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Do Foreign Grants and Capital Formation Indeed Impact Economic Growth? An Empirical Evidence from Bangladesh

K M Saemon Islam and Gautam Kumar Biswas

ABSTRACT

The paper examined how the growth of the foreign grants and the growth of gross fixed capital formation impact the growth of GDP in Bangladesh. We studied the relationships between those variables for a period spanning between 1983 and 2017. The Johansen cointegration test indicated that there is a long-run relationship between the variables. Therefore, by employing a vector error correction model (VECM), we found that previous year's divergence between the variables adjusted by 69% in the following year. The study also found that both foreign grants, and the gross fixed capital formation had a positive impact on GDP growth in Bangladesh.

Keywords: Cointegration, Economic Growth, Error Correction Model, Foreign Aid.

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I. Introduction

For the last few decades, Bangladesh achieved a robust economic growth. Experts and policy makers considered several factors behind this astonishing growth, namely the demographic dividend, the ready-made garment (RMG) export earnings (Jiban *et al.*, 2022), resilient remittance inflows (Islam, 2022), and stable macroeconomic conditions. Among other factors foreign aid and grants also plays a massive role in economic development of Bangladesh. Official development assistance (ODA) is that kind of transfers which contributes to economic development and wellbeing in the recipient country. The key objective of much of the aid inflows to developing countries such as Bangladesh is stimulating economic growth and reducing poverty. However, the topic of foreign aids and grants has sparked numerous economic debates regarding their effectiveness. Both in macroeconomics and development economics, this led to studies being conducted in understanding their impact on a growing economy. On the other hand, the net investment or the gross fixed capital component of an economy has theoretically been proven to be an integral component of the total output. We examined the relationships between the GDP growth of Bangladesh, the growth of the grant received, and the growth of the capital contribution in our paper.

The paper has the following sections: Section II reviews the existing literatures in understanding the current state of studies as well as the impacts of the potential variable to our model. Section III specifies the econometric model, whereas Section IV presents a summary statistic of the data along with sources. Section V and Section VI represents the empirical results and diagnostic test's results respectively. Finally, Section VII shows the forecasting of the growth of the GDP of Bangladesh for future periods.

II. Literature Review

Foreign aid could be used to minimize the savings constraints of a country (Papanek, 1973). Chenery and Strout (1967) developed a "two-gap" model, which was an extended version of the Harrod-Domar model. This model suggested that developing countries are most likely to face two constraints, namely saving constraints and foreign exchange constraints to attain economic growth. Foreign aid can contribute to economic growth by minimizing these two constraints if countries are not able to fill these gaps. Aid can be utilized to increase the capital stock is the underlying assumption of this model (Chenery & Strout, 1967; Hansen & Tarp, 2001). In addition to these two gaps, Bacha (1990) added a third gap-the fiscal gap in this model, which also impede the growth of developing countries. It is obvious that all these pieces of literature assumed that aid could be used to increase the capital stock.

Many studies found a positive association between foreign aid and economic growth (Gounder, 2001; Hansen & Tarp, 2001; Mitra, 2013), while some studies found a negative relationship between them (Mallik, 2008; Mitra & Hossain, 2013). On the other hand, Bird & Choi (2020) didn't find any significant effect of foreign aid on economic growth. Thus, the effect of foreign aid on economic growth varies depending on the countries' specific condition.

Tahir *et al.* (2019) analyzed the effects of foreign aid, trade flows, foreign direct investment, foreign debt, and remittances on the economic growth in SAARC countries. The study found that foreign aid and foreign direct investment had a positive impact on economic growth, while external debt and trade flows had a negative impact on economic growth in the region. They also revealed that remittances had no connection with economic growth.

Das & Sethi (2020) assessed the relationship between foreign direct investment (FDI), foreign aid, and remittances on Indian and Sri Lankan's economic growth. The study found that foreign direct investment and remittances had a positive impact Indian economic growth, which were statistically significant. Whereas in Sri Lanka foreign aid and remittances had played a significant role in augmenting economic growth. Asteriou (2009) investigated the long-run relationship between foreign aid and GDP growth in five South Asian countries and found that these variables had a positive relationship between them.

