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Investigation the Role of Exchange Rate Volatility on Iran's Agricultural Exports (Case Study: Date, Pistachio and Saffron)

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Abstract: This paper investigates the effect of exchange rate volatility on international trade flows by studying the case of Iran's agricultural exports with emphasis on pistachio, saffron and date for the period of 1978 to 2008. Autoregressive distributed lag approach was employed to estimate the main model and generalized autoregressive conditional heteroskedasticity model was used as a measure of volatility to estimate exchange rate volatility. The results show that there exist positive and statistically significant relationship among relative prices, exchange rate volatility and agricultural exports but negative and significant relationship between incomes of Iran's trading partners and agricultural exports flows. The variable income of Iran's trading partners is the only variable has had significant effect on exports of date, pistachio and saffron. The results of studying of volatility show that exchange rate volatility has had positive effect on exports of agricultural sector, pistachio and saffron but negative effect on date. So, Iran's agricultural trade policies toward different countries should be developed based on exchange rate fluctuations.

Key words: Exchange rate volatility · Agricultural Export · GARCH model · ARDL approach

INTRODUCTION

Trade is widely accepted as a major engine of economic growth [1]. The relationship between exchange rate and trade flows has been studied in a large number of theoretical and empirical papers. It is commonly accepted that the movements of the real exchange rate have a permanent effect on exports and imports. The widespread popular perception, that greater exchange rate risk reduces trade, has helped motivate monetary unification in Europe and is strongly related to currency market intervention by central bank [2,3]. Most current microstructural and theoretical models of exporter behavior predict a negative relationship between exchange rate risk and volumes of trade, reflected in the conditional variance of exchange rate and export volumes [4]. The increase in exchange rate volatility is widely believed to have detrimental effects on international trade and thus has a negative economic impact.

If exchange rate movements are not fully anticipated, an increase in exchange rate volatility may lead risk-averse agents to reduce their international trading activities. The presumption of a negative nexus between exchange rate volatility and trade is an argument routinely used by proponents of managed or fixed exchange rates [5].

Yet a vast economic literature yields highly inconsistent empirical results on this issue. One common argument is that exporters can easily ensure against short-run exchange rate fluctuations through financial markets, while it is much more difficult and expensive to hedge against long-run risk. Cho *et al.* [6] for example, demonstrate that long-run changes in exchange rates seem to have more significant impacts on trade volumes than do short-run exchange rate fluctuations that can be hedged at low cost.

On the other hand, Vianne and De Vires [7] show that even if hedging instruments are available, short-run exchange rate volatility still affects trade because it increases the risk premium in the forward exchange rate. Doroodian [8], Krugman [9], Mundell [10] and Wei [11] argue that hedging is both imperfect and costly as a basis to avoid exchange rate risk, particularly in developing countries and for smaller firms more likely to face liquidity constraints. This leads to the conventional argument that

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exchange rate volatility causes revenue uncertainty that will dampen trade due to risk aversion, irreversible investment in productive capital, or both [12,13].

The dependence of Iran on crude oil exports had important implications for the Iran's economy since the oil market is a highly volatile one. For example, being dependent on the exports of crude oil, the Iran's economy became subject to the vicissitudes and vagaries of the international oil market so that international oil price shocks were immediately felt in the domestic economy. Coupled with this, Iran has implemented a different exchange rate system that engendered overvaluation of the domestic currency, serving as a disincentive for increased exports through non-competitiveness of the country's non-oil exports. On the other hand, the overvalued exchange rate enhanced imports thereby exacerbating the already precarious balance of payment position [14].

The paper is organized as follows: Section 2 briefly reviews the theoretical and empirical literature on the impact of exchange rate volatility on international trade. Section 3 presents the research methodology. First a simple model is specified to investigate the impact of exchange rate volatility on exports. Then data sources, definitions of variables and econometric methods are discussed. Section 4 presents the estimation results and the discussion. Section 5 draws conclusions.

Theortical and Empirical Literatur: There exists an abundance of studies on the topic that have been undertaken internationally, both at theoretical and empirical levels. Two most popular and related approaches have been used in the analysis of trade and exchange rate volatility. One approach is to estimate a simple export demand equation generally with real exports as a dependent variable and exchange rate volatility together with relative prices and a measure of economic activity variable as regressors. The other approach is to use the so-called gravity equation model [3].

Chit *et al.* [5] employed a generalized gravity model that combined a traditional long-run export demand model with gravity type variables to analyze the impact of bilateral real exchange rate volatility on real exports of five emerging East Asian countries among themselves as well as to thirteen industrialized countries. In the empirical analysis they used a panel comprising 25 years of quarterly data and perform unit root and co-integration tests to verify the long-run relationship among the regression variables. The results provided strong evidence that exchange rate volatility has a negative impact on the exports of emerging East Asian countries.

