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The Influences of International Trade on Sustainable Economic Growth: An Economic Policy Perspective

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Abstract: This study uses the Gregory–Hansen cointegration method and the vector error correction model in the vector autoregression system to reveal how international trade contributes to economic sustainability. The Gregory–Hansen test for cointegration method reveals a permanent equilibrium relation among sustainably economic growth, exports, and imports and shows that exports facilitate GDP growth and accelerate improvements in the capability of imports in the long-run. The causality between GDP and exports is unidirectional, indicating that exports area determinant of sustainable economic growth. The bidirectional causality from imports to GDP also sheds light on the important influence of imports on economic sustainability; however, GDP growth also drives import growth. The interaction between imports and exports corresponds to their bidirectional causal relationship, which is indicative of imports contributing to export production and of export growth expanding the capacity for imports. This finding indicates that imports are both exogenous and endogenous factors for exports.

Keywords: international trade; ECM model; sustainable economic growth

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1. Introduction

Many previous studies have investigated how different variables contribute to economic growth. Some drivers of economic growth mainly include government spending [1], information and communication technologies (ICT) capital [2], human capital [3], inflation and inflation uncertainty [4], and free trade [5]. An interesting topic exists regarding how international trade affects economic growth;this topic would shed light on the relationship between trade and sustainable economic growth, and policymakers can design effective trade policies based on the empirical findings.

Based on the empirical study of [6], the results have shown that there is a strong relationship between international trade and sustainable development, which is focused on promoting prosperity and protecting the planet. At the global level, countries promote two of the indicators contemplated in sustainable development: decent work, and economic growth and poverty reduction, by integrating itself into the world economy with other countries that follow the same goals around the world, as well as by increasingly participating in the global value chain. The International Monetary Fund staff pointed out that international trade has served as an impetus to enhance economic development, and as a result, it has been highlighted that both developing and developed countries have benefited from this economic prosperity, which has brought an increase in income and standard of living, which has benefited the end of poverty. According to Frankel and Romer [7] trade has positively affected income in a quantitatively large and robust way, thus international trade improving standards of living. International trade contributes to the acceleration of economic growth by allocating resources among different trading partners and by specializing production in products that have relative comparative advantages.

From the United Nations Conference on Trade and Development (UNCTAD) celebrated in 2006, many developing countries participated successfully in international trade, which greatly helped these countries in attracting quantitatively large foreign direct investment (FDI), providing them with a sustainable engine of economic development.

Since then, exports have turned the tables and have become a much more important focus for economic growth in developing countries. The comparison between exports of traditional basic products, exports of manufactures, and services have skyrocketed substantially in developing countries since they joined the global value chain [8]. It is especially evident in the case of the Asian giant, since the market-oriented reforms and the implementation of free trade have obtained higher incomes and achieved accelerated economic growth, depending largely on exports. The aforementioned is demonstrated in the results of the study of Chia and Elsevier [9] in which exports had a positive impact on economic growth and that the export-oriented growth strategy was valid in selected countries in sub-Saharan Africa; indeed, export expansion leads to a higher rate of economic growth. The increasing intensity of global economic integration has introduced potential contributors to economic development, such as competition, learning and innovation, specialized production, and economies of scale; therefore, most economists support export expansion because of its potential economic benefits, especially economies of scale by specialization in production. Due to small economic entities, some countries, such as developing ones, fail to specialize in production without deep participation in international trade. Enterprises engaging in exports are operating in relatively competitive sectors where employees earn the highest wages and employers gain the highest profits. When participating in international trade, some developing countries can access all possible sources of innovation, including foreign direct investments (FDI) and technological transfer, and integrate them into their investments and production. New techniques and technological innovations endogenously bring about new production techniques, new products, and higher total factor productivity. These strategies and innovations produce even more exports in an upward spiral cycle in the economic growth model, and this outcome contributes to and even accelerates the growth of a nation. Consequently, the supply of products beyond the domestic demand leads to surplus supply and extra exports.

However, this theoretical link is driven by empirical studies on international trade policies. The import-led growth strategy indicates that the dominant cause of economic growth is growth in imports. This endogenous growth model implies that imports allow domestic industries to obtain intermediate factors for intensive production and internationally advanced technologies, such as imported machinery and growth-enhancing foreign R&D knowledge from rich countries, leading to the higher growth of developing countries [10]. The export-led growth strategy considers export expansion and trade liberalization as critical determinants of growth due to positive economic externalities. According to Baldwin et al. [11], international trade creates a large world market; therefore, economies can benefit from capturing international technology transfers and spillovers and from increasing their profits from economies of scale and specialization, which would facilitate their technological improvement and boost their productivity. International trade improves not only resource allocation efficiency but also the diffusion of international technological knowledge and development and technology transfers. The underlying driver of economic and export growth may be an enhancement in productivity in tradable or non-tradable industries. According to Yang [12], an exogenous increase in the volume of export trade or improvement in the productivity of export sectors mainly drives economic growth, export growth, and real exchange rate appreciation. This strategy is beneficial for several developing countries, which expand their product markets wider than their domestic consumer markets. Moreover, the foreign exchange obtained from exports enables the importation of intermediate goods, hence contributing to capital formation and increasing output. When developing countries involve themselves further in world markets, a large volume of export trade triggers a massive influx of foreign exchange, which helps these countries afford advanced technologies and capital inputs.