Marwan *et al.* (2013) studied the relationship between export, overseas development aid (ODA), remittance inflows and economic growth in Sudan from 1977 to 2010. The study showed that export earnings and remittance had a positive impact on economic growth, while foreign aid had a negative impact on economic growth in Sudan in the long run.

Kaosar and Idrees (2010) examined the relationship between foreign aid and economic growth in seven South Asian countries. The study revealed a positive association between foreign aid on economic growth, but as the country receives more foreign aid, this effect decreases.

Mitra (2013) conducted a study to estimate the effect of foreign aid on Cambodia's economic growth. The author found that there was a positive relationship between overseas aid and economic growth, while a negative relationship between openness to trade and economic growth in Cambodia. By using data of 48 countries from 1970 to 1998, Moreira (2005) found that in 48 developing countries, foreign aid contributed positively on economic growth. The author also revealed that foreign aid contributes more effectively in the long-run.

Mallik (2008) studied the relationship between foreign aid and economic growth in the six Sub-Saharan African countries. The author found a long-run relationship between per capita GDP, foreign aid, and openness. The growth rate of foreign aid had a negative effect on the growth rate GDP per capita in the long-run in five countries, while in the short-run, apart from Niger, the growth rate of foreign aid had no substantial effect on the growth per capita GDP in these countries.

Feeny (2005) studied the nexus between foreign aid and economic growth between 1965 to 1999 in Papua New Guinea (PNG). Although the study found that total foreign aid had no effect on economic growth, but when the country undertook World Bank's Structural Adjustment Program, aid had a small positive effect on economic growth during the period. The author also suggested that disaggregation of foreign aid is important for its effectiveness.

III. Theoretical Framework and Model Specification

Focusing on developing a theoretical understanding of economic growth, we primarily concentrated on the Solow-Swan neoclassical growth model (Solow, 1956). The Model is an exogenous economic growth model that examines changes in an economy's output level over time due to variations in population growth rate, savings rate, and technological advancement. The production function in the growth model is expressed as follows:

$$Y = F(A, K, L) \tag{1}$$

where K = Capital,
L= Labor, and
A = Labor-augmenting technology or total factor productivity (TFP).

As we understood from (1), according to the model, the total output could be expressed as a function of capital, labor, and technological advancement impacting production. Here, the production would exhibit a constant return to scale and positive (diminishing) marginal returns to inputs. Following a Solow residual from Solow (1956), we then focused on expressing the growth rate of total output as a factor of the rate of capital growth, labor growth, and the growth rate of TFP.

Early empirical studies explained the relationship between the growth of GDP and exports by incorporating exports in the production function.

In contrast, Biswas and Islam (2022) used the growth rate of export as a proxy of economic growth and explored its relationship with the GDP growth rate of its largest trading partner, the US. For our study, however, we focused on using the growth rate of GDP as an indicator of economic growth. As the empirical literature suggests, the savings rate impacts capital formation in an economy. Similarly, exogenous endowments (e.g., foreign grants) lead to a deepening capital base, while simultaneously impacting the productivity of the labor force.

Consequently, the aggregate production function can be written as following:

$$Y = F(grant, cap) \tag{2}$$

Subsequently, we considered the logarithm of the variables to isolate each one's effects by expressing them in an additive way as the following:

$$l\_gdp_t = \alpha_0 + \alpha_1 * l_{grant_t} + \alpha_2 * l_{cap_t} + \mu_t \tag{3}$$

where,
l_gdp= log of GDP,
l_grant=log of the total grant received,
l_cap= log of capital formation to GDP, and
μ = error term.

Following Bacha (1990) and Mallik (2008), we also assume that foreign grant can be used to increase domestic savings, which ultimately can be used as an investment. Therefore, we have used the extended version of the model to determine the effectiveness of foreign aid in Bangladesh. As we aim to model the relationship between GDP growth and the growth in grants received, from an economic understanding, we would expect the former to hold a positive relationship with the latter. Therefore, from an econometric standpoint, we expect our explanatory variable (l_grant) to have a positive coefficient.

Similarly, based on the economic perspective, we would expect the gross fixed capital formation, or the investment component (defined as the acquisition of fixed assets) to have a positive relationship with the GDP. This is because, in all likelihood, the amount of capital formation should lead to a larger output for a growing economy like Bangladesh. Consequently, we can expect the growth rates of those two variables to hold a positive relationship too. Therefore, we would expect the explanatory variable l_cap to produce a positive coefficient too.

