Economics Bulletin

Volume 43, Issue 1

Exchange Rate and Agricultural Trade: Evidence from Iran

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Abstract

Iran has been consistently running a trade deficit in agricultural products. Conditional upon domestic and global output as well as oil exports, we find that the effective real exchange rate plays a significant role in perpetuating this deficit. While we find no evidence of any J-curve dynamics, our results suggest that the effects from currency appreciation is of greater importance when compared to depreciation.

Citation: Behzad Fakari Sardehae and Naser Shahnoushi Foroushani and Saleh S. Tabrizy, (2023) "Exchange Rate and Agricultural Trade: Evidence from Iran", *Economics Bulletin*, Volume 43, Issue 1, pages 302-308
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Submitted: October 09, 2022. **Published:** March 30, 2023.

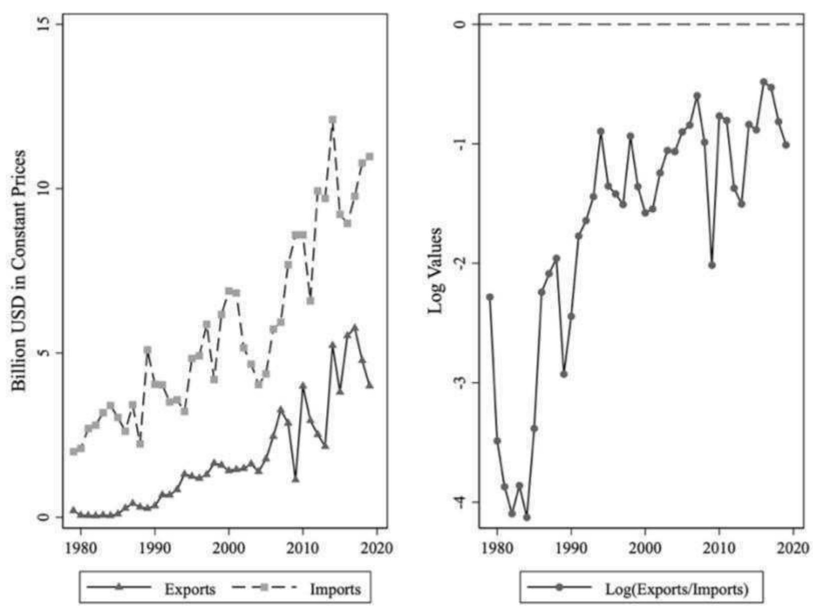
1. Introduction

The real exchange rate affects trade flows through varying dynamics (Bahmani-Oskooee and Hegerty, 2010). While some studies examine exchange rate's impact on aggregate trade flows (e.g., Reis Gomes and Paz, 2005), others explore industry-level variations (e.g., Neumann and Tabrizy, 2021) or firm-level information (e.g., Greenaway *et al*., 2010). This paper employs sector-level data for agricultural trade in Iran, where agriculture and related activities constitute more than 10% of the GDP and employ 17% of the workforce (World Bank, 2022).

Iran consistently runs an agricultural trade deficit (Figure 1), importing key staples while exporting products with elastic demand, such as pistachios and other nuts. This pattern results from frequent droughts (Salami *et al*., 2009), lack of production diversity (Aliabadi *et al*., 2021), the Dutch disease caused by oil exports (Apergis *et al*., 2014), and policies that aim at achieving self-sufficiency and, in return, limit exports to excess agricultural supply (Yazdani and Vaezi, 2009).

We examine whether Iran's agricultural trade responds to changes in the effective real exchange rate (ERER), despite running consistent deficits. We also explore the presence of any asymmetries between the responses to ERER appreciation versus depreciation. Our findings contribute to the literature that examines the impact of exchange rate swings on agricultural trade flows—examples include Kandilov (2008), Baek *et al*. (2009), Erdal *et al*. (2012), and Kohansal *et al*. (2013).

