ORIGINAL ARTICLE

How Did Globalization Boost the Nuts Production in Indonesia?

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ARTICLE INFO	ABSTRACT
	Agriculture plays a key role in Indonesia's economy as it provides notable job opportunities for the people and contributes to the country's foreign income. The Indonesian government initialized integration into the world economy through the implementation of development plans three decades ago. It has considerably influenced all economic sectors, including agriculture. Official data on nuts production shows that this activity has followed outstanding progress since the time that the plan came into force. Hence, the current study investigates the possible impacts of globalization on nuts production in Indonesia. To do so, we applied the non-linear autoregressive distributed lag model (NARDL) to two variables of interest, namely the nuts production and the KOF globalization index for the period 1975-2019. The main findings prove the existence of a long-run equilibrium relationship between the variables of interest. Moreover, the positive shocks to the globalization index have a direct impact on nuts production. In addition, we found evidence of the significant asymmetry between the globalization index and the nuts production in Indonesia, implying the significant difference between the effect of positive and negative shocks to globalization on nuts production.

Introduction

Nowadays, globalization has a growing trend in the economy of various countries and now is one of the most important issues the countries face. With the increasing development of globalization and its

relevant communications and technologies, this trend has been substantially accelerated (Tavakkolnia and Akbarian 2011). Globalization has created economic growth opportunities for many countries all over the world. It has fostered the linkages among countries, which has resulted in demand expansion for the commodities (Liu *et al.* 2020).

The foundation of the World Trade Organization (WTO) in 1995 has been a turning point in international trade history. The WTO's trade agreements insist on trade without unnecessary barriers. According to the WTO's agreements, member countries do not have permission to close their borders to imports originating from other member nations. A well-known economic theorem, namely "trade is the engine of growth" constitutes the core logic behind the above rule. Although, the value of world trade in terms of commodities and services has dramatically increased after the constitution of the WTO, however, some concerns have emerged as well. The main concerns relate to the impacts of the world trade development on the environment, and the uneven distribution of the benefits from world trade expansion between developed and developing nations (Ge and Wu, 2018).

On the other hand, the advocates of globalization and trade liberalization express that the liberalization of trade and foreign export assist the environmental conservation. They argue that, due to the countries' response to competitive pressures caused by globalization and the development of trade liberalization, the use of resources has become more efficient in all sectors, and, consequently, waste of resources, energies, and related pollution has decreased in various countries (You and Lv, 2018).

The Indonesian government has put special emphasis on more integration into the world economy in the national development plans since the late 1980s. The government has designed a package of support policies aiming at the promotion of exports to the regional markets at first, and to other Asian markets at second. The main element in the above policy package is the enhancement of productivity in domestic production processes in the way that Indonesian products can compete with the same products of rival countries in the world markets (Sudaryanto, 2018).

In this regard, new markets have emerged for Indonesia's agricultural products. Nowadays, the number of Indonesian agricultural products sold in the world markets is much more than in the 1980s. Nuts are among those agricultural products whose production has remarkably raised after the implementation of the national development plans (Susanto *et al.,* 2020).

The present study tries to test empirically the validity of the hypothesis on the possible long-run relationship between nuts production and the globalization index in the Indonesian context. To do so, we applied a recently developed time-series model, namely the non-linear autoregressive distributed lag model (NARDL), which section three represents in detail.

The remainder of the paper is organized as follows. The next section reviews relevant literature in the field. Section 3 focuses on the econometric model, data, and source of information. Section 4 presents the results and discusses them. Finally, section 5 concludes and provides some policy.

Literature review

Various studies have dealt with globalization

and its impact on economic growth. Mousavi *et al.* (2013) investigated the impacts of globalization on agricultural output and greenhouse gas emissions (especially CO_2) in Iran over the period 1980-2008. For this purpose, they used the economic openness index given by the ratio of total trade to gross domestic product (GDP). They used a vector autoregressive (VAR) model to examine the relationship between globalization (trade openness) and agricultural growth. Their results indicated a long-run relationship between globalization and other variables.

