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The Effect of Real Exchange Rate instability on Non-Petroleum Exports in Iran

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ABSTRACT

This article investigates the effects of uncertainty and instability in real exchange rate on non-petroleum exports in Iran for the years 1961-2006. In order to obtain instability index from real exchange rate variability Generalized Autoregressive Conditional Heteroskedastic model (GARCH) was used. The ARDL method was also applied to analyze the effect of uncertainty and instability in real exchange rate and other variables on non-petroleum exports. The results indicated that uncertainty in real exchange rate have a negative effect on non-petroleum exports in long term and short term periods. So to develop non-petroleum exports, it is recommended that real exchange rate and general level of prices controlling and stabilizing policies are implemented to decrease the uncertainty and risks regarding real exchange rate volatilities, and lead to clarity in the future of exchange rate trend.
KEY WORDS: Exchange Rate Uncertainty, Non-petroleum Exports, GARCH model, ARDL model.

INTRODUCTION

Volatilities and instability in the price and demand for oil have caused volatilities in oil producing countries' incomes. This has shed new light on the need to be more independent from oil incomes, and expanding and developing more non-petroleum exports. On the other hand, one of the factors leading to sustainable economic growth and development is growing export which is the main economical priority for every country in foreign section. Because of the importance of reducing dependency on oil incomes in Iran economy, the role of non-petroleum export in reducing this dependency and in developing economy, the importance of analyzing factors affecting non-petroleum exports and providing necessary programs for developing exports are of a great urgency. Foreign exchange rate is one of the important factors affecting non-petroleum exports. This vital economical variable has experienced high volatilities during last four decades. Economical studies show that due to instability and uncertainty in foreign exchange system and lack of a well integrated business and economical model there was a deep instability in the economy as well. It is notable that instability in foreign exchange real rate will lead to instability in production, business transaction, investment, and increase of domestic prices. This will create an uncertain and risky environment for foreign investments and exports.

It is believed that the increasing volatilities in exchange real rate will create uncertainty in the market and business place and consequently will increase the risk of business transactions and reduce the level of business. In this article the effect of uncertainty and volatility of exchange rate on non- petroleum exports in Iran during the years 1961-2006 is analyzed. In the first section the theoretical basis and the literature will be reviewed. Then, in an experimental model the volatility of exchange real rate model will be developed, using Autoregressive Conditional Heteroskedastic model (GARCH). In the second part, using Auto- Regressive Distributed lag the relationship between volatility of exchange rate and non-petroleum exports will be estimated. In the final section, the findings will be analyzed, and then some political implications will be suggested.

THEORETICAL BACKGROUND

Investment in foreign business would cause much sensitivity with regard to the risk which appears in many forms: uncertainty of future products and costs which directly determine cash flow, uncertainty of exchange rate, taxes, and regulatory policies. Thus, if the aim of macro economical policy is foreign trade and export growth, the stability and endurance should be more important than determining general level of tax rates, interest rate, etc.

Most of the developing countries experience high volatility in exchange rate which leads to high level of uncertainty in investment and profitability costs. Volatility in exchange rate is usually along with irregular and haphazard patterns of fluctuations in relative profitability of investment in foreign trade, consequently the cost of investment goods which are imported to developing countries become fairly unstable and unpredictable. Exchange rate real volatility is an indication of uncertainty in the process of relative prices leading to risk uncertainty increase. In situations like these investors in foreign trade do not tend to participate in projects in which they don't have any hope of future success, rather they are likely to invest where they can make profit in the short run.

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Experimental studies have proven in many cases the relation between exchange rate volatility and trade. According to its theoretical framework if businessmen are risk-averse, volatility in high exchange rate could lead to reduction of trade capacity (or bulk) partly because these businessmen try to evade risky investments. Economy agents in a risky situation call for higher prices so as to cover current risks. This will in turn lead to reduction in the trade level [1].

Early theoretical models of partial balance in risk-averse corporations, which are limited to decision making about trade level in situations of exchange uncertainty , and if using hedging is impossible or expensive wick yield negative the effect of volatility on trade. This theory is applicable for most of developing countries which want to expand their financial markets. In this case, firm's interest changes rely completely on the exchange real rate. Moreover, if the aim is maximizing the interests or profit, high volatilities in exchange rate will lead to reduction of exports [2]. By affecting profits, unexpected changes in exchange rate can have a bad effect on trade level. If exchange rate volatility increases, the risk of making profit will increase as well. Since exporters are more risk-averse, and exchange rate risk is expensive or impossible, higher risk of profits will reduce the profits and consequently will reduce the amount of international trade [3].

