Working Paper 187

SEPTEMBER 2020

Does Asymmetric Nonlinear Approach Explain the Relationship Between Exchange Rate and Trade of Iran?

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Acknowledgement: Special thanks should go to Kaveh Dalvand, who provided constructive comments for this paper and also to Marcus Owen Turner for proofreading of the text.

Abstract

Until 2012, the Central Bank of Iran (CBI) used its policy rate to stabilise the rial's exchange rate and, given a persistent current-account surplus, had accumulated sizeable currency reserves. In 2012, however, international sanctions against Iran intensified and the value of the rial halved against the US dollar. Since then Iran has followed a dual interest rate policy, with both a market rate and an official rate applied by the CBI to major imports. In recent years, as sanctions have cut access to foreign reserves, the gap between the two rates has widened substantially. Given these important changes in the exchange rate regime, this paper investigates the impact of the real exchange rate on the trade balance in Iran over the period 1997-2017. For this purpose, an asymmetric model is used, as the speed of the effects of changes in the exchange rate can be asymmetric. The results of the nonlinear autoregressive distributed lag model (NARDL) indicate that this is indeed the case. Results are generally consistent with the Marshall-Lerner condition: an exchange rate depreciation improves the trade balance, whereas an appreciation worsens it. However, the trade balance reacts more strongly in the short run to depreciations of the rial than to appreciations. Although the government could easily improve the trade balance in the short run through currency depreciation, policymakers should in the longer run promote non-oil exports to reduce dependency on oil and to diversify the economy.

Keywords: Exchange rate, Trade balance, asymmetric, NARDL, Iranian rial

JEL classification: F14, F30, F40

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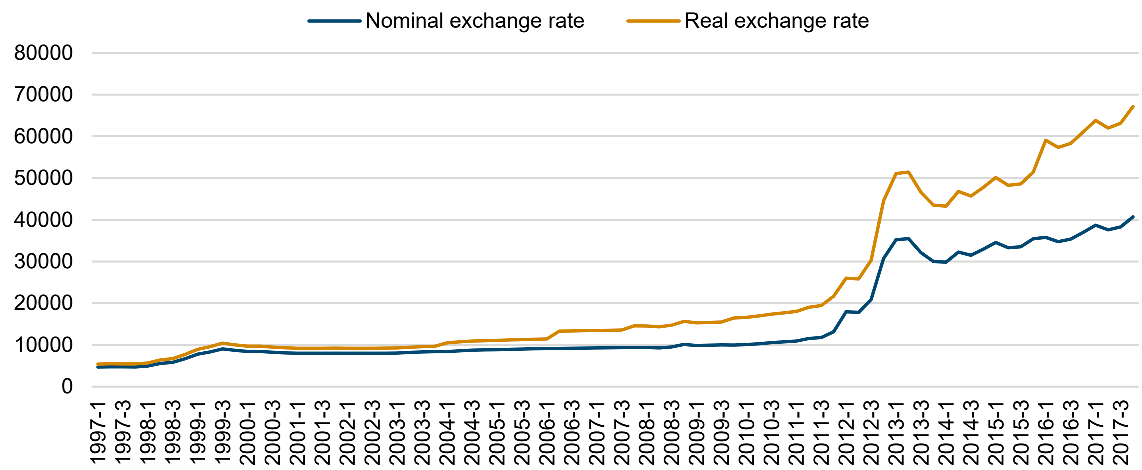
1. Introduction

The effect of changes in the exchange rates on the trade balance is an issue of fundamental importance for academics and policy-makers. This relationship has been widely investigated in literature, both theoretically and empirically. A real depreciation/devaluation of domestic currency makes imports more expensive and exports cheaper, which should lead to an improvement in the trade balance. This expected effect of a depreciation or devaluation of a currency on a country's trade balance holds if the Marshall-Lerner condition is satisfied. However, often this improvement in a country's trade balance materialises only in the medium term because, at the time of depreciation, previous purchase orders or contracts for import and export quantities have been agreed and so the volume of trade is not affected immediately. Nevertheless, in the short run, price changes tend to have an immediate effect on the nominal values of imports. This leads to a larger value of imports, which causes an immediate deterioration of the trade balance. In the medium term, the quantities of trade are adjusting according to the new exchange rate, and so the total value of imports would decrease and the total value of exports would increase as the depreciation leads to an improvement of the trade balance. This phenomenon is the so-called J-curve effect, which illustrates the short- and long-run effect of a currency's depreciation on the trade balance. The J-curve effect was first proposed by Magee (1973), which illustrates the mechanism of exchange rate changes in the short term (as long as the Marshall-Lerner condition is not satisfied) and in the medium term (when the Marshall-Lerner condition is satisfied).