Bohlooli (2013) studied the relationship between foreign direct investment (FDI), globalization, and economic growth in Iran. They used the ARDL model with time-series data over the period 1978-2008. The results confirmed the existence of a long-run and direct relationship between FDI and globalization.

Shahbaz *et al.* (2015) investigated the impact of globalization on economic growth and environmental quality in India using annual data for the period spanning from 1970 to 2012. To assess the relationship between globalization and CO_2 emissions, they examined the impact of energy consumption, financial development, and economic growth on CO_2 emissions. By estimating the long-run relationship between CO_2 emissions and globalization, they found that the accelerated globalization process led to increasing energy consumption and, consequently, increasing CO_2 emissions.

Kwabena Twerefou *et al.* (2017) studied the environmental consequences of economic growth and globalization in Sub-Saharan Africa over the period 1990-2013. They investigated the impact of economic growth and globalization on environmental quality and sustainability caused by CO_2 emissions for the 36 Sub-Saharan African countries. Using panel data and the Environmental Kuznets Curve, they concluded that globalization had a negative and significant effect on environmental quality and sustainability. They finally recommended that Sub-Saharan African countries should invest in and promote the application of cleaner technologies in the industrial production and transportation system.

Khan *et al.* (2019) examined the impact of globalization on agricultural growth and environmental pollution in Pakistan using a dynamic ARDL model over the period 1971-2016. Their results indicated that innovation directly affected agricultural growth in the long run. However, political globalization, energy consumption, and foreign direct investment positively influenced CO_2 emissions. All the above-mentioned works reported a direct association between globalization and economic growth.

Another group of studies concluded, at least partly, that globalization might lead to lower growth. Shahbaz *et al.*, (2016) investigated the impact of globalization on economic growth and energy consumption through the estimation of the Environmental Kuznets Curve for 19 selected African countries over the period 1971-2012. They used the panel ARDL model to examine the long-run association of variables. The main findings indicated that globalization had a positive effect on economic growth in Algeria, Angola, Cameroon, the Republic of Congo, Ghana, Kenya, Libya, Morocco, Nigeria, South Africa, Sudan, Togo, and Tunisia. However, this variable has negatively affected the economic growth in Zambia and Zimbabwe, i.e., globalization led to decreasing real output growth in these countries.

You and Lv (2018) investigated the effects of

globalization on economic growth and CO_2 emissions using a spatial panel approach for 83 countries over the period 1985-2013. Their results showed that not only spatial correlations exist in CO_2 emissions among neighboring countries but also the indirect effect of globalization on economic growth is negative at the high significance level. However, some minor direct impacts are weakly positive. Accordingly, they concluded that the overall impact of globalization on economic growth is negative.

By reviewing the literature, we recognized the third group of studies reporting mixed results regarding the impact of globalization on economic growth. Lin and Xu (2018) analyzed the factors affecting agricultural growth in China using quantile regression. They considered differences in agricultural production, population, economic growth, financial capacity, industrialization, and urbanization level over the period 2011-2015. For this purpose, they classified the information collected for more than 30 Chinese provinces according to average agricultural production level into six quantiles, including lower 10th, 10th-25th, 25th-50th, 50th-75th, 75th-90th, and upper 90th. Then, they estimated the model using quantile regression and the ordinary least squares method. The main results indicated that globalization had more impact on agricultural production in the upper 90th and 75th-90th quantile provinces, compared with other provinces.

They attributed this result to the differences in the agriculture and investment processes. On the other hand, agricultural productivity had more effect on upper 90th, 75th-90th, and 50th-75th quantile provinces, compared with 25th-50th, 10th-25th, and lower 10th quantile provinces. They also attributed the reason for this result to the high

difference in budgeting and investment in R&D. Moreover, they found that the impact of urbanization on agricultural growth in upper 90th quantile provinces was higher than that in other provinces, mainly due to agricultural mechanization and human capital accumulation. Similarly, financial capacity affected upper 90th quantile provinces more than other provinces due to foreign investment. Finally, they recommended studying the heterogeneous effects of different driving forces in an analysis of China's agricultural growth.

