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Original Article

On the role of government spending, trade openness and terms of trade in Iran's agricultural growth

Sobre o papel dos gastos governamentais, da abertura comercial e dos termos de comércio no crescimento agrícola do Irã

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Abstract

Agriculture is recognized as the driving force of economic growth, especially in developing economies. It plays a crucial role in Iran's economy especially during economic sanctions as it is a source of income for rural people, food security, job creation, and foreign exchange earnings. The present study investigates the impact of government spending, trade openness, and terms of trade on agricultural growth in Iran using annual data for the period 1978-2021 by application of the nonlinear autoregressive distributed lag model (NARDL). The results confirmed asymmetry in the impact of all three variables of interest on agricultural growth. In other words, the superiority of the nonlinear specification in explaining the relationships between variables was confirmed. To be specific, a positive and negative shock to government spending affects sector growth by 0.18 and -0.05 percent, respectively in the long run. The same finding was found for trade openness with 0.22 and -0.11 impact coefficients for positive and negative shocks, respectively. Moreover, we could not find significant impact for terms of trade.

Keywords: agriculture, trade, Nonlinear Autoregressive Distributed Lag (NARDL) model, Iran.

Resumo

A agricultura é reconhecida como a força motriz do crescimento econômico, especialmente nas economias em desenvolvimento. Desempenha um papel crucial na economia do Irã, sobretudo durante as sanções econômicas, pois é uma fonte de renda para a população rural, segurança alimentar, criação de emprego e receitas em divisas. O presente estudo investiga o impacto dos gastos governamentais, da abertura comercial e dos termos de troca no crescimento agrícola no Irã, utilizando dados anuais do período de 1978 a 2021, por meio da aplicação do modelo de lag distribuído autorregressivo não linear (NARDL). Os resultados confirmaram a assimetria no impacto das três variáveis de interesse no crescimento agrícola. Em outras palavras, confirmou-se a superioridade da especificação não linear na explicação das relações entre variáveis. Para ser mais específico, um choque positivo e negativo nas despesas públicas afeta o crescimento do setor em 0,18 e -0,05%, respectivamente, no longo prazo. A mesma conclusão foi encontrada para a abertura comercial com coeficientes de impacto de 0,22 e -0,11 para choques positivos e negativos, respectivamente. Além disso, não conseguimos encontrar impacto significativo nos termos de troca.

Palavras-chave: agricultura, comércio, modelo de Lag Distribuído Autorregressivo Não Linear (NARDL), Irã.

1. Introduction

Agriculture plays a vital role in economic growth as a food and foreign exchange provider, job creator, and food security guarantee (Najafi et al., 2020). Agricultural trade significantly promotes the economic boom in developing countries. Agriculture may need to sustainably meet the growing demand for basic foods; accommodate changing dietary patterns evolving from rising incomes and urbanization; and address the growing imperatives for more diverse, safer, and more nutritious foods. International trade encourages technology transfer and promotes new levels of consumption (Najafi et al., 2020; Dadgar and Nazari, 2010). International trade is regarded as a tool for sustainable economic growth, as trade makes it possible to generate products and services more economically by shifting the demand for more competitive output.

Agricultural growth and development in Iran is highly dependent on government spending. Development of agricultural infrastructure such as modern irrigation networks is completely financed by the government.

According to an empirical model by Bahmani-Oskooee and Goswami, there is a significant relationship between trade (imports) and economic growth. However, this association can be unilateral or bilateral (Monjezi et al., 2011; Bahmani-Oskooee and Goswami, 2004). The foregoing

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model introduces imports as a function of national income, relative import prices (ratio of prices of imported goods to domestic goods), and exchange rate. On the other hand, agricultural exports to the world markets results in agricultural demand increase, which may theoretically lead agricultural growth (Pahlavani et al., 2007). Therefore, trade openness should be considered as a driver for agricultural growth. Trade openness measures the degree to which a country interacts with the rest of the world through trade. The effect that trade openness has on government expenditure or size can either be positive or negative. If it is positive, trade openness is said to be "compensating", while a negative relationship is "efficient". When trade openness has a compensating effect on the size of government, it means that exposure to risks that come with interacting with the rest of the world is made up for (compensated), by increased domestic spending. On the other hand, when trade openness has an efficient effect on the size of government, it means that the increased competition that comes from firms abroad will make domestic companies put pressure on the government not to implement policies that will make labor more expensive, thus driving up production cost and making their products less competitive. An increase in export prices relative to import prices allows a larger volume of imports to be purchased with a given volume of exports. The implied increase in the real purchasing power of domestic production is equivalent to a transfer of income from the rest of the world and can have large impacts on consumption, savings and investment. The terms of trade (TOT) can also be thought of as a rate of return on investment and therefore a secular improvement in the terms of trade leads to an increase in investment and hence economic growth. Still in line with causal effect running from terms of trade to economic growth, Monjezi et al., (2011) interacted government spending and terms of trade volatility to find its effect on economic growth. The study found that volatility has significant negative effects on economic growth in countries with pro-cyclical government spending. In countries where government spending is counter-cyclical, terms of trade volatility has no significant effect on growth (Bakari, 2017a).