IV. Data and Software

For our study, we obtained the data related to the gross fixed capital formation from the databank of the International Monetary Fund (IMF). The GDP data of Bangladesh was collected from the World Bank's data bank. We gathered the data of the total grants received by Bangladesh from the databank of the Organization for Economic Co-operation and Development (OECD). For analyzing data, we used the statistical software called Gretl.

The summary statistics of the variables is shown in Table I.

TABLE I: Summary Statistics

Particulars	Variables		
	l_gdp	l_grant	l_cap
Mean	24.767	6.8988	13.464
Median	24.701	6.8834	13.441
Minimum	23.592	6.4582	11.407
Maximum	26.244	7.5886	15.692
Standard Deviation (SD)	0.73695	0.25795	1.2537

V. Empirical Results

A. Unit Root Tests

As a prerequisite for our econometric operations, we check for stationarity in our dataset. For this purpose, we performed the Augmented Dickey-Fuller (ADF) test both on levels and first differences. Table II shows the results of ADF tests of the variables.

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TABLE II: ADF TEST

Variable	Parameter	ADF Statistics	Asymptotic P-Value	Decision
l_gdp	Level	-0.436044	0.982	I(1)
	First diff.	-5.12008	0.001058	
l_grant	Level	-3.48289	0.05695	I(1)
	First diff.	-9.14324	1.986e-010	
l_cap	Level	-0.516476	0.9829	I(1)
	First diff.	-4.96437	0.0002119	

H_0: the variable has a unit root
Testing with constant and trend, down from 9 lags, criterion AIC

As evident from the table above, ADF tests show that at levels the variables are non-stationary. However, after taking first differences, the variables become stationary. Hence, the variables are integrated of order one.

B. Lag Length Selection Criteria

To identify the lag-lengths to run a VAR model as well as to check for probable cointegration between the variables, we go through the VAR lag-length selection process. The result of lag length selection is presented in Table III below.

TABLE III: LAG LENGTH SELECTION CRITERIA

lags	AIC	BIC	HQC
1	-8.919231	-8.245836*	-8.689584*
2	-8.914135	-7.836704	-8.546700
3	-9.088752*	-7.607285	-8.583529

As we understand, the lag that produces the lowest value would produce the optimum results in terms of our lag-length selection. The determining criterion for our selection is the Akaike Information Criterion (AIC). As stated in the table above, the recommended lags for a potential VAR model is a lag of 3.

C. Cointegration Tests

To determine whether to employ a VAR or an error-correction model, first, we need to check for any potential cointegration between the variables. Cointegration among the variables would indicate that the variables move together in the long run. Therefore, to produce a thorough examination of the relationships between the variable, we perform the Engle-Granger (Engle & Granger, 1987) and the Johansen test (Soren, 1988) in this section.

1) Engle-Granger test

As per the findings of Engle and Granger (1987) , we check for any probable stationarity of the residuals to identify cointegration. Table IV presents the results of the test.

TABLE IV: ENGLE-GRANGER TEST

Unit-root $H_0: a = 1$ Model: (1-L)y = (a-1)*y(-1) + e	Estimated value of (a - 1): -1.33025 Test statistic: tau_c(3) = -4.80553 The p-value 0.00614

As we can see from Table IV, we able to reject the null hypothesis 1% significance level. Therefore, the Engle-Granger test indicates that at least one cointegrating relationship exists between the variables.

2) Johansen Cointegration test

As the Engle-Granger test indicated that there is a cointegrating relationship between the variables, we check for the rank of cointegration (Soren, 1988). As our VAR lag-length selection found the optimum lag to be 3, for this Johansen test, we use the lag of 2 (i.e., p-1). The results of the test are shown in Table V.