Many studies, however, show that increase in exchange rate volatility can, surprisingly, increase the profitability. According to these studies if trade institutions are chosen as a good option, and then preserved, trade will grow considerably.

Theoretical studies show that this estimation, on the basis of limitation hypothesis, with regard to the form, is dependent on desirability. Even under risk-averseness theory, the effect of exchange real rate volatility on exports will be quite vague and uncertain by eliminating the limitations. Higher risk has substitution and income effect. In substitution effect, due to the increase of exchange risk, the export activities will decrease, and this will encourage companies and businessmen to transfer high risk export activities to low risk ones.

In the case of high risk, however, the transfer of resources to export section will increase, partly due to income effect. Therefore, if income effect overcomes the substitution effect, uncertainty and instability of exchange rate volatilities will have positive effect on exports [2].

Moreover, the increase in exchange rate volatilities can create a good opportunity for companies and institutions that are capable of adjusting trade level with exchange changes to make more profit. Through experimental studies, it has been shown that the increase in volatility of exchange rate could increase the value of export companies and their activities. Studies show that an international company with a huge domestic market is capable of making profit from exchange by reallocating products between domestic and foreign market. Furthermore, exchange changes facilitate the regulations of payment balances in case of foreign shocks, and reduce the use of trade limitations and asset controlling to get more balance and encourage more international trade and transaction [2].

In short, theoretical results are constrained to hypothesis about approaches to risks, function, kind of businessmen, regulation, costs, market structure, and hedging opportunities. It can, then, be concluded that the effect of volatility and its consequent uncertainty or instability on each country's own conditions and its results will differ for countries of different economical structures. As a result, the direction and significance of instability and uncertainty due to exchange rate volatility on non-oil exports will be put into experiment.

REVIEW OF LITERATURE

In a paper Pickard (2003) explores the effect of instability due to exchange rate volatilities on Canada's export to the US from 1971-2000 [4]. Using ARDL model, he obtained negative effect of exchange rate volatility on exports in the short run. Bustaman and Jayanthakumaran (2006) examined the long term and short term effects of exchange rate volatility on Indonesian exports to the US [5]. They used monthly data from the years 1997–2005. Using ARDL model, the results from estimation of correlation showed that there are significantly both negative and positive coefficients among columns of goods. However, in the long term exchange rate high volatilities will cause higher costs and lower foreign trade.

The gross effect of exchange rate uncertainty and instability on production and export depend on the degree of exporters risk taking ability. Chitt et al., (2008) in a study on the relation between exchange volatility and exports for the developing East Asian countries economy, used data for 25 years and cumulative test of regression long term relation between variables [2]. Their results showed that exchange rate volatilities, considered as the exchange rate proxy, had a significantly negative effect on the developing eastern Asian exports.

Vergil (2003) explored the relation between exchange rate volatility and exports from Turkey to the US and her three allies in EU for the years 1990 to 2000 [6]. They used cumulative model error correction. The results of estimation showed that exchange rate volatilities had a significantly bad effect on real exports.

Ricardo and Vittorio (1989) in an analysis on the effect of exchange rate volatilities on exports concluded that exchange positive or negative effect depends on the way export companies view or consider risks [7]. With the increase of uncertainty and instability in exchange rate risk-averse companies' exports decrease whereas for risk-taking companies this variable shows increase. Using GARCH, Ozbay (1999) measured the effect of exchange rate volatility for the years 1988 to 1997. His results showed that there was a negative relationship between exchange rate volatility and exports [3].

Todani and Munyana (2005) used the ARDL method to analyze the seasonal data for 1984 to 2004. Their results showed that there wasn't a significant relationship between exchange rate volatilities and exports, but if there were any relation at all, it would be a positive one [8].

Shakeri (2004) studied the different effective price and non-price factors, and considered export a function of two price variables: free exchange rate, inflation rate, and two basis variables of efficiency and competition. Using ARDL model he concluded that price variable had a positive effect on non-oil exports [9].

Hejhabr Kiani and Nikeqbali (2000), in an analysis of the effect of exchange rate instability on agricultural products, showed that any deviation of exchange real rate from its balanced and long term direction, exchange volatilities and domestic demand pressure for exportable goods will have a negative effect on the supply of agricultural products [10].