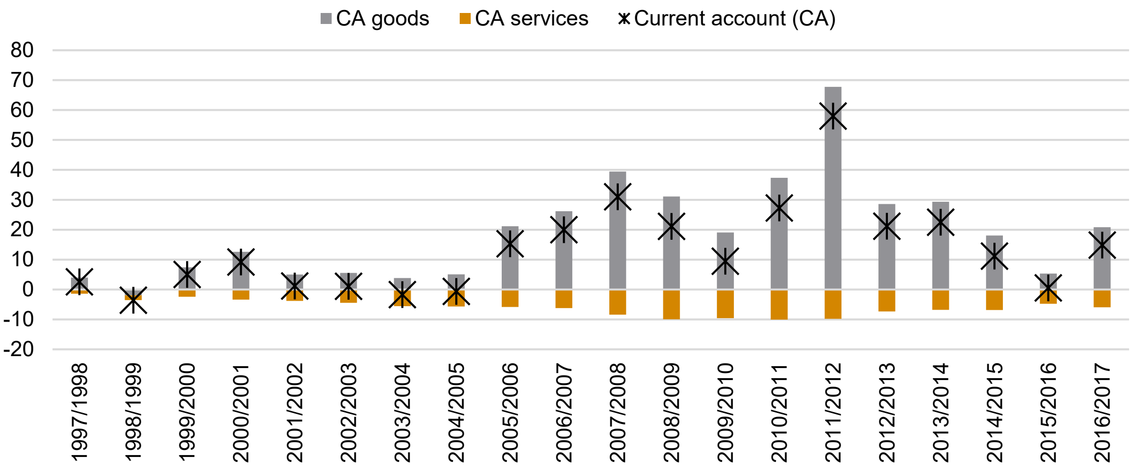
Figure 1 / The nominal exchange rate and the real exchange rate, Iranian rial per US dollar, 1997-2017



Sources: Central Bank of Iran; authors' elaboration.

Over the past 20 years, the Iranian currency (the rial) has lost much of its nominal value. Figure 1 shows that both the nominal and real value of the rial against the US dollar have continued to decline. Iran's economy, however, has been isolated by international and US sanctions, and is organised by centralised government planning. Therefore, it should not be taken for granted that dynamics such as the J-curve are important. After the Islamic Revolution in 1979, the revolutionary government in Iran confiscated assets of Iran's Shah (King), Mohammad Reza Pahlavi, and many of his supporters who were leaving the country. Their assets were transferred to state-owned enterprises that comprise a major part of Iran's total capital (see Section 2.2 of Ghodsi et al., 2018). Moreover, Iran is a centralised economy that is governed by an annual government budget allocated to semi-public companies and public entities. Furthermore, since 1979 Iran has been targeted by US sanctions, and since the early 2000s it has been targeted by sanctions mandated by the UN Security Council and other Western countries and institutions, such as the European Union (Ghodsi and Karamelikli, 2020). Under these circumstances, Iran's economy and its trade, capital and financial relations with the international economy remain less open than those of many neighbouring countries.