TABLE V: JOHANSEN COINTEGRATION TEST

Rank	Trace Test		λ_{max} Test	
	Test stat	p-value	Test stat	p-value
0	39.384	0.0154	30.443	0.0051
1	8.9417	0.5927	8.3116	0.5755
2	0.63002	0.4273	0.63002	0.4273

As evident from the test statistics and the corresponding p-values, both the Trace test and the Eigenvalue test (λ_{max}) reject the H_0: $Rank$ 0 at a 5% significance level. In contrast, for rank 1, the tests fail to reject the null hypothesis. Hence, there is indeed a long-run relationship between the variables. After renormalizing the vector, the long-run relationship becomes (4).

$$l\_gdp = 0.059035 \times l\_grant + 1.8263 \times l\_cap \tag{4}$$

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Based on (4), we see that the growth of the GDP of Bangladesh indeed has positive relationships with the growth of the amounts of the grant received and the growth of the capital contribution to the GDP. The relationship between an increase in the l_grant and $l_gdp$is an inelastic one. However, in contrast, the long-run relationship between an increase in the l_cap and $l_gdp$appears to be significantly elastic, with the coefficient proving to be considerably larger than unit-elasticity.

D. Vector Error Correction Model (VECM)

Based on the findings of the cointegration tests, we estimated an error-correction specification. Under the conditions of error correction, the variables would correct their short-run divergence by returning to their equilibrium, where the correction term would indicate the rate of correction in the corresponding period. Theoretically, we would expect the correction term to possess a negative sign indicating a convergence.

Additionally, the amount of grant received, and consequently, the growth of grant shows an outlier amount for the year of 2008. So, to account for the outlier as well as for the normality conditions integral for the forecasting capabilities of our model, we add an observational dummy ($D08$) for the year of 2008 to our model. Furthermore, a closer inspection of our time series indicates a probable presence of a time trend in the short run.

Accounting for the observational outlier and the presence of a potential time trend, our error-correction model essentially becomes (5).

$$\Delta l\_gdp = \alpha_0 + \sum_1^n \alpha_{1\,i} \times \Delta l\_gdp_{t-i} + \sum_1^n \alpha_{2\,i} \times \Delta l\_grant_{t-i} + \sum_1^n \alpha_{3i} \times \Delta l\_cap_{t-i} + \alpha_4 \times D08 + \alpha_4 \times time + \alpha_6\, EC_{t-1} + \mu_t \tag{5}$$

Where,EC_{t-1}= the error correction term.
Table VI presents the results of the VECM.

TABLE VI: VECM ESTIMATION

Variables	Coefficient	Std. Error	t-ratio	p-value	Significance
α_0	2.06995	0.703973	2.940	0.0065	***
$d\_l\_gdp\_1$	0.285363	0.178448	1.599	0.1210	-
$d\_l\_grant\_1$	−0.0242083	0.0409092	−0.5918	0.5588	-
$d\_l\_cap\_1$	0.258559	0.473128	0.5465	0.5891	-
$D08$	0.0239189	0.0494934	0.4833	0.6327	-
$time$	−0.104955	0.0353979	−2.965	0.0061	***
EC_{t-1}	−0.691158	0.230393	−3.000	0.0056	***
R-squared				*0.424106*	
Adjusted R-squared				*0.300701*	
Durbin-Watson				*1.857924*	
*Note: *** denotes significance at 1% significance levels*					

The results of our model under the error-correction specification show that as we theorized, the correction term EC_{t-1} indeed holds a negative sign. The term is also statistically significant at a 1% significance level). This essentially indicates that the specifications of our model under the error-correction conditions indeed hold. As far as the rate of correction is concerned, the coefficient of EC_{t-1} state it for the corresponding period. As we observe from the table above, the coefficient of −0.691158 denotes that the variable converges at a rate of around 69.12% to the equilibrium in the period after the disequilibrium.

In regard to the other variables, we see that in the short run, the intercept and the time trend are statistically significant at a 1% significance level. This shows that the lagged values of the change in l_gdp, l_grant and $l_cap$are not statistically significant in the short run. However, as we expected and found out, their convergence happens at a significant rate by correcting the divergence. The observational dummy does not appear to be statistically significant in our model. In contrast, the inclusion of the time trend is proven to be statistically highly significant.

The primary diagnostic indicators of our model indicate it to be relatively free from serial correlation with a Durbin-Watson value of 1.857924. However, in the next section, we perform additional specific diagnostic reviews to check the robustness of our model.

VI. DIAGNOSTIC TESTS

In this section, we perform diagnostics to whether there exists any problem of conditional heteroskedasticity, serial correlation, and non-normality.