Ehsani et al., (2009) using Johnsin and Joselius, and ARDL models showed that exchange rate had a positive effect on non-oil exports, but its instability or volatility had a negative effect [11].

METHODOLOGY

Ever growing, yet unstable, exchange rate has always imposed heavy costs on the shoulders of economy. Instability and volatility of exchange rate will add to business companies' concerns about government policies and the future of exchange rate. This results in less (or lack of) motivation to production activities.

To confirm the above mentioned hypothesis, we need to measure exchange rate volatility, and then analyze its effects on non-oil exports. In recent studies, volatility is measured on the basis of time series model in which exchange rate conditioned variance changes from one period to another. GARCH model has been used for almost all the recent studies. In this model deviated statements of regression were not equal. This variance inequality causes volatility in time series. In order to be sure about the existence (or non- existence) of variance heterogeneity, we used the Arch test (Test LM Arch). The method had two stages:

First Stage: Using OLS method the best model of exchange rate regression was estimated, and using this model's value residue the sequent of $\{\hat{\varepsilon}_t^2\}$ was formulated.

Second Stage: the square residue is regressed on a fixed value, and q value with $\hat{\varepsilon}_{t-1}^2$, $\hat{\varepsilon}_{t-2}^2$, ... , $\hat{\varepsilon}_{t-q}^2$ lag.

$$\hat{\varepsilon}_t^2 = \alpha_0 + \alpha_1\hat{\varepsilon}_{t-1}^2 + \alpha_2\hat{\varepsilon}_{t-2}^2 + \ldots + \alpha_q\hat{\varepsilon}_{t-q}^2 \qquad (1)$$

If there isn't a form of ARCH or GARCH, the estimated amount $\alpha_1 \ldots \alpha_q$ will equal zero [12]. The simplest mode for conditioned heterogenic variance was ARCH (1) model in which v_t was the white noise.

$$\varepsilon_t = v_t\sqrt{\alpha_0 + \alpha_1\varepsilon_{t-1}^2} \qquad (2)$$

Engle developed this process into the following form (ARCH (q)) in which conditional variance, mean weight of square errors are anticipated:

$$\varepsilon_t = v_t\sqrt{\alpha_0 + \sum_{i=1}^{q}\alpha_i\varepsilon_{t-i}^2} \qquad (3)$$

Bollersleve (1986) developed Engle's equation using the error process as $\varepsilon_t = v_t\sqrt{h_t}$ [13].

$$h_t = \alpha_0 + \sum_{t=1}^{q}\alpha_i\varepsilon_{t-i}^2 + \sum_{t=1}^{p}\beta_i h_{t-i} \qquad (4)$$

In the above formula h_t is the conditional variance of $\{\varepsilon_t\}$ and is considered as the uncertainty proxy. This model is called GARCH (p,q). To get the best model of ARCH or GARCH we used the AIC and SBC criteria, then, to examine the effect of exchange rate volatility on non- oil exports the ARDL model was used. The optimal lags for every explanatory variable can be determined using one of AIC, SBC, HQC, or $\bar{R}^2$ criteria. ARDL model is as follows [14]:

$$Q(L,P)Y_t = \alpha_0 + \sum_{i=1}^{k}\beta_i(L,q_i)X_{it} + \delta' W_t + u_t \qquad (5)$$

$$Q(L,P) = 1 - Q_1L - Q_2L^2 - \ldots - Q_PL^P$$

$$\beta_i(L,q_i) = 1 - \beta_{i1}L - \beta_{i2}L^2 - \ldots - \beta_{iq}L^{qi}$$

L is the functional lag, W_t is the vector of flow, external variable. In estimating ARDL model there is no need to test the consistency of every variable. In other words, it is not necessary that the entered variable to be zero (0), because I (1) variable could have co-integration relation. It is also possible that a combination of I (0) variable do not co-integrate. There should be a co-integration test after estimating and examining the model so that if the equation is toward co-integrating variables or not [9]. So in the $\dfrac{\sum_{i=1}^{n}\alpha_i - 1}{\sum_{i=1}^{n} S_i}$ in which α_i is the variable with lags related to dependent variable and S_i standard deviation of those co efficiencies is calculated and compared and contrasted with its extreme equal ant value proposed by Banjee et al. If the absolute value of the calculated formula is more than excessive absolute value, the co-integrational relation will be confirmed. Otherwise we can conclude that there is no lasting and long term relationship between those variables. If there is a relationship between co-integrational and lasting relationship between this model's variables then we can conduct the analysis of long term coefficient and their value is explored. Co-integration between a set of economical variables can provide a useful model for correcting errors deviations. The model of error correction can relate short term volatilities to their balanced long term values [14].