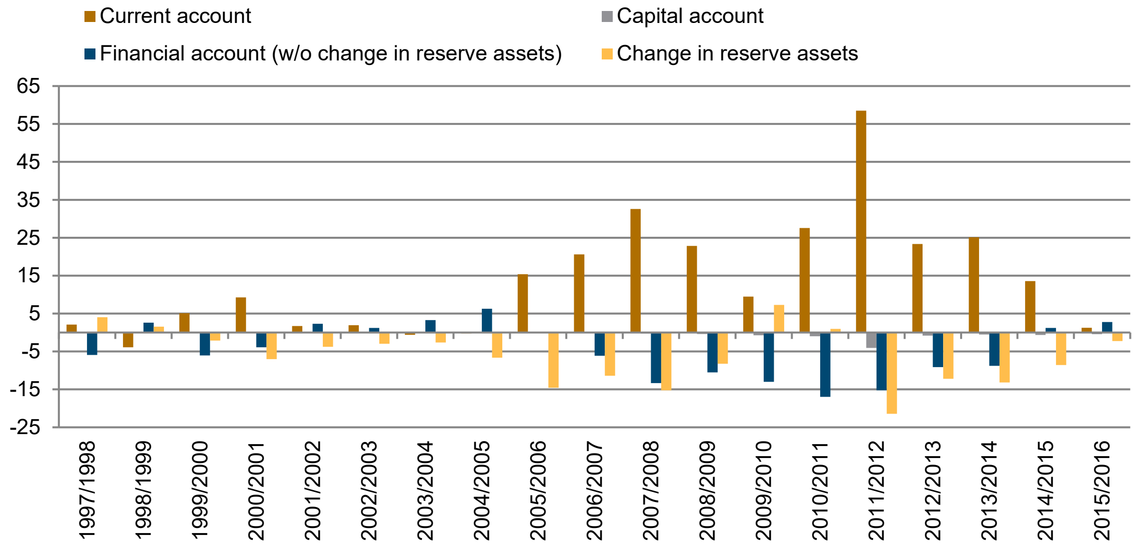
Figure 2 / Development of Iran's current account in USD billions, goods vs services, 1997-2017



Sources: Central Bank of Iran; authors' elaboration.

Furthermore, for many years Iran's administrations had been using a policy to stabilise the exchange rate and, in addition, had long enjoyed a current-account surplus. To have an autonomous monetary policy, Iran does not allow for perfect mobility of capital, partly because of its domestic capital controls and partly owing to international sanctions. As shown in Figure 2, except for one year, the current account has remained in surplus, with a long-standing pattern of a surplus in goods and a deficit in services trade. Owing to the surge in oil prices in 2006/2007, 20% of Iran's GDP was generated in the oil and gas industry, with oil accounting for about of 85% exports. Persistent high revenue from oil exports during the period 2006-2012 was one major reason to increase Iran's reserves of currency overseas. Despite these current-account surpluses, Iran was using a policy to stabilise the exchange rate. In 2012, after the international economic sanctions intensified, the foreign reserves and the overseas assets of the Central bank of Iran (CBI) were frozen and access to them was blocked. Furthermore, due payments of oil exports were no longer transferable to Iran as it was disconnected from the Society for Worldwide Interbank Financial Telecommunication (SWIFT). Iran was losing its export revenues, with particularly steep declines in exports to the EU and exports of oil, as a consequence of sanctions. With blocked access to currency reserves leading to problems in financing imports, in 2012 the exchange rate doubled against the US dollar. The depreciation of the rial then became an important factor to foster non-oil exports (the trade balance of non-oil exports was in deficit). This allowed Iran to finance its imports.

Figure 3 / Balance of payments, USD billion



Note: A negative change in reserve assets corresponds to their accumulation, and vice versa.
Source: Ghodsi et al. (2018), Figure 25, p. 29.

Given these important changes in the Iranian exchange rate regime, this article firstly answers the question whether the massive depreciation of the rial in the past decade has improved Iran's trade balance or not. Secondly, it shows that there is an asymmetry in the impact of the rial's appreciation or depreciation on Iran's trade balance. Hence, we investigate whether the expectations of Iranian traders differ when the currency depreciates compared with when it appreciates, and examine the scope for the exchange rate fluctuations to have asymmetric effects on the trade balance. In doing so, we rely upon both linear and nonlinear econometrics models developed by Shin et al. (2014) to assess the asymmetric effects of exchange rate variations. The remainder of this paper is organised as follows. In Section 2, a short review of the related literature is provided. Section 3 discusses the model specification and empirical methodology used to study asymmetric nonlinear models of the exchange rate and trade; Section 4 presents and discusses the empirical results; and Section 5 concludes with policy implications.