This study aims to compare the extent to which terms of trade, trade openness, and government spending influence the size of agricultural growth in Iran. The contribution of the study into the existing Iranian literature is the application of NARDL model and examination of possible nonlinear influence of three variables of interest on agricultural growth in Iran. The rest of the paper is organized as follows. Section 2 contains the literature review, the methodology is situated in Section 3, while Section 4 is where results are presented and discussions done; finally, Section 5 concludes the study.

2. Literature Review

Studies on the effect of terms of trade on economic growth are varied. Some argue that growth can respond to changes in terms of trade directly or indirectly depending on its impact on the volume of imports and exports.

Studying the volatility of terms of trade further and how it is related to government spending, Bakari (2017a) found that there is no association between the size of government and terms of trade volatility in a cross-section of 96 countries. However, a granger causality test indicated that a reverse causality going from government size to volatility is found, suggesting that an increase in government size causes a decrease in terms of trade volatility.

Monjezi et al., (2011) studied the effect of terms of trade shocks on economic growth in Burkina Faso and Mali limiting his analysis to the shocks in commodities prices. The study confirmed that external shocks had adverse negative effects on the economic performance of the two countries, fueled by counter-cyclical foreign official assistance.

Bakari (2017b) narrowed their study to the monetary and fiscal policies effect of commodity price fluctuations in Western and Central Africa (WCA). In their study, they confirmed that following the rise in commodity prices between 1999 and 2005, net oil exporters recorded strong growth rates while net oil-importing countries displayed somewhat lower growth. For most WCA economies, inflation rates appeared less affected by commodity price changes and more determined by exchange rate regimes as well as monetary and fiscal policies. While pass-through effects from international to domestic energy prices were significant, notably in oil importing countries, second-round effects on overall prices seem limited. Governments of oil-rich countries reacted prudently to windfall revenues, partly running sizable fiscal surpluses.

Ahmed and Salam (2018) in a study on terms of trade shocks and fiscal policies in 74 countries using panel OLS and 2SLS found that booms in the terms of trade did not necessarily lead to larger government surpluses in developing countries, particularly in emerging markets and especially during capital flow bonanzas. Bakari and Mabrouki (2017) studied the effect of terms of trade shocks on inflation, output, interest rate and exchange rates in Australia adopting the VAR technique. The study found that a higher terms of trade tends to be expansionary but is not always inflationary. A key result is that the floating exchange rate had provided an important buffer to the external shocks that move the terms of trade.

Kassouri and Altıntas (2020) disaggregated the response of real effective exchange rate to TOT changes. Using the panel ARDL estimation technique, the study found that positive changes in commodity terms of trade had a more pronounced effect on real currency exchange rate depreciation in the long-run than negative shocks; while negative shocks in commodity terms of trade in the short-run had a significant effect on real effective exchange rate depreciation. Torayeh (2011) examined the impact of the export of three groups of commodiies (textile, chemical products, and food) on economic growth in Egypt during 1980-2008 using cointegration and causality. He found a significant relationship among all variables in the long run. Based on the Granger causality test, the export of chemical products improved economic growth in the short run.

3. Materials and Methods

3.1. Econometric model

The nonlinear autoregressive distributed lag model (NARDL), proposed by Shin et al. (2014) is an asymmetric specification of the ARDL used to assess nonlinear and asymmetric relationships between economic variables in the short and long term. According to Golkhandan (2016), the NARDL approach has advantages over its rivals. Firstly, it can be used regardless of whether the variables of interest are I(1) or I(0) or mutually cointegrated. Moreover, the technique does not enter short-term dynamics into the error correction component and can be used with a small number of observations. Another advantage of the model is its ability to be used even in the presence of endogenous explanatory variables.