Figure 1. Iran's agricultural trade



Source: FAO (2022a) and authors computation

2. Empirical Approach

We employ annual data for Iran's real agricultural exports and imports, from 1979 to 2019. We also use an ERER measure, released by the IMF (2022). We further incorporate FAO's index for agricultural production in Iran and the world, with the average index value for 2014-2016 being set at 100 (FAO, 2022). And we lastly control for the share of oil exports in Iran's GDP (OPEC, 2022). Table I reports the summary statistics and the unit-root test results. Except for oil exports share, which is *I(0)*, all variables are *I(1).*

Table I: Summary statistics and unit-root test results

Variable	Mean	SD	P-value[a]
Log(TB)	-1.71	1.04	0.51
ΔLog(TB)	0.03	0.52	0
Log(ERER)	4.31	0.53	0.40
ΔLog(ERER)	0.01	0.28	0
$\mathrm{Log}(Y_D)$	4.16	0.40	0.14
$\Delta\mathrm{Log}(Y_D)$	0.03	0.07	0
$\mathrm{Log}(Y_G)$	4.25	0.26	0.95
$\Delta\mathrm{Log}(Y_G)$	0.02	0.01	0
Log(Oil)	2.59	0.38	0.05
ΔLog(Oil)	-0.05	0.37	0

a.) The p-values are for Dickey-Fuller unit-root test, computed by MacKinnon (1994). Null hypothesis implies non-stationarity.

We then model agricultural trade balance (TB) as a function of the exchange rate (ERER), domestic and global agricultural production indexes (Y_D and Y_G), and the share of oil exports in GDP (Oil):

$$\mathrm{Log}(TB_t) = \alpha + \beta_1 \mathrm{Log}(ERER_t) + \beta_2 \mathrm{Log}(Y_{D,t}) + \beta_3 \mathrm{Log}(Y_{G,t}) + \beta_4 \mathrm{Log}(Oil_t) + \varepsilon_t \quad (1)$$

Since an increase in the IMF's ERER measure implies real appreciation (i.e., loss of trade competitiveness), β_1 is expected to be less than zero. Also, Iran tends to export its excess agricultural supply, implying that an increase in domestic production increases exports and reduces trade deficit. More important, an increase in domestic production triggers a relative price effect, lowering imports, and, in return, trade deficit. In contrast, an increase in global agricultural production of staple foods makes imports cheaper and increases trade deficit. Thus, β_2 is expected to be greater than zero and β_3 less than zero. Further, resulting in part from the Dutch disease, an increase in oil exports is associated with a decline in non-oil exports and an overall increase in imports; β_4 is, therefore, expected to be less than zero.

The parameters in Equation 1 merely reflect long-run elasticities. To study short- and long-run relationships in a unified framework, we follow the approach described in Bahmani-Oskooee and Hegerty (2010, pp. 583-586) and rely on the Error Correction (EC) representation of an Autoregressive Distributed Lag (ARDL) model à la Pesaran *et al.* (2001). This approach enables us to estimate short-run adjustments and, since our timeseries are either *I(0)* or *I(1)*, conduct bounds tests for long-run relationships (PSS F- and t-tests).

The EC representation is as follows (short- and long-run parameters are noted by β and γ, respectively):

$$\begin{aligned}\Delta\mathrm{Log}(TB_t) =\; & \alpha + \sum_{i=1}^{n_{TB}} \beta_{TB,t-i}\, \Delta\mathrm{Log}(TB_{t-i}) + \sum_{i=1}^{n_{ERER}} \beta_{ERER,t-i}\, \Delta\mathrm{Log}(ERER_{t-i}) + \\ & \sum_{i=1}^{n_{YD}} \beta_{YD,t-i}\, \Delta\mathrm{Log}(Y_{D,t-i}) + \sum_{i=1}^{n_{YG}} \beta_{YG,t-i}\, \Delta\mathrm{Log}(Y_{G,t-i}) + \sum_{i=1}^{n_{Oil}} \beta_{Oil,t-i}\, \Delta\mathrm{Log}(Oil_{t-i}) + \\ & \gamma_1 \mathrm{Log}(TB_{t-1}) + \gamma_2 \mathrm{Log}(ERER_{t-1}) + \gamma_3 \mathrm{Log}(Y_{D,t-1}) + \gamma_4 \mathrm{Log}(Y_{G,t-1}) + \gamma_5 \mathrm{Log}(Oil_{t-1}) + \varepsilon_t\end{aligned} \quad (2)$$