2. Literature review

The role of exchange rate policy as an important factor in trade practice has long been studied in the empirical literature. Hooper and Kohlhagen (1978) redefined the model by Clark (1973) and tested it empirically, but found no significant negative effects of exchange rate volatility on trade volume. Rose (1990), Bahmani-Oskooee and Alse (1994), Demirden and Pastine (1995), Bahmani-Oskooee and Brooks (1999), Wilson and Tat (2001), and Baharumshah (2001) found no evidence for the J-curve, unlike Mahdavi and Sohrabian (1993), Marwah and Klein (1996), Shirvani and Wilbratte (1997), Anju and Uma (1999), Bahmani-Oskooee and Goswami (2003), Onafowora (2003), Arora et al. (2003), and Prakash and Maiti (2016).

One main assumption behind all the works mentioned above, aggregate or bilateral, is that exchange rate variations have symmetric effects on the trade balance. It is a common knowledge, explained in the economic literature, that the impact on wages of a reduction in prices on wages is not as equal as the impact of an increase in prices. This phenomenon is referred to as 'sticky wages'. In fact, the main reason for asymmetry and nonlinearity is price stickiness. Rhee and Rich (1995) and Peltzman (2000) show that firms increase their prices when costs go up faster than they bring them down when their costs decrease. This is because firms are profit-maximising agents, sensitive to any decrease in profit while welcoming any increase.

A similar pattern can exist in the impact of currency depreciation on trade balance. Using nonlinear econometric models, Bahmani-Oskooee and Fariditavana (2015, 2016) and Bahmani-Oskooee et al. (2016) have shown that, while it is possible for the exchange rate to be insignificant in the linear model, it could be significant in the nonlinear model. Bahmani-Oskooee and Aftab (2018), for instance, find that depreciation and appreciation of the Malaysian currency against the euro have symmetric impact on sectoral bilateral imports and exports between Malaysia and the EU.

Arize and Malindretos (2012) show that asymmetry might occur in positive and negative deviations from the mean or the speed of adjustment when there is a deviation from equilibrium. Many studies have indicated that numerous economic variables demonstrate nonlinear and asymmetric behaviours (Sollis et al., 2002; Kapetanios et al., 2003; Wickremasinghe and Silvapulle, 2004; Nam et al., 2006; Sollis, 2009; Arize and Malindretos, 2012; Bahmani-Oskooee et al., 2017). These findings suggest a need for caution in interpreting empirical results from studies that assume symmetry, as this could cause bias and inaccuracy in the estimation results.

Baldwin and Krugman (1989) show that the movement of the trade balance and its adjustment might be asymmetric. When a currency appreciates, it is expected that export revenue will decrease by less than it would increase in the event of a similar magnitude of currency depreciation. This is the case because, after appreciation, the new entrants into the exporting market would make the competition harder for the established firms and consequently revenue would be smaller.

In the policy realm, government intervention in the exchange rate market could lead to asymmetries and nonlinearity by creating uncertainty in exchange rate levels in the long run. Usually, government officials are willing to respond to currency depreciation more quickly than to currency appreciation. This is because depreciation can have immediate adverse effects on consumers by making imports more expensive and by reducing consumers' real income. These government interventions give rise to the heterogeneity of beliefs about the equilibrium value of the real exchange rate versus the nominal exchange rate; in developing countries this divide is greater because of the information barriers in the markets. As the gap between real and nominal exchange rates widens, market participants can more easily predict the direction of exchange rate movements. This would make the exchange rate revert to its latent level (Kilian and Taylor, 2003).

Bahmani-Oskooee (2002) investigates the impact of volatility of black-market exchange rates on the trade balance in Iran. He uses a symmetric model and shows that real exchange rate fluctuation has a negative impact on imports and non-oil exports.

3. Empirical framework

Following the existing empirical literature in this area (Bahmani-Oskooee and Fariditavana, 2015; Halicioglu, 2008; Rose and Yellen, 1989), the relationship between the trade balance and the real effective exchange rate, augmented by domestic and foreign real income, may take the following form:

$$\ln(TB_t) = \alpha + \beta_1 \, ln(Yd_t) + \beta_2 ln(Yw_t) + \beta_4 ln(R_t) + e_t \tag{1}$$

where $\ln(TB_t)$ denotes the logarithm of Iran's value of non-oil exports X_t divided by its value of imports M_t at time t; R_t is a measure of the real exchange rate and is defined so that an increase reflects the Iranian rial depreciation; $Yd_t$is an index of real domestic incomes; Yw_t is an index of real foreign income and e_t is the error term. All the variables in our reduced form, Equation (1), are transformed into natural logarithm to enable the slope coefficients to be interpreted as a measure of elasticity. Equation (1) is our long-run model; to incorporate the possibility of asymmetric nonlinear adjustments to equilibrium, any short-run shock in long-run equilibrium could be displayed as follows:

$$\Delta \ln(TB_t) = \beta_0 + \sum_{j=1}^{p} \beta_{1j} \Delta \ln(TB_{t-j}) + \sum_{j=0}^{q} \beta_{2j} \Delta ln\left(Yd_{t-j}\right) + \sum_{j=0}^{m} \beta_{3j} \Delta ln\left(Yw_{t-j}\right) + \sum_{j=0}^{n} \beta_{4j} \Delta ln\left(R_{t-j}\right) + \theta \epsilon_{t-1} + e_t \tag{2}$$

Equation (2) is an error correction model (ECM) in which any shock in the long-run could be adjusted in the short-run. The adjustment parameter is shown with θ, which adjusts shocks in the long-run; the short-run errors could be displayed with e_t in this model. Changes in variables in logarithm that are shown with *Δ* indicate growth rates. With a combination of Equation (1) and Equation (2), both the long-run and short-run dynamics could be rewritten in a single equation. Equation (3) is our basic autoregressive distributed lag (ARDL) model that contains long and short-run dynamics simultaneously. This model is a full symmetric model that consists of symmetrical behaviour at both short- and long-run.

$$\Delta \ln(TB_t) = \psi + \eta_0 \ln(TB_{t-1}) + \eta_1 ln(Yd_{t-1}) + \eta_2 ln(Yw_{t-1}) + \eta_3 \ln(R_{t-1}) + \sum_{j=1}^{p} \beta_{1j} \Delta \ln(TB_{t-j}) + \sum_{j=0}^{q} \beta_{2j} \Delta ln\left(Yd_{t-j}\right) + \sum_{j=0}^{m} \beta_{3j} \Delta ln\left(Yw_{t-j}\right) + \sum_{j=0}^{n} \beta_{4j} \Delta ln\left(R_{t-j}\right) + e_t \tag{3}$$

The parameters in Equation (3) are explained as: $\psi = \beta_0 - \theta\alpha_0$, $\eta_0 = \theta$, $\eta_1 = -\,\theta\alpha_1$,$\eta_2 = -\,\theta\alpha_2 \; and \; \eta_3 = -\,\theta\alpha_3$. Also, the long-run parameters could be recalculated by $\theta = \eta_0$,$\alpha_1 = -\,\frac{\eta_1}{\theta}$, $\alpha_2 = -\,\frac{\eta_2}{\theta} \; and \; \alpha_{23} = -\,\frac{\eta_3}{\theta}$ relations. Equation (3) is used for fully symmetric estimation that means all variables have a linear relation with changes in the trade balance. However, if any nonlinear relationship between variables exists, such a linear estimation may give biased results. For a nonlinear model, the model can be estimated by nonlinear autoregressive distributed lag (NARDL). Such a nonlinear model should indicate the asymmetric impact of an explanatory variable on the dependent variable. Equation (4), below, will produce the nonlinear variables for the level of real exchange rate at each point in time t, which is the asymmetric accumulated level of exchange rate from the beginning of the period.

$$\ln(R_t)^+ = \sum_{j=1}^{t} \Delta \ln(R_j)^+ = \sum_{j=1}^{J} max(\Delta \ln(R_j), 0) \; ; \; \ln(R_t)^- = \sum_{j=1}^{t} \Delta \ln(R_t)^- = \sum_{j=1}^{t} min(\Delta \ln(R_j), 0) \tag{4}$$

The long-run model could be then rewritten including the asymmetric level of exchange rate $\ln(R_t)$ variables from (4) as follows.

$$\ln(TB_t) = \alpha_0 + \alpha_1 \, ln(Yd_t) + \alpha_2 ln(Yw_t) + \alpha_3 ln(R_t)^+ + \alpha_3 ln(R_t)^- + \epsilon_t \tag{5}$$