DATA ANALYSIS

Statistical sample used in this paper covers the fixed price for 1997, and the years between 196-2006. Data were obtained from IMF's Statistics, Iran's Statistic Center. In this article the statistics and all the data were analyzed using economy measure model, Eviews 4, Microfit 4 software.

THE ESTIMATION OF MODEL

A: The estimation of exchange rate volatility and uncertainty model: In order to estimate exchange rate volatility we used the GARCH model. We had to develop the early model for exchange real rate. On the basis of Box & Jenkins method the best model for describing exchange rate behavior is

$$LRER = \alpha_0 + \alpha_1 LRER_{t-1} + \varepsilon_t \qquad (6)$$

$$\varepsilon_t \approx N(0, h_t)$$

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1}$$

Before calculating the firs model, the consistency of real rate variable needed to be tested. Because of the structural split of failure in Iran's date and special foreign exchange rate, the results of consistency sum squared Augmented Dicky-Fuller Test and Philip-Perron Test were invalid. The estimation was conducted using *Eviews4* software and OLS technique. In structural break situation for sum square test the semi-revolution Dum 11 variable is used. Perron's test along with the changes in slope and width from basis is as follows:

$$\tau = \frac{\hat{\rho} - 1}{S_{\hat{\rho}}} = \frac{0.741 - 1}{0.0526} = -4.92$$

$\hat{\rho}$ is the coefficient estimation with one lag , $S_{\hat{\rho}}$ is the standard deviation. The excessive value of distribution of $t_{\hat{\rho}}$ test on the 95 percent of certainty is -3/ 76.

According to the quantity of the test (-4/92) which is larger than the absolute value of excessive quantity on the certainty level of 95 percent (-3/76). It is concluded that real rate logarithm time series does not have an integrated root and consequently it is consistent in the results.

Table1. Manayy Test of Peron for Real Exchange Rate

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.0003	0.4039	4.9518	0.0000
LRER(-1)	0.7409	0.0526	14.0777	0.0000
DUM57	0.4768	0.0707	6.7438	0.0000
D57	-0.1097	0.1035	-1.0594	0.2959
DT	-0.0026	0.0045	-0.5684	0.5730
@TREND	-0.0071	0.0041	-1.7147	0.0943

$R^2 = 0.979 \quad \overline{R}^2 = 0.978 \quad D.W = 1.78 \quad F\ Stat. = 371.4$

Perron's consistency test of exchange real rate to determine the existence (or not existence) of variance incongruity the ARCH LM test was conducted. ARCH test is conducted for major model's residue. The results for F, obs * R-Squared on the highest level of certainty shows that there is variance inconsistency in the exchange real rate residue. As a result the null hypothesis that there is no variance inconsistency is rejected. The foreign exchange real rate mode residue chart shows that variance incongruity in statement.

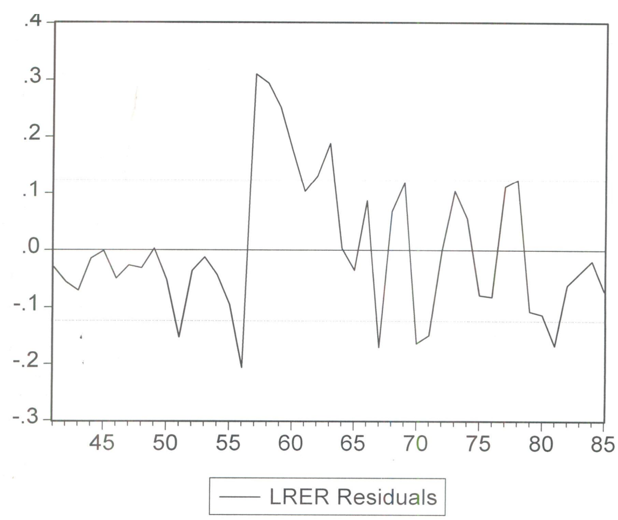
Table2.ARCH-LM Test

F-statistic	42.97064	Probability	0.000000
Obs*R-squared	22.25131	Probability	0.000002