Hipolito Leal and Cardoso Marques (2019) aimed at identifying the possible effects of globalization on agricultural productivity. They considered 25 European countries over the period 1990-2016 and classified the countries into two groups, namely low globalized and high globalized, using the de facto and de jure measures provided by KOF Swiss Economic Institute. Then, they analyzed energy consumption, output growth, and productivity using an ARDL model. The results indicated that globalization strongly affected agricultural productivity in some countries. The social dimension of globalization was detrimental to the environment, while the political dimension did not show an unfavorable impact. Moreover, in high-globalized countries, agricultural productivity showed significant changes. Also, agricultural productivity made a negative impact on CO_2 emissions in most countries.

Table 1 provides the summary of the literature review. As is clear, we could not find any study in the context of Indonesian agriculture. In addition, we could not find the application of the NARDL model, which has the capability of examining the impact of positive and negative shocks of independent variables on the dependent variable, in the assessment of the impact of globalization on

agricultural growth.

Table1. Summary of literature review.

Researcher(s)	Year	Region	The effect of globalization on economic growth
Mousavi *et al.*	2013	Iran	Positive
Bohlooli	2013	Iran	Positive
Shahbaz *et al.*	2015	India	Positive
Kwabena Twerefou *et al.*	2017	Selected African countries	Positive
Khan *et al.*	2019	Pakistan	Positive
Shahbaz *et al.*	2016	Algeria, Angola, Cameroon, …	Positive
Shahbaz *et al.*	2016	Zambia and Zimbabwe	Negative
You and Lv	2018	Selected countries	Negative
Lin and Xu	2018	China	Mixed
Hipólito Leal and Cardoso Marques	2019	Selected European countries	Mixed

Materials and Methods

Econometric model

As an alternative to the co-integration model, which has widely been applied by different researchers for examining the long-run relationship among variables during the last four decades, Pesaran and Pesaran (1997), Pesaran and Shin (1998), and Pesaran *et al*. (2001) proposed a new model called autoregressive distributed lag (ARDL) with greater capabilities. In this model, one may treat variables with different integration orders for detecting long-run equilibrium association. In addition, by using ARDL, one can detect short and long-run relations at the same time. The general form of the ARDL (p,q) model for the current study is as follows:

$$NP_t = \mu + \sum_{j=1}^{p-1} \alpha_j NP_{t-j} + \sum_{j=0}^{q-1} \beta_j G_{t-j} + \varepsilon_t \quad (1)$$

Where NP is nuts production in tonnes, and G is globalization index. μ is the feedback coefficient, α_j, and β_j are coefficients to be estimated and ε_t is the co-integrating residual. All variables might be used in the natural logarithm. The model (1) can be rewritten using the lag operator as:

$$C(L)NP_t = \mu + B(L)G_t + \varepsilon_t \quad (2)$$

Here, L denotes the lag operator, which is as follows for the ARDL (p,q) model:

$$C(L) = 1 - \alpha_1 L + \alpha_2 L^2 + \cdots + \alpha_p L^p \quad (3)$$

$$B(L) = \beta_0 - \beta_1 L + \beta_2 L^2 + \cdots + \beta_q L^q \quad (4)$$

In this model, the optimal lag, i.e., p and q, is determined using common criteria including Akaike Information Criterion (AIC), Schwarz Bayesian Criterion (SBC), and Hannan-Quinn Criterion (HQC) (Sarrafi Zanjani and Mehregan 2018., Tang *et al.* 2020). The asymmetric co-integration approach proposed by Shin and Greenwood-Nimmo (2014) applies a non-linear autoregressive distributed lag (NARDL) model, which its structure is derived from the ARDL model. The NARDL is non-linear since it decomposes each explanatory variable into two different terms, one that cumulatively sums positive changes, and the other one that cumulatively sums negative changes. As a result following equation, which is a non-linear error correction model (ECM) derives:

$$\Delta NP_t = \rho\xi_{t-1} + \sum_{j=1}^{p-1} \alpha_j \Delta NP_{t-j} +$$
$$\sum_{j=0}^{q-1}(\beta_j^+ \Delta G_{t-j}^+ + \beta_j^- \Delta G_{t-j}^-) + \varepsilon_t \qquad (5)$$