Consistent with Shin et al. (2014), the model in the case of existence of asymmetry in both long-run and short-run is presented in equation (6). This model is a full asymmetric model that consists of asymmetric behaviour at both short-run and long-run, and the trade balance equation can be represented by the following asymmetric ARDL model:

$$\begin{aligned} \Delta \, ln(TB_t) = \psi + \eta_0 \, ln(TB_{t-1}) + \eta_1 ln(Yd_{t-1}) + \eta_2 ln(Yw_{t-1}) + \eta_3^+ \, ln(R_{t-1})^+ + \eta_3^- \, ln(R_{t-1})^- \\ + \sum_{j=1}^{p} \beta_{1j} \Delta \, ln(TB_{t-j}) + \sum_{j=0}^{q} \beta_{2j} \Delta ln(Yd_{t-j}) + \sum_{j=0}^{m} \beta_{3j} \Delta ln(Yw_{t-j}) \\ + \sum_{j=0}^{n} \left(\beta_{4j}^+ \Delta \, ln(R_{t-j})^+ + \beta_{4j}^- \Delta \, ln(R_{t-1})^-\right) + e_t \end{aligned} \tag{6}$$

3.1. DATA

Quarterly data over the period 1997Q1-2017Q4 are used in the analysis. Most data are obtained from the International Monetary Fund's *International Financial Statistics (IFS)* and *Direction of Trade Statistics (DOTS)*; the data on Iran's non-oil exports and non-oil imports are collected from the latter source. Yd_t is a measure of Iranian income and it is proxied by the seasonally adjusted index of industrial production (IIP); Yw_t is a measure of world income gathered from the IFS. It is the sum of real GDP for OECD countries and some other countries that are important trading partners of Iran (China, United Arab Emirates and Iraq); R_t is the real exchange rate of the US dollar against the Iranian rial and is calculated as:

$$R_t = \frac{NEX_t \times PIR_t}{PUS_t} \tag{7}$$

where NEX_t is the nominal exchange rate defined as one unit of US dollars in Iranian rials, PIR_t is the price level in Iran, measured in consumer price index (CPI) terms; and PUS_t is the price level in the United States, also measured in CPI terms. Thus, a decline in R_t reflects a real appreciation of the Iranian rial against the US dollar. All nominal exchange rates and consumer price index data are collected from the IMF's *IFS*.

4. Empirical results and discussions

To apply the ARDL model, the variables used in the model must be integrated of order one or zero. Thus, it must be first ensured that the variables are not integrated of the order of two or more. Table 1 presents the unit root tests of variables using Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. In addition to the variables, the unit root of negative and positive decompositions must be also tested.

Table 1 / Results of Unit Root Test

		Augmented Dickey-Fuller		Phillips-Perron	
		Level	First Difference	Level	First Difference
$ln(TB_t)$	Constant	-2.48	-7.54*	-2.41	-8.55*
	Constant + Trend	-2.86	-7.78*	-2.92	-10.58*
$ln(Yd_t)$	Constant	-2.08	-5.11*	-2.59	-7.95*
	Constant + Trend	-2.21	-5.02*	-2.78	-7.87*
$ln(R_t)$	Constant	-1.10	-7.4*	-1.27	-7.37*
	Constant + Trend	-1.50	-7.46*	-1.62	-7.44*
$ln(Yw_t)$	Constant	-0.39	-7.59*	-0.39	-7.57*
	Constant + Trend	-2.33	-7.53*	-2.48	-7.51*

* Represents 1% level of significant.

According to the test statistics presented in Table 1, it is possible to use NARDL for a combination of variables integrated of orders zero I(0) and one I(1). ADF and PP unit root tests indicate that none of the variables is integrated in order of 2. It is found that for the levels of the series, the test does not reject the null hypothesis of non-stationarity or having a unit root; however, with the first differences each variable clearly indicates the rejection of the null hypothesis at 1 percent level. It is thus shown that all series are stationary of order 1. Thus, if these variables are used in their first differences, the series will become stationary and there will be no need for second-order differencing.

The optimum lag j of NARDL models formulated in previous equations is chosen on the basis of the Akaike Information Criterion (AIC), with a maximum lag of four. The estimates, presented in Table 2, provide evidence in favour of the non-rejection of the null hypothesis of no co-integration in the symmetric model with F-value equal to 1.612 that is smaller than the lower bound critical value. This means that there is no co-integration in the symmetric model. A possible reason for not detecting a causal long-run relationship might be the existence of nonlinearities among the variables.