Todani and Munyama [15] used the ARDL[1] econometrics technique to analyze the impact of exchange rate volatility on South African exports to the rest of the world. The study estimated an export demand equation and concluded that South African exports to the rest of the world are largely unaffected by exchange rate volatility.

Notini *et al.* [16] examined the relation between exchange rate volatility and Brazil volume of exports. After establishing the existence of co-integration among the variables included in their model, they estimated the long-run coefficients by means of ARDL model. The results show that exchange rate volatility had a significantly negative effect on Brazilian manufactured exports in the period 1986-2002.

Wang and Barrett [17] employed sectoral level, monthly data and an innovative multivariate GARCH-M[2] estimator with corrections for leptokurtic errors to estimate the effects of exchange rate volatility on international trade flows by studying the case of Taiwan's exports to the United States from 1989-1999. They found change in importing country industrial production and expected exchange rate jointly drive the trade volumes. More strikingly, monthly exchange rate volatility affects agricultural trade flows, but not trade in other sectors.

Doyle [18] used error correction model to estimate Irish exports to Britain. He found that both real and nominal exchange rate volatility are significant determinants of changes in total exports and in a number of sectors. Both positive and negative short-run elasticities for exchange rate volatility were estimated, although positive elasticities predominate.

Exchange rate volatility and misalignment in Iran are recognized as two major limits on export promotion during last three decades. These occurred primarily due to some breaks like Iraq imposed war against Iran which brought serious problem for our economy [3]. So it's really a matter of debate that to what extent export is responsive to exchange rate volatility. This paper seeks to provide some evidence on the above topics.

Research Methodology

Model Specifications: In this section we discuss our approaches to estimation of export demand equation and to specifying exchange rate volatility.

[1] Autoregressive Distributed Lag

[2] Generalized Autoregressive Conditional Heteroskedasticity

The empirical export demand equation: We follow Hosseinipour and Moghaddasi [3] and De Vita and Abbotte [19]. Amongst others and specify a demand equation of the following from:

$$LEX = \beta_0 + \beta_1 LRP + \beta_2 LIN + \beta_3 VOL + \varepsilon_0 \quad (1)$$

Where *LEX* is natural logarithm of real export; *LRP* is natural logarithm of relative prices; *LIN* is natural logarithm of income in our trading partners and is an indicator of potential demand for our exports; *VOL* is the exchange rate volatility and measures uncertainty associated with fluctuations in the exchange rate. β_0 and ε_0 are a constant and a normally distributed error term, respectively. This equation says that our exports depend on the relative prices, income in our trading partners and uncertainty/risk associated with exchange rate fluctuations. Theoretical priors dictate that we should expect $\beta_1>0$ and $\beta_2>0$ and as discussed in the introduction, the sign of β_3 is theoretically ambiguous.

There are different econometrics techniques that can be used to estimate equation (1). If all the variables are stationary, then equation (1) can simply be estimated by ordinary least squares (OLS). If all or some variables are I(1) and not co-integrated, some data transformation may be necessary before estimating by OLS. If there exist some co-integration among the variables of interest, then there are a number of approaches different complexities to estimate the model. Some main approaches are Engel Two step procedure proposed by Engel and Granger [20] and the Johansson maximum likelihood reduced rank procedure proposed by Johansson [21]. Both these procedures work well when all variable are I(1). This paper employs the autoregressive distributed lag (ARDL) approach to co-integration proposed by Pesaran and Pesaran [22]. This methodology allows testing for the existence of co-integration irrespective of whether the underlying regressors are I(0), I(1) or mutually co-integrated.

Data Description: This study uses annual data for the period 1978 to 2008. The variables are constructed as follows:

Real export is defined as nominal exports deflated by the export price index (EPI) in natural logarithm as follows:

$$Ex_t = ln\,(NEX_t / EPI_t) \quad (2)$$

Where EX_t is real exports, NEX_t is nominal exports and EPI_t is the export goods price index. EX_A, EX_D, EX_P and EX_S are real exports of agriculture sector, date, pistachio and Saffron, respectively. In this paper we used gross domestic product (GDP) of European Union as a measure of income for Iranian trading partners. More to, bilateral trade between two countries depends upon, exchange rate and relative price level of the two partners. Hence, the following definition of real exchange rate in Iran captures both the effects related to the price of countries and of goods and services [3].

$$Rp_t = (ER_t * CPI_F / CPI_{IR}) \quad (3)$$

Where CPI_F is consumer price index in the U.S. and CPI_{IR} is consumer price index in Iran and ER_t is exchange rate in open market.