Motivated by Bahmani-Oskooee and Fariditavana (2015 and 2016), we also employ a non-linear model to test for the presence of any asymmetric effects à la Shin *et al.* (2014):

$$\begin{aligned}
&\Delta \mathrm{Log}(\mathrm{TB}_t) = \\
&\alpha + \sum_{i=1}^{n_{TB}} \beta_{TB,t-i}\, \Delta \mathrm{Log}(\mathrm{TB}_{t-i}) + \sum_{i=1}^{n_{APR}} \beta_{APR,t-i}\, \Delta \mathrm{APR}_{t-i} + \sum_{i=1}^{n_{DPR}} \beta_{DPR,t-i}\, \Delta \mathrm{DPR}_{t-i} + \\
&\sum_{i=1}^{n_{YD}} \beta_{YD,t-i}\, \Delta \mathrm{Log}\left(\mathrm{Y}_{D,t-i}\right) + \sum_{i=1}^{n_{YG}} \beta_{YG,t-i}\, \Delta \mathrm{Log}\left(\mathrm{Y}_{G,t-i}\right) + \sum_{i=1}^{n_{Oil}} \beta_{Oil,t-i}\, \Delta \mathrm{Log}(\mathrm{Oil}_{t-i}) + \\
&\gamma_1 \mathrm{Log}(\mathrm{TB}_{t-1}) + \gamma_2 \mathrm{Log}(\mathrm{APR}_{t-1}) + \gamma_3 \mathrm{Log}(\mathrm{DPR}_{t-1}) + \\
&\gamma_3 \mathrm{Log}(\mathrm{Y}_{D,t-1}) + \gamma_4 \mathrm{Log}(\mathrm{Y}_{G,t-1}) + \gamma_5 \mathrm{Log}(\mathrm{Oil}_{t-1}) + \varepsilon_t
\end{aligned} \quad (3)$$

The non-linear components of this model include:

$$\mathrm{APR}_t = \sum_{j=1}^{t} \mathrm{Max}[\Delta \mathrm{Log}\left(\mathrm{ERER}_j\right), 0] \quad (4)$$

$$\mathrm{DPR}_t = \sum_{j=1}^{t} \mathrm{Min}[\Delta \mathrm{Log}\left(\mathrm{ERER}_j\right), 0] \quad (5)$$

APR is the partial sum of increases in Log(ERER) (i.e., cumulative appreciations), and DPR is the partial sum of declines (i.e., cumulative depreciations). Comparing γ_2 and γ_3, we test for the presence of any long-run asymmetries. The equality of γ_2 and γ_3 implies that the effects from appreciation and depreciation are symmetric, otherwise, the effects are asymmetric (Bahmani-Oskooee and Fariditavana, 2015, p. 522).

We use OLS to estimate the parameters in Equations 2 and 3. We also employ Bayesian information criterion (BIC) (Schwarz, 1978) to determine the order of the underlying ARDL models. Imposing greater penalty for the lost degree of freedom, BIC is shown to be useful for short timeseries (Greene, 2012, pp. 139-140).

3. Results

Table II reports the estimation results. For the parameters in Equation 2, column *I* shows that lagged trade balance is negatively correlated with its contemporaneous growth; the point estimate for the adjustment parameter is between -1 and zero. As for the long-run parameters, we find that rial's appreciation (i.e., increase in ERER) has an adverse impact on trade balance and amplifies the deficit. Also, domestic output is positively correlated with trade balance. However, an increase in global output amplifies trade deficit. Lastly, increase in oil exports has an adverse effect on Iran's agricultural trade balance. The PSS test statistics used for the bounds test are more extreme than critical values of interest, as computed by Kripfganz and Schneider (2020), confirming the significance of the long-run relationships.