The superscripts "+" and "-" indicate the positive and negative changes in the globalization index, respectively. The short-run coefficients differ for positive and negative changes, and ξ is the co-integrating residual obtained from Eq. 6:

$$\xi_t = gG_t - \beta_1^+ G_t^+ - \beta_1^- G_t^- \qquad (6)$$

Here again, a "+" and "-" over the variables indicates the partial sum of its positive and negative changes, respectively as follows:

$$G_t^+ = \sum_{j=1}^{t} \Delta G_t^+ = \sum_{j=1}^{t} max(\Delta G_j, 0); G_t^- =$$
$$\sum_{j=1}^{t} \Delta G_t^- = \sum_{j=1}^{t} min(\Delta G_j, 0) \qquad (7)$$

By definition, the value of variables G at time t equals the sum of its initial value and the positive and negative partial sums:

$$G_t = G_0 + G_t^+ + G_t^- \qquad (8)$$

In the common ECM model, the reactions to a positive or a negative shock are exactly symmetric, but the NARDL model permits for asymmetric responses i.e., different short-run and long-run elasticities. In other words, it is possible to estimate different dynamic coefficients following a positive or a negative shock to each explanatory variable. Following Pesaran *et al*. (2001) estimation of NARDL, as well as the bounds testing for the existence of a long-run asymmetric relation between the variables, are performed in the following unrestricted ARDL parameters function (Ge and Wu 2018).

$$\Delta NP_t = \rho g_{t-1} + \theta_1^+ G_t^+ + \theta_1^- G_t^- +$$
$$\sum_{j=1}^{p-1} \alpha_j \Delta NP_{t-j} + \sum_{j=0}^{q-1}(\beta_j^+ \Delta G_{t-j}^+ + \beta_j^- \Delta G_{t-j}^-) +$$
$$\varepsilon_t \qquad (9)$$

Data

To test the hypothesis of the research, we considered the nuts production and the globalization index for Indonesia over the period 1975-2019. We extracted the nuts production data from Indonesia's Ministry of agriculture publications. The information regarding the KOF globalization index is extracted from the KOF Swiss Economic Institute databases. Table 2 provides the summary of the variables.

Table 2. Definition of variables.

Variable	Symbol	Definition	Unit
Nuts production	NP	Total nuts production	tonne
Globalization	G	KOF globalization index	-

Results

Evolution of variables

Figs 1 and 2 depict the trend of variables of interest. Fig. 1 depicts the evolution of nuts production in Indonesia over the period 1975-2019. Because of export promotion policies and incentives provided by the government, nuts production has soared from 9122 tonnes in 1975 to more than 243336 tonnes in 2019. Hence, Indonesia has become a leading nuts exporter in Southeast Asia.
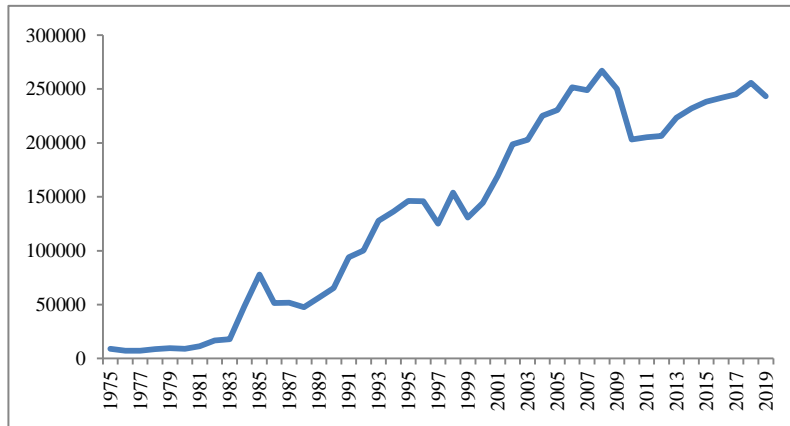
Fig.1. Nuts production in Indonesia during 1975-2019 (tonnes)