Modeling Volatility: Exchange rate volatility is a measure that intends to capture the uncertainty faced by exporters due to unpredictable fluctuations in the exchange rate clearly, this is an unobservable variable and thus its measure is a matter of serious contention. Consequently, the literature is not unanimous as to which measure is most appropriate. Recent literature, however, seems to be increasingly adopting the use of Bollerslev's GARCH models and the moving average standard deviations and to a very less extent, simple standard deviations [3]. This paper follows recent literature and uses the measures derived from the AR-GARCH(1,0) model as measures of exchange rate volatility.

Conditional variance of the first difference of the log of exchange rate is a measure of exchange rate volatility. We use the generalized conditional heteroskedasticity (GARCH) proposed by Bollerslev [23], which is the generalization of ARCH model. We assume exporters from expectations of the real exchange rate series following an ARMA(m,n)[3] process, with conditional specified variance as a GARCH(p,q). In this paper we simplify the notation and denote the appropriate GARCH model by VOL. Equation (1) will be used separately to examine the role of exchange rate volatility on agricultural (EX_A), date (EX_D), pistachio (EX_P) and saffron exports (EX_S).

RESULTS AND DISCUSSION

We first check the unit roots using Augmented Dickey-Fuller (ADF)[4] and Philips-Peron (PP) tests.

[3]Augmented Dickey-Fuller unit root test
[4] Philips-Peron unit root test

Table 1: Results of ADF and PP unit root tests on variables of model

	ADF test		PP test	
Variables	Level	First difference	Level	First difference
LEX_A	-1.91	-4.9***	-1.91	-4.88***
LEX_D	-2.72*	-7.5***	-2.71*	-8.21***
LEX_P	-1.63	-5.81***	-1.61	-6.36***
LEX_S	-0.68	-5.74***	-0.63	-5.72***
LRP	-3.85***	-3.43**	-3.42**	-3.66**
LIN	-0.46	-5.51***	-0.38	-5.56***
VOL	-3.83***	-6.87***	-3.83***	-10.54***

Note: *, ** and *** denotes 10%, 5% and 1% significance levels, respectively.

Source: Research findings

Table 2: Results of the estimation of agricultural, pistachio, saffron and date exports by using ARDL approach

Products Variables	Agricultural sector	Pistachio	Date	saffron
LEX(-1)	0.762***	0.381**	0.38**	0.475***
	(11.53)	(2.66)	(2.7)	(3.65)
LRP	-0.022**	-0.04	-0.03	-0.043
	(2.3)	(-0.95)	(-0.6)	(-0.95)
LIN	-0.034***	0.32***	0.386***	0.505***
	(-4.37)	(4.2)	(4.06)	(4.21)
VOL	0.48***	0.52	-0.035	0.68
	(2.87)	(0.43)	(-0.026)	(0.54)
C	2.69***	2.92	-1.52	-7.39***
	(-3.86)	(1.35)	(0.6)	(-2.9)
R^2	0.88	0.80	0.81	0.92
D.W	1.78	1.98	2.13	2.19

Note: *, ** and *** denotes 10%, 5% and 1% significance levels, respectively.

The numbers in parentheses are (t) statistics.

Source: Research findings

Table 3: Results of the estimation of long-run relationships for agricultural, pistachio, saffron and date exports functions

Variables Products	C	LRP	LIN	VOL
LEX_A	11.37***	-0.096*	-0.15***	2.04**
	(8.12)	(-1.76)	(-2.9)	(2.26)
LEX_D	-2.5	-0.04	0.63***	-0.06
	(-0.58)	(-0.61)	(5.21)	(-0.026)
LEX_P	4.72	-0.07	0.52***	0.84
	(1.5)	(-.89)	(5.58)	(0.44)
LEX_S	-14.1***	-0.1	0.96***	1.3
	(-3.58)	(-0.9)	(8.25)	(0.54)

Note: *, ** and *** denotes 10%, 5% and 1% significance levels, respectively.

The numbers in parentheses are (t) statistics.