The simplest representation of the NARDL model is observed by assuming two dependent and independent variables of y and x, respectively, as shown in the Equation 1 below:

$$y_t = \beta^+ x_t^+ + \beta^- x_t^- + u_t \tag{1}$$

where x_t and y_t are integrated of order one or I(1), and changes in x_t are divided into two positive (increase) and negative (decrease) components, as presented in Equation 2.

$$\begin{aligned} x_t &= x_0 + x_t^+ + x_t^- \\ x_t^+ &= \sum_{j=1}^{t} \Delta x_j^+ = Max\left(\Delta x_j, 0\right) \\ x_t^- &= \sum_{j=1}^{t} \Delta x_j^- = Min\left(\Delta x_j, 0\right) \end{aligned} \tag{2}$$

Now, the linear combination of positive and negative cumulative components of the variables can be defined as follows (Equation 3):

$$z_t = \beta_0^+ y_t^+ + \beta_0^- y_t^- + \beta_1^+ x_t^+ + \beta_1^- x_t^- \tag{3}$$

If z_t is integrated of order zero (stationary), then x_t and y_t would be cointegrated asymmetrically. However, cointegration is symmetrical if $\beta_0^+ = \beta_0^-$ and $\beta_1^+ = \beta_1^-$. Now, the x variable is shown as a linear combination of positive and negative shocks, namely; $x_t = x_0 + x_t^+ + x_t^-$. The NARDL(p,q) model could be specified by entering x into an ARDL(p,q) model (Equation 4):

$$y_t = \sum_{j=1}^{p} \varphi_j y_{t-j} + \sum_{j=1}^{q} \left(\theta_j^+ x_{t-j}^+ + \theta_j^- x_{t-j}^-\right) + \varepsilon_t \tag{4}$$

where p and q are the optimal lag lengths, φ is the weight on lagged dependent variable, θ_j^+ and θ_j^- are asymmetric coefficients of lagged explanatory variable, and ε_t is the disturbance term with zero mean and fixed variance. Each long-term relationship in the ARDL (p,q) model cane assigned a short-term error correction model (ECM), which shows how to correct short-term dis-equilibriums.

Accordingly, the ECM is specified in NARDL as shown below (Equation 5):

$$\begin{aligned} &\Delta y_t = \rho y_{t-1} + \theta^+ x_{t-1}^+ + \theta^- x_{t-1}^- + \sum_{j=1}^{p-1} \gamma_j \Delta y_{t-j} + \\ &\sum_{j=0}^{q-1} \left(v_j^+ \Delta x_{t-j}^+ + v_j^- \Delta x_{t-j}^-\right) + \varepsilon_t = \\ &\rho \xi_{t-1} + \sum_{j=1}^{p-1} \gamma_j \ddot{A} y_{t-j} + \sum_{j=0}^{q-1} \left(v_j^+ \Delta x_{t-j}^+ + v_j^- \Delta x_{t-j}^-\right) + \varepsilon_t \end{aligned} \tag{5}$$

where

$$\rho = \sum_{j=1}^{p} \varphi_j - 1, \gamma_j = -\sum_{t=j+1}^{p} \varphi_i \; for \; j = 1, \ldots p-1$$

$$\theta^+ = \sum\nolimits_{j=0}^{q} \theta_j^+, \theta^- = \sum_{j=0}^{q} \theta_j^-,$$

$$\upsilon_0^+ = \theta_0^+ æ \; \upsilon_j^+ = -\sum_{i=j+1}^{q} \theta_i^+ \; for \; j = 1, \ldots, q \tag{6}$$

$$\upsilon_0^- = \theta_0^- æ \; \upsilon_j^- = -\sum_{i=j+1}^{q} \theta_i^- \; for \; j = 1, \ldots, q-1$$

Moreover, $y_{t-1} - \beta^+ x_t^+ - \beta^- x_t^- = \xi_t$ in Equation 6 is an asymmetric error correction component, and $\beta^+ = -\theta^+ \big/ \rho, \beta^- = -\theta^- \big/ \rho$ are long-term asymmetric coefficients. Existence of the same order of integration for the variables and significance of ξ_{t-1} in the estimation of short-term coefficients will indicate the existence of a long-term association between the variables.