A. Autoregressive Conditional Heteroskedasticity (ARCH) Test

LM test can be used to test for Autoregressive Conditional Heteroskedasticity (ARCH) effects (Engle, 1982). The results of the test are presented in Table VII.

TABLE VII: ARCH TEST

Lag	LM	p-value
1	49.485	0.0666
2	77.648	0.3036

As evident from the table above, for both lags at a 5 % significance level, the test fails to reject the null hypothesis (H_0: $No\ conditional\ heteroscedasticity$). Therefore, it proves that our model is free from the problem of conditional heteroscedasticity.

B. Serial Correlation Test

Although our preliminary observation of a Durbin-Watson value of 1.857924 points to an insignificant presence of serial correlation in our model, here we check the Rao F statistics to rule out any serial correlation in our model. The table below summarizes the results:

TABLE VIII: RESULT OF SERIAL CORRELATION TEST

La	Rao F	p-value
1	1.632	0.1254
2	1.404	0.1601

As the results show, for both lags, the Rao F statistics fail to reject the null hypothesis (H_0: $No\ serial\ correlation$) even at a 10 % significance level. Therefore, as expected from the Durbin-Watson statistic, this model does not suffer from the presence of any serial correlation.

C. Normality Test

The presence of a non-normality would hurt the forecasting abilities of our model. Therefore, as proposed by Doornik and Hansen (2008), we conduct the Doornik-Hansen test for multivariate normality to check for the presence of a potential non-normality in our model. The results of the test are presented in Table IX.

TABLE IX: RESULTS OF DOORNIK-HANSEN TEST

Test Stat	p-value
Chi-square(6) = 10.4201	0.1080

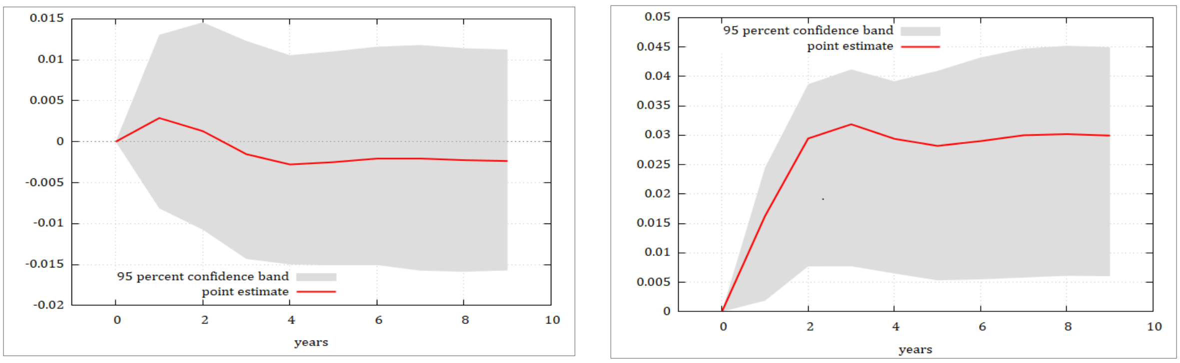
As apparent from the results presented in the table above, the Chi-square test statistic of 10.4201 with a p-value of 0.1080 fails to reject the null hypothesis at a 10% significance level. Based on the results of the test, we can conclude that our model does not appear to suffer from a non-normality.

VII. FORECASTING

In this section, we center our discussions on the impulse responses to shocks and the forecasting of l_gdp over the subsequent periods.

A. Impulse Response Functions

We check for the impulse responses to identify the impact of one standard deviation shock to a variable to our model. The responses are presented graphically in Fig. 1a and 1b.



(a) (b)

Fig. 1. Impulse Response Functions of l_gdp (with 95% Confidence Band): a) Response of l_gdp to a shock in l_grant, with Bootstrap Confidence Interval; b) Response of l_gdp to a shock in l_cap, with Bootstrap Confidence Interval.

Fig. 1a and 1b show that a shock in l_grant is of a short-run nature, while a shock to thel_cap is of a long-term one on l_gdp. The initial response of l_gdp to a shock to$l_grant$is positive, but after the third period, it becomes and stays negative. In contrast, the response of l_gdp to a shock to l_cap is of a positive nature and stays positive in the longer term.