Although the periods in Figs. 1 and 2 are a bit different, a simple examination of them reveals a nearly similar trend between the two variables (as expected). The similarity of the observed trend in nuts production and the globalization index, along with the theoretical background stated before, constitutes the hypothesis of the research.
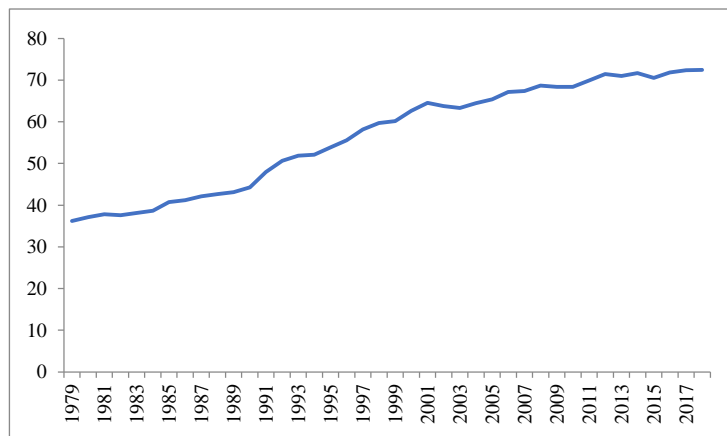

Fig. 2. Trend of Indonesia's globalization index.

Unit root test

It is important to examine the stationarity of variables before estimating the model as the main assumption in using NARDL is that all variables must be integrated of orders zero (I (0)) and one (I (1)). Here, the Augmented Dickey-Fuller and Phillips-Perron tests, which are widely used in assessing stationarity, are applied. Tables 3 and 4 present the results.

Table 3. Augmented Dickey-Fuller test result.

Variable	ADF statistic			
	Level		First difference	
	t-statistic	Result	t-statistic	Result
G	0.423	Non-stationary	-4.23***	Stationary
NP	-1.145	Non-stationary	-5.12***	Stationary

*** Denotes significance at 1% level

Table 4. Phillips-Perron test result

Variable	PP statistic			
	Level		First difference	
	t-statistic	Result	t-statistic	Result
G	-0.19	Non-stationary	-5.79[***]	Stationary
NP	-1.47	Non-stationary	-8.12[***]	Stationary

*** Denotes significance at 1% level

Tables 3 and 4 show that the integration order for two variables is one. Therefore, we proceed to the next step and estimate our model.

Model estimation results

The NARDL model presented in equations (5) to (9) is estimated using 45 observations over the period 1975-2019. STATA, the professional econometric software, is used in conducting all tests and estimations. The computed F-statistic (an indicator of the overall significance of the estimated model) confirmed that the independent variable (G) well explains the variation of the dependent variable (NP) as the F-statistic is significant at the 95% significance level. In other words, we found evidence of the existence of asymmetric co-integration among variables meaning that nuts production (NP) and globalization (G) for Indonesia's economy have an asymmetric long-run relationship. So, two variables of interest tend to move together in long run.

To examine the adequacy of the estimated model, three common tests are applied (Table 5). The Breusch-Pagan test, which examines possible variance heteroscedasticity in the residuals of the model shows that there is not enough evidence for

the rejection of the null hypothesis of variance homoscedasticity. The estimated model is well-specified and there is no model specification error since the Ramsey RESET test statistic is highly significant. Finally, the Jarque-Bera test result confirms the normal distribution of residuals, as the test statistic is not significant at the 5 percent significance level. Moreover, the value of the F-statistic taken by the co-integration test is 16.51 indicating the existence of a co-integration relationship between two variables over the period 1975-2019.

Discussion

It is confirmed that globalization has an asymmetric association with nuts production in the long-run and short-run (Table 6). This finding implies that a given percentage (say 10 percent) of positive and negative shock by globalization leads to different responses from nuts production. From the policy-making point of view, it would be of great importance if the exact magnitudes of the impacts are available. So, we estimated these important parameters at the next stage. Tables 7 and 8 portray the results.

Table 5. Diagnostic tests result

Hypothesis to be tested	Test applied	Statistic	Probability
Homoscedasticity	Breusch-Pagan	0.32	0.52
Specification Error	Ramsey RESET	1.11	0.33
Normality	Jarque-Bera	1.30	0.25

Table 6. Symmetry test result

variable	Short-run		Long-run	
	F-statistic	Probability	F-statistic	Probability
G	18.29	0.00	9.35	0.02

Table 7. Long-run coefficients estimate

Variable	Positive shock			Negative shock		
	Coefficient	F-statistic	Probability	Coefficient	F-statistic	Probability
G	0.24	15.72	0.00	-0.39	6.12	0.03

Table 8. Short-run coefficients estimate.