Source: Research findings

Table 4: Results of the estimation of ECM for agricultural, date, pistachio and saffron exports

Variables products	dc	dRP	dIN	dVOL	ECM
LEX_A	2.87***	-0.02	-0.31***	0.26	-0.26***
	(3.64)	(1.49)	(-3.36)	(1.49)	(-3.35)
LEX_D	-1.53	-0.03	0.38***	-0.035	-0.61***
	(-0.6)	(-0.61)	(4.05)	(-0.025)	(-4.24)
LEX_P	2.92	-0.04	0.32***	0.51	-0.62***
	(1.34)	(-0.95)	(-4.19)	(0.43)	(-4.32)
LEX_S	-7.4***	-0.043	0.51***	0.68	-0.53***
	(-2.9)	(-0.95)	(4.22)	(0.53)	(-4.03)

Note: * and ** and *** indicate significance at the 10%, 5% and 1% percent respectively.

The numbers in parentheses are (t) statistics.

Source: Research findings

Table (1) provides the results of unit root tests on the data. Results of the ADF and PP tests showed that some of the variables are I(0) and some are I(1). Then, using of ARDL approach will be provided.

Estimation of the Exchange Rate Volatility: In order to estimate the exchange rate volatility, stationary of the logarithm of the exchange rate was investigated. Then, the behavior of exchange rate was predicted by using ARMA model. Equation (4) is GARCH (1,0). This estimated equation provides necessary and sufficient conditions for the GARCH model based on the theory. The estimated results are as follows:

$$\sigma_t^2 = 0.002 + 0.86\, \varepsilon_{t-1}^2 \quad (4)$$
$$(0.63) \quad (2.39)$$

Estimation of Export Demand by Using Ardl Approach: Table (2) show the results of the estimation of agricultural, pistachio, saffron and date exports by using ARDL approach based on Schwartz-Bayesian criterion showed that there is a positive and significant relationship between exchange rate volatility and demand for agricultural exports, but negative and significant relationship between relative prices and income of Iran's trading partners. Sign of the variables VOL and RELP that are marked as exchange rate volatility and relative prices were consistent with the theory, but sign of the variable income of Iran's trading partners is inconsistent with theory. Perhaps, Reduction of the volume of trade flows among Iran and its trading partners due to existing political pressures is the most reason for being a negative relationship between incomes of Iran's trading partners and demand for agricultural exports. Results of estimation

for agricultural sector, date, pistachio and saffron exports show that relative prices and exchange rate volatility have had negative impacts on exports of date but income of trading partners has a positive impact on date exports in the period of study. Income of trading partners and exchange rate volatility have had positive impacts on pistachio and saffron export, but relative prices had a negative impact on exports of pistachio and saffron that shows the results are consistent with the theory.

Estimation of Long-run Relationships: Long-run relationships were estimated for agricultural sector, pistachio, saffron and date demand functions. The results are given in Table (3). All variables are significant in agricultural sector function, so that only positive sign in the model is VOL. But considering the exports of date, pistachio and saffron, the only variable which has positive and significant impact is LIN with positive effect on the export of these products at one percent significant level. Variable VOL in agricultural exports demand function is more sensitive than other explanatory variables. So, if a percentage is added to the amount of exchange rate volatility it will be added about 2.04 percent on demand for agricultural exports.

Estimation of Error Correction Model (ECM): Table (4) shows the results of the estimation of error correction model (ECM) for agricultural sector, pistachio, saffron and date exports in short-run. As can be seen, the error correction coefficient for agricultural sector is -0.26 and it is significant at one percent level. This coefficient indicates that the impact of adopted policies in this case will be seen after about four years. The coefficient for date, pistachio and saffron equals to -0.61, -0.62, -0.53 and is significant at one percent level respectively. In fact, it indicates that the rate adjustment of date and pistachio is faster as compared to agricultural sector and saffron.

CONCLUSION

The main purpose of this study is investigating the effect of exchange rate volatility on exports of agricultural products with emphasis on pistachio, saffron and date. In this case, after estimating exchange rate volatility from GARCH model, the models of research were estimated to investigate long-run and short-run relationships between variables of model by using ARDL approach. The results of the exchange rate volatility show that this factor has different impacts on exports. For example, exchange rate volatility has had a positive effect on exports of pistachio and saffron but a negative effect on export demand of date. So, exchange rate volatility can have different effects on exports of different products. Accordingly, it will be important that Iran's agricultural trade policies toward different countries, should be developed based on exchange rate fluctuations. Moreover, other effective factors on trade relationships such as marketing and gross domestic product of importing countries should be noted.

According to the negative relationship between relative prices and the exports of date, pistachio and saffron, effort to reduce the relative prices is one of the important points for a stronger presence in international markets. This can be achieved through the reduction of production and products marketing costs. As a clear solution, allocation of export subsidies can reduce export prices in the face of high prices as a result of fewer production and fluctuations can be prevented. However, it will be advisable as long as the World Trade Organization (WTO) rules on export subsidies are not still implemented in Iran.

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