3.2. Data

In order to estimate our model, annual data are gathered from different local and international sources including Central Bank of Iran (CBI), World Bank (WB), and International Monetary Fund (IMF) for the period spanning from 1978 to 2021.

The interested research variables are: agriculture value added at constant prices (2011) in thousand USD (AVA), government spending in agriculture in thousand USD (GE), trade openness defined as the ratio of agricultural products trade over agriculture value added (TO), and terms of trade defined as the ratio of unit import price over unit export price (TOT).

3.3. Model specification

The final model to be estimated is presented in Equation 7:

Table 1. Stationarity tests results.

Variable	ADF		Phillips-Perron		Zivot-Andrews			
	Level	FD	Level	FD	Level	Break	FD	Break
AVA	-1.02	-4.53***	-1.23	-5.26***	-1.48	2008	-5.68***	2005
GE	-1.21	-4.84***	-1.11	-4.61***	-1.30	2012	-5.26***	2015
TO	-0.89	-4.38***	-1.01	-4.59***	-1.16	-	-4.64***	-
TOT	-1.05	-5.22***	-1.06	-4.94***	-1.11	1987	-4.97***	1990

Variables are in natural logarithm.
***Significant at 1% level, FD: First Difference.

Table 2. BDS test results.

	AVA	GE	TO	TOT
M2	12.77***	7.45***	11.12***	13.63***
M3	12.97***	7.80***	11.31***	13.68***
M4	13.92***	8.56***	10.66***	14.55***
M5	15.77***	9.66***	12.01***	15.64***
M6	17.36***	11.17***	14.35***	16.89***

Variables are in natural logarithm. ***Significant at 1% level.

$$\Delta \ln AVA_t = \alpha_0 + \sum_{1}^{q1}\beta_{1i}\Delta \ln AVA_{t-i} + \sum_{0}^{q2}\beta_{2i}\Delta \ln GE^{+}_{t-i} + \sum_{0}^{q3}\beta_{3i}\Delta \ln GE^{-}_{t-i} + \sum_{0}^{q4}\beta_{4i}\Delta \ln TO^{+}_{t-i} + \sum_{0}^{q5}\beta_{5i}\Delta \ln TO^{-}_{t-i} + \sum_{0}^{q6}\beta_{6i}\Delta \ln TOT^{+}_{t-i} + \sum_{0}^{q7}\beta_{7i}\Delta \ln TOT^{-}_{t-i} + \varepsilon_t \quad (7)$$

where all three explanatory variables are decomposed into positive and negative components letting us to test their asymmetric impact on the dependent variable. Parameters qs are optimal lag lengths determined by Schwarz Information Criterion (SIC). Other definitions and decision rules are as those presented in the previous section.

4. Results and Discussion

In order to examine stationarity of the variables, two conventional tests, namely; Augmented Dickey-Fuller (ADF) and the Phillips-Perron were applied. However, due to possible existence of break in the data, the Zivot-Andrews (ZA) test was considered too. The results obtained are shown in Table 1. Evidently, all variables have a unit root and must be regarded as nonstationary time series.

At next stage, possible nonlinear association among variables was investigated. To do this, the widely used test known as BDS introduced by Bakari (2017a)) was applied. This is a non-parametric test and belongs to the group of Portmanteau tests. Results are portrayed in Table 2.

Clearly, all the reported statistics were significant at one percent level, thereby rejecting the null hypothesis supposing superiority of the linear model. This necessitates the use of nonlinear approaches in estimating the relationships between the desired variables. Therefore, the use of the NARDL model was appropriate. In the next stage, the long-term relationship between the variables was tested by the foregoing model, which led to the confirmation of a significant association (Table 3). This implies that all variables have followed same path through the period under study.

Table 3. Cointegration test results (NARDL specification).

F-statistic	Lower Bound (95%)	Higher Bound (95%)	Test Results
9.29	2.79	4.10	Cointegration Exists

After checking our series characteristics and considering the BDS test result, the NARDL model in Equation 7 was estimated. Table 4 presents the estimation findings along with corresponding significance probabilities.

According to the results, in the long term, the positive shock (net increase) to government spending in agriculture has led to a positive and significant influence on agricultural growth (0.18), while a similar effect for the negative shock (net decrease) was estimated to be indirect and significant (-0.05). It clearly states the huge potential in terms of investment, especially infrastructure, in the agriculture sector of Iran. This finding coincides with those reported by Najafi et al. (2020), Mahmood and Munir (2018), and Golkhandan (2016).