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.004403	0.002819	1.561524	0.1259
RESID^2(-1)	0.709368	0.108215	6.555200	0.0000

$R^2 = 0.50 \quad \overline{R}^2 = 0.49 \quad D.W = 1.62 \quad F\ Stat. = 42.97$

Figure1. Real Exchange Rate Residuals



In order to determine the exchange rate behavior pattern we tested different models of GARCH, and then compared them. On the basis of Box-Jenkin, and Shwarts-Bizin criteria, the best model for the exchange rate residue is the GARCH (1,1). The results of this model are:

$$h_t = 0.0013 + 0.599\varepsilon_{t-1}^2 + 0.36h_{t-1}$$

$Z - Sta \quad 1.068 \qquad 3.70 \qquad 2.26$

$R^2 = 0.937 \quad D-W = 1.09 \quad F = 149.87$

h_t is the error process's conditional variance which is considered as the exchange rate real uncertainty.

B. The Estimation of Non-Oil Exports Model

In analyzing international, open, and financial macro-economies, export is a function of exchange rate, domestic, prices, and foreigners' incomes. Ricardo and Vittorio (1989) introduced real exchange rate and global demand as the descriptive and explanatory variables for exports [7], whereas Todani and Munyama (2005) described exchange rate, business sector income, and exchange rate volatilities as the explanatory variables for exports [8]. Pickard (2003), on the other hand, suggests US gross production, exchange rate, and its volatilities as the explanatory variables for the exports [4]. For a low-exporting country such as Iran, because of the importance of the supply sector, the foreigners' income will not have a significant effect on exports; rather country's production potentials will have a great effect on exports.

On the basis of Iran's economic structure, we can illustrate every function of non-oil exports as follows:

$$LEX = f(LGDP, LRER, LUNCR, DUM)$$

In the above function LGDP is Iran's gross domestic product, LRER is the real exchange rate, LUNCR is the uncertainty due to real exchange rate volatilities. DUM is the unreal variable. All variables are put into the model through logarithm. The real exchange rate's effect is highly significant on non-oil exports. Real exchange rate is calculated as: $RER = E.\frac{WPI}{CPI}$ in which WPI is the US wholesale price index, and E is the exchange rate in informal market. Real exchange instability which is the result of exchange rate volatilities, and developed with the use of GARCH model is introduced to this model. War as an unreal variable is one of the economic factors afflicting economy and exports. Functional relation of non-oil exports model was estimated Using Microfit 4 software and ARDL model.

$$LEX = -6.9018 + 0.6503LEX(-1) + 0.514LGDP + 0.379LRER - 0.1519LUNCR - 0.493DUM59 \quad (8)$$

SE:	1.6218	0.0746	0.117	0.1319	0.0647	0.1947
t:	-4.2557	8.7137	4.602	2.877	-2.34	-2.535
$prob$:	(0.000)	(0.000)	(0.000)	(0.007)	(0.025)	(0.016)

$R^2 = 0.92$ $\quad \bar{R}^2 = 0.91$ $\quad D-W = 2.34$ $\quad F = 88.12$

All variable coefficients in the above model are meaningful and in line with expectations. Non-oil export with a short lag is under its own affect. Country's product in the same period will lead to the increase in the exports with the increase of real exchange rate. Domestic products will be cheaper compared to foreign products, and consequently the more domestic consumption the less imports. This will lead to increase in exports. Real exchange rate instability and volatility has a significantly negative effect on non-oil exports. War unreal variable co-efficiency indicated decrease in non-oil exports. Finally, the resulted co-efficiency is 0/92 which is a good justification for this model. Moreover, the resulted Durbin- Watson is 2/34 indicating lack of co-integration in the model's residue statements. The resulted F confirms all the co-efficiencies in non-oil exports model as fully meaningful. As mentioned earlier in ARDL method, if there is a convergence among variables, it is not needed that all variables put into this model have a zero level. In other words, to have a long term balance the developed model it is necessary that the sum of dependent variable coefficient in different lags be less than 1. According to the short term relation of non-oil exports' model we will have:

$$\tau = \frac{\sum_{i=1}^{n} \alpha_i - 1}{\sum_{i=1}^{n} S_i} = \frac{0.6503 - 1}{0.0746} = -4.68$$