The nature of the long-run ERER effect will be explored more fully when we study the asymmetric impacts from appreciation versus depreciation. It is, however, important that we discuss the obtained long-run estimates for the control covariates.

All other covariates being constant, an increase in domestic agricultural output would reduce the domestic prices and, in return, relative prices (defined as domestic over global prices, measured in a common currency). Thus, an increase in Y_D reduces the agricultural trade deficit. In contrast, an increase in global agricultural production would reduce global prices, increasing relative prices of domestic output. Thus, an increase in Y_G amplifies agricultural trade deficit. Importantly, in line with the Marshall-Lerner condition (e.g., Krugman *et al*., 2012, pp. 488-492), these trade effects depend on the magnitude of the elasticity of agricultural exports and imports with respect to changes in relative prices. As mentioned previously, Iran's agricultural exports are elastic, but its imports are relatively inelastic. Nevertheless, given their absolute values, the sum of these elasticities is likely to be large enough, which implies that the long-run parameters associated with domestic and global agricultural output are likely to be statistically significant: the former is expected to be positive, while the latter is negative. Our estimates for Y_D and Y_G coefficients are indeed supportive of these propositions.

We also find that an increase in oil exports (relative to GDP) amplifies agricultural trade deficit in Iran. A symptom of the Dutch disease, an increase in oil rents crowds out the productive activities of non-oil sectors, including the agriculture sector (Apergis *et al*., 2014). Such long-run contractions are often coupled with amplification of trade deficit, and they are more likely to be observed in countries with poor institutions (Van der Ploeg, 2011). Our estimation results offer support for such propositions.

In the short run, along with effects from domestic and global production as well as oil exports, Iran's agricultural trade is significantly affected by ERER changes. However, the short- and long-run parameters share the same sign. Thus, similar to Baek *et al*. (2009), we find no evidence of any J-curve dynamics à la Bahmani-Oskooee (1985) or Rose and Yellen (1989).

We then use Equation 3 to set apart the impacts of ERER appreciation from depreciation. Considering the IMF definition, an increase in APR is associated with cumulative appreciation, while a decline in DPR is associated with cumulative depreciation. As shown in column *II*, the long-run parameter for APR is less than zero and significant; the 95% confidence interval for this parameter begins at -1.700, ending at -0.577. In contrast, the parameter for DPR is statistically indistinguishable from zero; its 95% confidence interval begins at -0.413, ending at 1.469. These confidence intervals suggest that the long-run parameters for APR and DPR (γ_2 and γ_3, respectively) are statistically different from each other. This, in turn, implies that the long-run impact of ERER on agricultural trade in Iran is merely evident through real appreciation channel. In the short run, however, there is limited evidence of a symmetric impact, as one of the lagged DPR coefficients (associated with ΔDPR_{t-2}) shares the same sign with the contemporaneous changes in APR measure (ΔAPR_t); there also exists a significant overlap in their 95% confidence intervals.

Other long-run parameters are similar to what we found in the absence of non-linear terms. Also, the PSS test statistics confirm the presence of long-run relationships. Lastly, the short-run effects of domestic and global production as well as oil exports remain almost intact.