Table 2 / Bounds test for co-integration in the linear and the nonlinear models

Dep. Var.: $\Delta\, ln(TB_t)$	F-statistic	95% lower bound	95% upper bound
Symmetric model	1.612	3.756	4.227
Asymmetric model	5.334	3.618	4.872

Note: F-statistic testing the null hypothesis ρ = η = 0 and ρ = η^{+}= η^{-} =0 in symmetric and asymmetric models, respectively.

The F-statistic for the joint significance of the parameters in the asymmetric model is 5.334 and exceeds the upper bound critical value. Therefore, this reveals statistically significant evidence in favour of the existence of a long-run co-integration relationship between the examined variables.

The estimates of the asymmetric model of the form of equation (6) are presented in Table 3. In order to verify the appropriateness of an asymmetric model, we used the Wald test (W_{LR}) and (W_{SR}) symmetries for the long-run and the short-run respectively. Regarding the long-run time horizon, the results are reported in the lower panel of Table 3 and suggest the rejection of the null hypothesis of long-run symmetry between the positive and negative components of each one of the examined variables. This finding shows that a linear model for the behaviour of the trade balance and real effective exchange rates in Iran would be misspecified.

Next, we turn to the analysis of the long-run dynamics of the exchange rate, presented in Table 3. Focusing on the estimated long-run coefficients of the asymmetric ARDL model, we note that for the real effective exchange rate, significant impact is confirmed for both positive $ln(R_t)^+$ and negative $ln(R_t)^-$ coefficients, with the signs in line with the reported literature. The estimated long-run coefficients of $ln(R_t)^+$and $ln(R_t)^-$ are 0.47 and -1.89, respectively. Therefore, we may conclude that a 10% increase in the real exchange rate (depreciation of the rial) generates an increase (improvement) in the trade balance of about 4.7%. This means that the depreciation of the rial increases exports more than imports, leading to a better trade balance. Appreciation has a strong effect on the long-run trade balance. A 10% decrease in the real exchange rate of the US dollar (appreciation of the rial) leads on average to an 18.9% decrease (deterioration) in the trade balance. Taking both effects into consideration, this means that the trade balance reacts more strongly to an appreciation of the rial than to a depreciation. As discussed above, Iran enjoyed a current-account surplus for many years, and its exchange rate was kept constant for more than a decade. Allowing for a floating exchange rate, an appreciation would have narrowed the surplus on the current account, moving it into balance in the long run. This did not happen, and in 2012, after the currency reserves of the CBI became frozen, accumulated significant claims against the rest of the world were not accessible to sustain the fixed exchange rate regime. With access to currency reserves blocked, and with the dollarisation of the market, the exchange rate doubled in 2012. This led to a 47% improvement in the trade balance of non-oil exports, which had been in deficit.

For the short-run impact of the exchange rate, we observe that current negative changes in exchange rate $\Delta\, ln(R_t)^-$ (short-run appreciation of the rial) has no statistically significant impact on the trade balance, while its one lag $\Delta\, ln(R_{t-1})^-$ does have a statistically significant impact on the trade balance. In contrast, positive changes in the exchange rate in the current period $\Delta\, ln(R_t)^+$ (short-run deprecation of the rial) has a positive coefficient that is weakly significant at the 10% level. This alone indicates an asymmetric response of the trade balance to short-run changes in the exchange rate. Furthermore, positive changes in the exchange rate in the previous period $\Delta\, ln(R_{t-1})^+$ influence the trade balance only at the 5% level of statistical significance.

Other explanatory variables carry at least one significant coefficient in the short run and the long run. In the long-run perspective, Iran’s income has a negative impact, while world income has a positive impact on Iran’s trade balance. From the short-run estimates, world income at the current period was found to be statistically insignificant, but it is significant with one lag. This implies that world income has positive significant effects on Iran’s trade balance also in the short run.