B. Forecasting of the Growth of GDP

The normality check and other diagnostic tests indicate that our model is indeed a good fit for forecasting the growth in the GDP of Bangladesh. Therefore, we forecast the growth of GDP for next five periods. Fig. 2 shows the forecasted growth in the GDP of Bangladesh between 2018 and 2022. By superimposing our model on the preceding in-sample timeline, we graphically illustrate the fit of our model in Fig. 2.

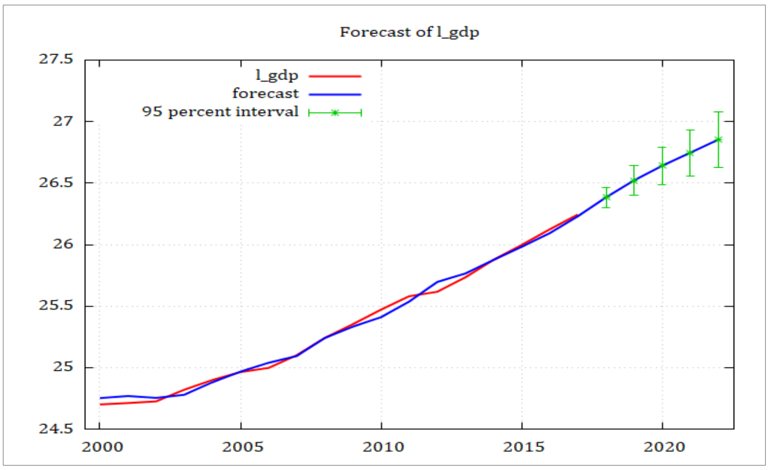


Fig. 2. Forecast of l_gdp for 2018-2022 (Including Fitted Values for Pre-forecast Range)

Based on our forecasting, we would expect the GDP of Bangladesh to grow at a steady rate in the subsequent periods with the prevailing conditions holding in the economy. However, the rate of growth appears to slow down marginally approximately from the year 2020.

VIII. Conclusion

In this paper, we focused on examining the impact of foreign grants and the gross fixed capital formation (i.e., net investment) on the total output. Our primary objective has been to understand the relationships in the movements between the growth rates of those macroeconomic variables. We obtained the data from the databanks of the IMF, World Bank, and OECD and studied the movement of the variable occurring between 1983 and 2017 for a period of 35 years.

After ensuring the non-stationarity, the precondition to econometric analyses, we proceeded to observe whether the variables in question would move together. For robustness, we employed both the Engle-Granger test and the Johansen test to examine whether the variable moved together in the long run as well as to identify to what rank they were cointegrated. As both tests mentioned above indicated a long-run relationship did exist between the variables, we proceeded to identify their long-run movement as well as the short-run ones in case of divergence.

Based on the findings of the cointegration tests, we employed a multivariate model with an error-correction term. In addition to the variables in question, we incorporated an observational dummy and the time-trend, which proved to be statistically highly significant. The model passed diagnostic reviews for any potential serial correlation, ARCH, and non-normality. The error-correction rate exhibited that if disequilibrium occurred in the preceding period, the adjustment occurred in the period in question towards the equilibrium at a rate larger than 69%. This rate was highly significant both from the statistical and the economic standpoint, as it signified that the convergence between the variables occurred at a substantial rate.

As far as the long-run relationships between the growth of GDP of Bangladesh and foreign grants and the gross fixed capital formation were concerned, we found out that there were positive relationships between them. This means, if there was a growth in the amounts of the grant received, the growth in the total output would be impacted positively. Similar relationships were found to be true between the growth in the gross fixed capital formation and the growth in Bangladeshi GDP. However, this relationship appeared to more than unit-elastic, unlike the other one.

As our model passed all the rigorous diagnostic tests, we proceeded to understand the impact of innovations (shocks) on a particular variable before moving on the forecasting. From the impulse response functions, we discovered that the effect of a shock to the growth of the gross fixed capital formation is of a long-run nature on the growth of the GDP. Subsequently, our forecasting showed that the GDP of Bangladesh should grow at a steady rate in the periods following our study, with the growth marginally slowing down from around the year 2020. The scope for further studies exists by incorporating other significant macroeconomic variables into this model to examine their dynamics.

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Conflict of Interest

Authors declare that they do not have any conflict of interest.

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