Table II: Estimation results

	I	*II*
	$\Delta \text{Log}(\text{TB}_t)$	$\Delta \text{Log}(\text{TB}_t)$
Adjustment		
$\text{Log}(\text{TB}_{t-1})$	-0.835***	-0.868***
	(0.143)	(0.123)
Long-run		
$\text{Log}(\text{ERER}_{t-1})$	-0.568***	
	(0.149)	
$\text{Log}(\text{APR}_{t-1})$		-1.139***
		(0.269)
$\text{Log}(\text{DPR}_{t-1})$		0.525
		(0.450)
$\text{Log}(\text{Y}_{D,t-1})$	5.318***	8.823***
	(0.782)	(1.560)
$\text{Log}(\text{Y}_{G,t-1})$	-5.048***	-1.842
	(1.082)	(1.488)
$\text{Log}(\text{Oil}_{t-1})$	-1.415***	-0.866***
	(0.310)	(0.303)
Short-run		
$\Delta \text{Log}(\text{ERER}_t)$	-0.475***	
	(0.136)	
ΔAPR_t		-0.988***
		(0.234)
ΔDPR_t		0.108
		(0.272)
ΔDPR_{t-1}		-0.0136
		(0.275)
ΔDPR_{t-2}		-0.887***
		(0.275)
$\Delta \text{Log}(\text{Y}_{D,t})$	1.471*	2.227***
	(0.821)	(0.756)
$\Delta \text{Log}(\text{Y}_{D,t-1})$	-0.228	-1.327
	(1.067)	(1.088)
$\Delta \text{Log}(\text{Y}_{D,t-2})$	-2.026**	-3.609***
	(0.789)	(0.819)
$\Delta \text{Log}(\text{Y}_{D,t-3})$	-1.855**	-2.716***
	(0.742)	(0.649)
$\Delta \text{Log}(\text{Y}_{G,t})$	-4.216***	-8.158**
	(1.178)	(3.533)
$\Delta \text{Log}(\text{Oil}_t)$	-0.343**	-0.350**
	(0.163)	(0.149)
$\Delta \text{Log}(\text{Oil}_{t-1})$	0.464**	0.371*
	(0.214)	(0.180)
Obs.	37	37

R-squared	0.797	0.894
Adj. R-squared	0.707	0.809
PSS t-test statistic	-5.832***	-7.074***
PSS F-test statistic	7.589***	10.260***

Standard errors in parenthesis; *** P-value<1%, ** P-value<5%, and * P-value<10%

4. Conclusion

We explore the impact of ERER changes on Iran's agricultural trade and find that, despite running consistent deficits, exchange rate remains a significant determinant of trade balance in agricultural products over the short and long run. We also find that the long-run parameter associated with cumulative appreciation is statistically significant, while a similar parameter for cumulative depreciation is statistically insignificant. The long-run impact of ERER, therefore, is merely evident through a real appreciation channel.

There are two caveats, however. Rather than relying on bilateral trade and exchange rates, this study relies on aggregate trade and ERER measures. Also, the data in use are based on annual frequency, limiting the degree of freedom. Future studies may explore bilateral patterns in more detail and using higher time frequency.

References

Aliabadi, M. M., M. Daneshvar Kakhky, M. Sabohi Sabouni, A. Dourandish, and H. Amadeh (2021) "Food Production Diversity and Diet Diversification in Rural and Urban area of Iran." *Journal of Agriculture and Environment for International Development* 115, No. 1, 59-70.

Apergis, N., G. El-Montasser, E. Sekyere, A. N. Ajmi, and R. Gupta (2014) "Dutch Disease Effect of Oil Rents on Agriculture Value Added in Middle East and North African (MENA) Countries." *Energy Economics* 45, 485-490.

Baek, J., Won W. K., and M. Kranti (2009) "Exchange Rate Dynamics and the Bilateral Trade Balance: The Case of US Agriculture." *Agricultural and Resource Economics Review* 38, No. 2, 213-228.

Bahmani-Oskooee, M. (1985) "Devaluation and the J-curve: Some Evidence from LDCs." *The Review of Economics and Statistics*, 500-504.

Bahmani-Oskooee, M. and H. Fariditavana (2016) "Nonlinear ARDL Approach and the J-curve phenomenon." *Open Economies Review* 27, No. 1, 51-70.