The greatest significant coefficient goes to trade openness. The corresponding values for net increase and net decrease are estimated at 0.22 and -0.11, respectively. This powerful association should be interpreted as the notable

Table 4. Estimated long-term and short-term coefficients (NARDL model).

Variable	Long term		Short term	
	Coefficient	Prob	Coefficient	Prob
GE^+	0.18	0.03	0.07	0.04
GE^-	-0.05	0.04	-0.08	0.07
TO^+	0.22	0.02	0.02	0.09
TO^-	-0.11	0.03	-0.01	0.12
TOT^+	0.23	0.13	0.03	0.05
TOT^-	-0.15	0.16	-0.04	0.05
ECT (-1)	-	-	-0.54	0.03

dependence of the Iran's agriculture to the world markets. Available data shows that something about 35 percent of fertilizer needs are imported from abroad. Same figure for pesticides (on average) is about 65 percent. Therefore, more interaction with international markets (greater TO value) is expected to result in more sector growth. Other findings provide no evidence on the significant impact of terms of trade (TOT) on agricultural growth. This is in line with Bakari (2017a) Saeed and Hussain (2015), Mehrara and Baghbanpoor (2016), Shakeri and Maliki (2010), and Ahmed and Salam (2018).

The last two columns present the corresponding short term impact multipliers, which are lower (as expected) in magnitude than the corresponding long term values. The last row of the Table 4 includes information on error correction term of the model, which is very important from the policy making point of view. The estimated coefficient is -0.54 meaning that the effect of any shock (disequilibrium factor) to the long term association among variables would be decayed in nearly six month. This is another indication of the strong correlation among our variables.

In Table 5, information regarding the asymmetry in the influence of three independent variables (GE, TO, and TOT) on the dependent variable of the NARDL model (AVA) is reported. It shows whether there is significant difference between the impact of positive and negative components of each variable. In the long term, such difference is statistically significant for GE and TO implying that the impact of positive component is much greater (in absolute term) than the negative one. This confirms the nonlinear influence of GE and TO on agriculture growth in Iran. However, such interpretation cannot be provided in the short term since the relevant statistics are insignificant.

Diagnostic checking of the estimated NARDL model can be accomplished according to the information available in Table 6. The estimated R-squared of 0.97 is another symptom of strong association among variables. The computed JB and LM statistics confirm appropriate behavior of the model's residual term. Moreover, the Ramsey Reset and CUSUM statistics show the proper specification of the model and stability of its coefficients, respectively.

Table 5. The results of asymmetry test in the effects of variables.

Variable	Long-term	Short-term
	Chi-square (prob)	Chi-square (prob)
GE	9.56 (0.02)	1.23 (0.14)
TO	6.25 (0.04)	1.42 (0.11)
TOT	3.62 (0.06)	1.36 (0.12)

Table 6. The results of diagnostic checking tests.

CUSUM	RESET	LM	JB Normality	R^2
Stability at 95% level	0.40 (0.53)	1.90 (0.18)	1.30 (0.52)	0.97

5. Conclusion

The present study aimed to study empirically the existence of nonlinear impact of three macroeconomic variables consisting of government spending in agriculture, trade openness, and terms of trade on agricultural growth in Iran. We used annual data for the period 1978-2021 in order to fit the NARDL model to the gathered information.

After checking for non-stationarity of the series, the BDS test confirmed the nonlinear relationship among variables, which provided theoretical justification for application of the NARDL approach. This coincides to the bulk of studies published recently suggesting superiority of nonlinear model specifications in economic research.

We found long term equilibrium relationship among variables implying that they follow same trend through time. Trade openness (TO) reveals the strongest impact on agricultural growth. To be specific, a one percent increase in the positive component of TO is expected to lead to 0.22 percent rise in the sector growth. Thus, more integration to the world markets and trade promotion can be recommended as the main policy implication of our findings.

Furthermore, government expenditure in agriculture showed the second greatest impact on agriculture growth. In fact, it confirms our a priori expectation as the Iranian government acts as the sole financer of infrastructural projects in the agriculture sector in Iran. The estimated error correction term possesses desired magnitude and sign. It suggests approximately that the impact of any disequilibrium factor would be vanished in 6.5 month. All diagnostic checking criteria approve the appropriateness of the estimated NARDL model.

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