Table 3 / Regression results of dynamic asymmetric estimation

Dep. Var.: $\Delta\, ln(TB_t)$ Variable	Coefficient	T-ratio [Prob.]	Standard error
Constant	0.7403*	3.409 [0.000]	0.2721
$ln(TB_{t-1})$	-0.4307*	-5.0851 [0.000]	0.1097
$ln(Yd_t)$	-0.75**	-2.4224[0.018]	0.2205
$ln(Yw_t)$	1.95***	1.9154 [0.058]	0.3223
$ln(R_t)^+$	0.47**	2.5365[0.013]	0.0124
$ln(R_t)^-$	-1.89**	2.2392 [0.027]	0.2353
$\Delta\, ln(TB_{t-1})$	0.08**	2.4701 [.0115]	0.0196
$\Delta\, ln(Yw_t)$	1.16	1.2124 [0.372]	0.0721
$\Delta\, ln(Yw_{t-1})$	1.15***	1.9886 [0.052]	0.0238
$\Delta\, ln(Yd_t)$	-1.59**	2.4781 [.0151]	0.1035
$\Delta\, ln(Yd_{t-1})$	-1.66*	7.1545 [0.000]	0.1757
$\Delta\, ln(R_t)^+$	0.39*	4.0501 [0.000]	0.1593
$\Delta\, ln(R_t)^-$	- 0.55	-1.1124 [0.481]	0.0173
$\Delta\, ln(R_{t-1})^+$	0.79**	2.9032 [0.004]	0.8593
$\Delta\, ln(R_{t-1})^-$	-0.33***	-1.6837 [0.095]	0.0214
Summary statistics			
R^2	0.4219	Adjusted R^2	0.3811
DW	1.98	BG χ^2	4.78
χ^2 Normal	31.093*	Bound F	5.334
W_{LR}	17.12 *	W_{SR}	1.84 ***
CUSUM	Stable	CUSUMSQ	Stable

***, **, and * denote 10%, 5% and 1% level of significance, respectively.
W_{LR} refers to the Wald test for the null of the long-run symmetry.
W_{SR} refers to the Wald test for the null of the short-run symmetry.

5. Summary and conclusions

This paper investigates the relationship between real exchange rates and the trade balance in Iran. Previous studies have not distinguished the significant effects of exchange rate depreciations and appreciations on the trade balance, owing to the implicit assumption in an autoregressive distributed lag (ARDL) model that the exchange rate in levels and first differences have symmetric effects on the trade balance. In this paper, we use nonlinear ARDL techniques following Shin et al. (2014) to examine this relationship, allowing for such asymmetries. Specifically, we separate the effects of real appreciations from real depreciations on the trade balance via the partial sum concept and introducing nonlinearity into the adjustment process of the error correction model (ECM). Our results suggest that there are statistically significant long-run and short-run relationships between Iran's trade balance and its real exchange rate, which are in line with the Marshall-Lerner condition. Specifically, the evidence therefore does not indicate a J-curve phenomenon in Iran's economy as a depreciation (appreciation) of the rial leads to an improvement (worsening) of the trade balance in both the long run and short run.

However, these responses of the trade balance to appreciations and depreciations in the short and long run are asymmetric with respect to their speeds. The negative impact of an appreciation of the real exchange rate on the trade balance in the long run is stronger than the positive impact of the depreciation of the real exchange rate on the trade balance; in the short run, the opposite is the case.

These results would suggest that Iranian policy-makers have it relatively easy as exchange rate adjustments go in a favourable direction. Depreciations work quickly in the short run, and this could be used to easily remedy trade deficits. Despite these findings, however, policy-makers might not be able to rely on this mechanism and should instead promote fundamental factors such as increasing non-oil exports to reduce dependency on oil and to diversify the economy.

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IMPRESSUM

Herausgeber, Verleger, Eigentümer und Hersteller:
Verein „Wiener Institut für Internationale Wirtschaftsvergleiche“ (wiiw),
Wien 6, Rahlgasse 3

ZVR-Zahl: 329995655

Postanschrift: A 1060 Wien, Rahlgasse 3, Tel: [+431] 533 66 10, Telefax: [+431] 533 66 10 50
Internet Homepage: www.wiiw.ac.at

Offenlegung nach § 25 Mediengesetz: Medieninhaber (Verleger): Verein "Wiener Institut für Internationale Wirtschaftsvergleiche", A 1060 Wien, Rahlgasse 3. Vereinszweck: Analyse der wirtschaftlichen Entwicklung der zentral- und osteuropäischen Länder sowie anderer Transformationswirtschaften sowohl mittels empirischer als auch theoretischer Studien und ihre Veröffentlichung; Erbringung von Beratungsleistungen für Regierungs- und Verwaltungsstellen,
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