Variable	Coefficient	Std.Error	t-statistic	Probability
NP_{t-1}	-0.31	0.03	-10.33	0.00
G^{+}_{t-1}	0.05	0.11	0.45	0.27
G^{-}_{t-1}	-0.11	1.05	-0.10	0.43

***

It is expected that a one percent positive shock to globalization would lead to a 0.24 percent increase in nuts production in the long-run. It is a theoretically consistent claim since a more globalized economy the inflow of capital into Indonesia would increase, modern technologies would be easily accessible to farmers, and, therefore, nuts production would increase. On the other hand, a one percent negative shock to globalization indirectly affects nuts production. Our findings predict that a one percent negative shock to globalization, on average, would lead to a 0.39 percent decrease in nuts production. It is noteworthy that the negative shock brings a detrimental impact on the nuts industry. Thus, it recommends that the Indonesian officials should prevent any action hindering the economy from getting more involved in the world economy. These

results are in line with those obtained by You and Lv (2018) and Shahbaz *et al*. (2016) in the context of Zambia and Zimbabwe. Works conducted by Lin and Xu (2018), Omokpariola *et al*. (2021), Chupradit *et al*. (2021), Umapathi and Natarajan (2020), and Moghaddasi and Anousheh Pour (2016) have reported the same findings.

One of the unique features of the NARDL is that in addition to long-run effects, one can estimate short-run impacts on the dependent variable for each covariate. The short-run effect might be similar to or different from its long-run counterpart. Table 8 shows the summary of the short-run effects. A positive shock to the globalization index has a positive, but insignificant relationship with nuts production in the next year. It is an expected result since an increase in nuts production (intensive or extensive) can take place after a couple of years.

Moreover, a negative shock to globalization indirectly affects nuts production in the short-run, though this effect is insignificant at the conventional significance levels.

Therefore, we conclude that positive shock to globalization has been a driver of nuts production in Indonesia in the period under study. Ease of access to new technologies and emergence of new markets for Indonesia's nuts are the main achievements of more integration into the world economy granted by globalization. These are in line with those reported by Asadikia *et al.* (2009), Moghaddasi and Anousheh Pour (2016), and Khan *et al.* (2019).

Conclusions

Indonesia has experienced an increasingly nuts production growth (despite some exceptional years) during the last five decades naming it an emerging Southeast Asian nuts exporter. This is, to some extent, due to more engagement of the national economy in the world economy, which is called globalization. This global phenomenon has raised national welfare for the Indonesian nuts producers. It has also increased the export earnings from the agriculture sector. To test the possible association between globalization and nuts production in Indonesia, the present study applied the recently developed NARDL model to the data over the period 1975-2019. Both the short-run and the long-run effects of globalization on nuts production are estimated.

Overall results reveal the significant co-integration relationship between globalization and nuts production through the considered period. We found significant asymmetry in the impact of globalization on nuts production as positive and negative shocks of the same size to globalization

lead to significantly different responses by the nuts production. A positive shock to globalization increases nuts production, while a negative shock to globalization causes a fall in nuts production.

The Indonesian officials are recommended to follow a twofold policy program. While trying to boost economic growth, production efficiency, the competitiveness of the domestic products, export to international markets, and all other activities creating more welfare for the society, they must pay special attention to possible adverse impacts of globalization, especially in terms of environmental protection. They should arrange their growth strategies for the whole economy in general, and in agriculture in particular, in a way compatible with sustainability. To do this, productivity enhancement is a core policy leading to more production from each unit of natural resources, including water and land. Provision of non-price incentives along with education on good agricultural practice (GAP) to the nuts growers is a key policy in the development of nuts production in a sustainable manner. In other words, the Indonesian agricultural authorities should prevent extra pressure on natural resources and the environment.

Conflict of interest

The authors declare they have no conflict of interest.

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