_____ (2015) "Nonlinear ARDL Approach, Asymmetric Effects and the J-curve." *Journal of Economic Studies* 42, No. 3, 519-530

Bahmani-Oskooee, M. and S. W. Hegerty (2010) "The J-and S-curves: A Survey of the Recent Literature." *Journal of Economic Studies* 37, No. 6, 580-596.

Erdal, G., H. Erdal, and K. Esengün (2012). "The Effects of Exchange Rate Volatility on Trade: Evidence from Turkish Agricultural Trade." *Applied Economics Letters* 19, No. 3, 297-303.

FAO (2022). FAOSTAT, Retrieved from https://www.fao.org/faostat/en

Greenaway, D., R. Kneller, and X. Zhang (2010) "The Effect of Exchange Rates on Firm Exports: The Role of Imported Intermediate Inputs." *The World Economy* 33, No. 8, 961-986.

Greene, W. H. (2000). *Econometric Analysis* (7th Ed.). Prentice Hall.

IMF (2022). International Financial Statistics, Retrieved from https://data.imf.org/?sk=4c514d48-b6ba-49ed-8ab9-52b0c1a0179b

Kandilov, I. T. (2008). "The Effects of Exchange Rate Volatility on Agricultural Trade." *American Journal of Agricultural Economics* 90, No. 4, 1028-1043.

Kohansal, M., A. Shahpoori, B. Fakari, and M. Negahdar (2013) "Effect of Exchange Rate Fluctuations on the Production, Import and Export of Rice in Iran." In *National Conference of State Rice*.

Kripfganz, S., and D. C. Schneider (2020) "Response Surface Regressions for Critical Value Bounds and Approximate P-values in Equilibrium Correction Models." *Oxford Bulletin of Economics and Statistics* 82, No. 6, 1456-1481.

Krugman, P. R., M. Obstfeld, and M. Melitz (2012). International Economics: Theory and Policy. 9th Ed., Global Ed. *Pearson*.

MacKinnon, J. G. (1994) "Approximate Asymptotic Distribution Functions for Unit-root and Cointegration Tests." *Journal of Business & Economic Statistics* 12, No. 2, 167-176.

Neumann, R. and S. S. Tabrizy (2021) "Exchange Rates and Trade Balances: Effects of Intra-Industry Trade and Vertical Specialization." *Open Economies Review* 32, No. 3, 613-647.

OPEC (2022). Annual Statistical Bulletin 2021, Retrieved from https://asb.opec.org/index.html

Pesaran, M. H., Y. Shin, and R. J. Smith (2001) "Bounds Testing Approaches to the Analysis of Level Relationships." *Journal of Applied Econometrics* 16, No. 3, 289-326.

Reis Gomes, F. A. and L. S. Paz (2005) "Can Real Exchange Rate Devaluation Improve the Trade Balance? The 1990–1998 Brazilian Case." *Applied Economics Letters* 12, No. 9, 525-528.

Rose, A. K. and J. L. Yellen (1989). "Is There a J-curve?" *Journal of Monetary Economics* 24, No. 1, 53-68.

Salami, H., N. Shahnooshi, and K. J. Thomson (2009) "The Economic Impacts of Drought on the Economy of Iran: An Integration of Linear Programming and Macroeconometric Modelling Approaches." *Ecological Economics* 68, No. 4, 1032-1039.

Shin, Y., B. Yu, and M. Greenwood-Nimmo (2014) "Modelling Asymmetric Cointegration and Dynamic Multipliers in a Nonlinear ARDL Framework." In *Festschrift in Honor of Peter Schmidt* (281-314). Springer.

Schwarz, G. (1978) "Estimating the Dimension of a Model." *The Annals of Statistics* 6, 461-464.

Van der Ploeg, F. (2011) "Natural Resources: Curse or Blessing?" *Journal of Economic Literature* 49, No. 2, 366-420.

World Bank (2022). World Bank Open Data, Retrieved from https://data.worldbank.org

Yazdani, S. and L. Vaezi (2009) "Agricultural Producer Support Policy in Iran and Selected Countries." *Agricultural Economics Review* 10, 104-115.