it seen in Table (1), variable of logarithm of balance of trade and logarithm of real capital accumulation are at stationary level but they were used by one difference degree compared to ratio of price to capital cost and became as real wealth. Summary of results from unit root of Augmented Dickey-Fuller (ADF) test is shown in Table (1).

**Table 1. Augmented Dickey-Fuller Tests for Unit Roots.**

Variable	Statistic	Critical value 1%	Critical value 5%	status
LnRXM	-3.84	-3.64	-2.95	I(0)
RPU	-1.19	-3.65	-2.95	I(1)
LnWR	-0.33	-3.64	-2.95	I(1)
lnk	-3.93	-3.64	-2.95	I(0)

Determination of suitable lag length for difference of variable in the model is the first phase for estimation of VECM model. In order create lag in this model, E-view.6 software uses automatically lags 1 and 2. Use of ordinal test is the proper method for finding lags in such a way that the lag is subsequently given to the model as long as to obtain the best results (with respect to statistics of model). At the end, that lag is selected as suitable lag that gives the best result based information criteria (Akaike and Schwartz- Bayesian). This operation is done by iteration of test. Table (2) shows the results of optimal lag test.

**Table 2. Selecting the optimal lag.**

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-728.91	NA	4.03	47.28	47.46	47.34
1	-626.30	172.11*	1.53	41.69	42.62*	41.99*
2	-607.97	26.01	1.39*	41.54*	43.21	42.08
3	-592.49	17.97	1.68	41.58	43.98	42.36

\* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

As the results of above tables indicate, compared to other values, Schwartz- Bayesian Criterion (SBC), Akaike Information Criterion (AIC), and Hannan- Quinn (HQ) test are minimized at one lag. It should be mentioned that SBC and AIC criteria were used for selection of number of optimal lag in this model since based on parsimonious principle, it offers fewer lags and finally it presents a parsimonious model. Overall, all indices introduce lag-1 as the optimal VAR lag.

#### 4-2. Cointegration test

It was seen that all three variables have become stationary at first-order difference level and one can get rid of false regression by first- order differentiation but valuable information may be lost about level of variables. However at the fixed mode of cointegration, one can fit variables or at this level and/ or through Vector Error Correction Model (VECM). The usual cointegration comprise of Engel- Ganger test, Cointegrating Regression Durbin- Watson (CRDW) test, and Fully- Modified Ordinary Least Squares (FM-OLS) test but it should be noticed that there are some important constraints in using Ordinary Least Square (OLS) technique for estimation of long-run balanced relation. Whereas use of difference variables causes missing valuable information regarding level of variables thus it is fitted by means of cointegration techniques and Vector Error Correction Model (VECM). For this purpose, VAR method is employed since in comparison with traditional approach, the existing potential information is considered among variables in long term. These models consider long-run relations and dynamic balance between variables by creation of balanced conditions.

The basis for selection of model denotes in this paper if long-run relation exists it is necessary to estimate Vector Error Correction Model (VECM). Therefore, with respect to results of Johansen test that confirmed presence of at least a long- run relationship among model variables, it was necessary this relationship to be adjusted by VECM model.

#### 4-3. Results for estimation of Vector Error Correction Model (VECM)

Given that number of lags in VECM model in difference of variables is related to quantity of lags at level of variables in VAR model and by knowing number of lags in this model, quantity of lags is derived for difference among variables in this model. With respect to this fact that the optimal lag is assumed one in the model, the lag will be zero for difference among variables in the model. In fact, with respect to presence of a long-run relationship in VECM model for the optimal lag, the lag-zero was obtained in difference among variables and by considering intercept in short- term and long term relations.

##### Unrestricted Cointegration Rank Test (Trace)

Hypothesized	Trace	0.05		
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.596	60.97	47.85	0.0018
At most 1 *	0.44	31.89	29.79	0.0282
At most 2	0.24	13.17	15.49	0.1085
At most 3 *	0.11	3.98	3.84	0.0459

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level

\* denotes rejection of the hypothesis at the 0.05 level

\*\*MacKinnon-Haug-Michelis (1999) p-values

These relations should be considered in estimation of long-run relations. The long run relationship between a few variables includes linear relation between them that is not unique. The estimated long-run relation has been automatically normalized and according to one of variables in

E-views.6 software so to finally results in a unique relation. The existing long-run relation has been normalized according to variable of logarithm of balance of trade. The VECM examines pure effects for each of explanatory variables on dependent variable separately in the given long-run relations and in the other words the collinear relation between variables in long-run relationships is neutralized by the estimated model. With respect to the following formula, ratio of cost to the used capital cost has negative and significant effect on balance of trade in the long run. Similarly, capital logarithm has positive impact on balance of trade but real wealth logarithm has negative and significant impact on balance of trade.

**Table 4. Mechanism of Long-term vector error correction model.**

lnRXM	Const nt	RPU	LnWR	Lnk
1	-60.74	6.17[5.62]	7.70[ 6.11]	-1.72[-4.46]

We examine short-term relationship existing between variables and present the related VECM model to above long-run model in the following.

#### 4-4. Analysis on short-term relationship of variables in VECM model

According to theory of Engel-Granger (1978), there should be a short-term relation corresponding to any long run economic relation as error correction mechanism to achieve long-run balance. In addition to review on short term relationship between models in this section, using VECM model, the short term fluctuations of variables are related to their long-run values. The summary of results from the short-term mechanism relating to long run (4) is presented in the following test. The real wealth has negative and significant effect on balance of trade in the short term while capital has no negative and significant impact on balance of trade. The impact of ratio of cost to the used cost in capital is positive and insignificant.

**Table 5. The mechanism of short-term vector error correction model.**

T-statistic	coefficients	variable
0.95	92400	D(RPU(-1))
-3.93	-0.10	D(LnWR (-1))
-0.60	-0.090	D(LnK (-1))

To ensure from this fact that the given cointegration formula is really applicable in the long run and imbalance will be gradually corrected toward long-term balance, error correction model (ECM) is utilized.

**Table 6. The results of vector error correction model.**

variable	coefficients	standard deviation	T-statistic
ECM(-1)	-0.13	0.061	-2.16

With respect to Table (6), ECM (-1) coefficient is negative (among zero and one) and significant. As a result, the given cointegration relationship is applicable for the long run and short-term imbalances are corrected toward long run balance at high speed (with respect to error correction coefficient).

#### 4-5. Conclusion and suggestions

The optimization model for Iranian balance of trade has been utilized in the present essay. The results of study indicated that there was strong cointegration between variables of model. Theoretically, estimation of coefficients has been predicted for all variables in the long run and they are statistically significant as well. This study shows that the variables e.g. relative prices to the used capital cost, real wealth, and real capital may play important role in Iranian balance of trade in the long run.

Rise of relative price to the used cost has negative effect on balance of trade while increase in capital was led to improvement in balance of trade. However effects of capital are weaker than impacts of real wealth and relative prices. Also Error Correction Model (ECM) indicated that it significantly impacted on lag in balance of trade.

The important role of exportation and importation price compared to cost of capital user may negatively impact on trading performance and this is possible through rent-seeking by reducing in tariff and non- tariff importations and efficient use of production capacity and removing structural constraints in economy. This study indicates that it necessitates for conducting economic reforms to reduce costs and omit capital control. This study shows that it needs to strengthening of complementary infrastructures and encouraging for foreign investment as a non- debt related facilitator source and completion of domestic investment and accumulation of capital. Accumulation of capital is deemed as an important and contributive factor to improve balance of trade and it necessitates for strengthening toward increase of domestic investment and acceleration in accumulation of capital.

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