Benarji-Dollado excessive value on the 95% level of certainty is -3/82. Since absolute value of calculated statistics on the basis of model's estimated coefficient is more than its excessive value, the converging relation in this model is confirmed and proved. As a result, non-oil export model for Iran's economy for a long term period was estimated, and its results are as follows:

$$LEX = -19.738 + 1.47LGDP + 1.086LRER - 0.4345LUNCR - 1.411DUM59 \quad (9)$$

SE:	5.692	0.3157	0.377	0.2229	0.433
t:	-3.467	4.657	2.875	-1.94	-3.259
$prob$:	(0.001)	(0.000)	(0.007)	(0.059)	(0.002)

All the coefficients are meaningful and in line with expectations. In the long run gross domestic products and real exchange rate variables have a positive and meaningful effect, whereas exchange rate instability and volatility have a significantly negative effect on non-oil exports.

Since war unreal variable causes changes on width from basis and structural split in model, the *CUSUM* test was conducted to examine parameters' structural solidarity and stability. In this test critical bounds are introduced, and if sum of residue statements cross two critical bounds, this will show structural instability in the equation.

The cumulative sum of recursive residuals (Figure2) has not crossed the bounds on the %5 level. Therefore the estimated coefficient for that period has a structural stability.

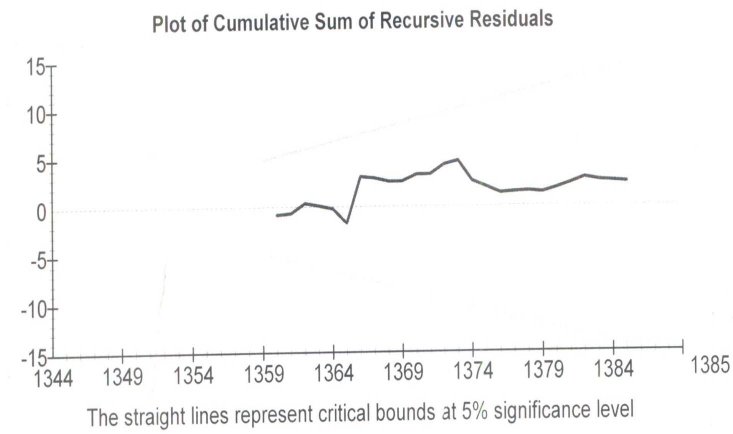


Figure 2. *CUSUM* Test

ERROR CORRECTION MODEL

A long term balance relationship among non-oil exports model variables has provided the basis for error correction in which short term volatilities are related to long term balanced amounts. Error correction for long term model of non-oil exports is estimated and developed. The results are:

$$\Delta LEX = -6.90 + 0.514\Delta LGDP + 0.379\Delta LRER - 0.151\Delta LUNCR - 0.493 DUM\,59 - 0.349\,ecm(-1) \qquad (10)$$

SE :	1.6218	0.111	0.131	0.0647	0.194	0.0746
$t =$	-4.255	4.602	2.877	-2.34	-2.535	-4.685
$prob$:	(0.000)	(0.000)	(0.007)	(0.025)	(0.016)	(0.000)

in which Δ is the first phase's difference operator, and ecm_{t-1} is the remainder of estimated regression with a lag. Error correction statement coefficient is meaningful (-0/34) which shows that 0/34 is reduced from a period's lack of balance in the next period. In other words, a small shock or injury related to non-oil exports is amended only after three years. In ECM model all the explanatory variables have been introduced with a meaningful difference. The results show that current differences for all variables are meaningful.

CONCLUSION

In this article the effect of uncertainty due to exchange real rate volatility on non-oil exports in Iran (1961-2006) was studied. The results show that major economical variables such as gross domestic product, and exchange real rate have a direct and meaningful effect on non-oil exports, both in the long and short run. In this study, uncertainty and instability due to exchange rate volatility is one of the export deterring factors for the above mentioned years. To have a developed non-oil exports, we need to review and revise our exchange policies, and eliminate exchange rate instability for ever. Since domestic prices , too, are considered in calculating real exchange rate, and the soaring of prices is one of the most important factors in exchange rate instability the economy policy makers should create conditions for stabilizing general level of prices so that it would lead to stabilizing real exchange rate. Furthermore, clarity in the future process of exchange rate changes has an important effect on increasing exports income and maintaining Iran's position in global market. Because of the direct role of production on non-oil exports, having an export-oriented view on production and tackling production problems such as cash scarcity, limitations on importing raw materials, effective production, efficiency of domestic resources, and activating production potentials are some of the requirements for developing non-oil exports.

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