However, excessive reliance on an export-led growth strategy may make a country vulnerable to exogenous shocks, such as economic downturns in other areas. During the global financial recession, the negative shocks stemming from the US drove developing countries to adopt export-led growth strategies and suffer from economic downturns. For instance, by adopting a low-cost and export-oriented strategy, the participation of China in the global value chain has contributed to its rapid economic development since its reform and opening-up in the late 1970s. With the potential negative shocks or economic threats in mind, the Chinese government started to adopt a "dual circulation" strategy that focuses on both internal and international circulations.

This paper contributes to a knowledge body, which illustrates the link between international trade and sustainable economic growth. With the acceleration of strategic promotion of Chinese exporting, the empirical evidence of the influences of participation in the global market on Chinese economic growth should inspire some policymakers. Although there are many studies on the relationship between international trade and economic growth in the Chinese context, little is known about the impact on sustainable economic growth through a lens of policy and some positive effects of economic policies which encourage their foreign sectors in international trade and export expansion; furthermore, bidirectional causality between international trade and GDP growth actually sustains the benefits that China gains from policies, which promote key sectors of China's economy; hence, this paper fills the gap and makes the contributions of exports to productivity and sustainable economic growth, as well as a virtuous cycle between GDP, exports, and imports.

2. Literature Review

Measuring economic growth is critical, and GDP level and GDP growth have substantial differences in their consequences. Economic growth mainly refers to growth in an entity's productive capacity in the long-term, which is typically measured by real growth in GDP or the monetary value of all final goods and services produced within a country or region in a given period. The size and economic performance of a country can be measured by its GDP, while real GDP growth rate indicates the health of an economy. Feng [13] investigated the effects of local economy on commercial real estate (CRE) performance and found that GDP level, which represents the size of an economy, leads to the income return and capital appreciation of CRE, whereas GDP growth, on behalf of economic growth, leads to capital returns. Both the Office of Management and Budget and Congressional Budget Office [14,15] indicate that economic growth contributes to significantly reducing deficits by increasing revenue.

Previous studies have examined the nexus of both international trade policies and economic prosperity. Continually implementing well-considered and effective export-promoted and growth-oriented policies enables countries to reap the benefits of trade in either the short or long-term, thus accelerating their development and leading to their economic prosperity. Dilek and Aytac [16] pointed out that countries adopting export-oriented strategies continuously absorb the inflow of foreign exchange, hence generating more output and new employment opportunities and accumulating greater trade volume. Chia and Elsevier [9] showed that exports significantly affected the economic growth of sub-Saharan African countries from 1985 to 2014. Their panel cointegration estimation results also indicated a long-term relationship between outputs and exports; meanwhile, the statistical results of a nonlinear test indicated a significant bidirectional causality [17].

Different econometric techniques have been applied to study the effects of international trade on economic growth. By applying both Granger causality tests and impulse response functions to explore whether trade growth, including imports and export expansion, increases in economic development or vice versa, Awokuse [18] investigated the causality among exports, imports, and GDP growth. Results from these methodologies indicate that imports significantly promote economic growth, whereas GDP growth spurs the growth, as seen in exports and imports in Argentina, Colombia, and Peru.Shandre and Gulasekaran [19] explored nine essential Asian countries using a vector error correction model

(VECM), and discovered that imports have a greater effect on output growth than exports. Under the growth-led export assumption, the findings of their vector autoregression (VAR) framework imply that the Granger causality among Canadian exports, terms of trade, and GDP is statistically significant, and that export growth leads to GDP growth [20];therefore, while cointegration analysis highlights long-term relations, the Granger causality test determines the direction of causal relations among exports, imports, and growth.

3. Theory Background

3.1. International Trade Theory

Heckscher–Ohlin (H-O) theory explores and sheds light on the essence of the links between GDP growth and growth in international trade. Specifically, this theory describes the general equilibrium, which highlights the patterns of both production specialization and trade exchange based on a country's relative factor abundance and factor intensity of production [21]. In other words, H–O theory posits that, in the absence of trade, a developing country with abundant unskilled labor has a lower relative price of unskilled intensive goods. As the theory holds, trade contributes to a convergence of products' relative prices. In response to trade, the relative price of exported goods that are produced by intensively unskilled labor tends to increase. Under the framework of H–O theory, the Stolper–Samuelson (S–S) theorem, the factor–price equalization theorem, the Rybczynski theorem, and the aggregate economic efficiency theorem give detailed explanations of the effects of trade on growth. Specifically, S–S theorem indicates that with international trade, a rise in the relative price of traded goods that intensively use a country's abundant factor increases the prices of such intensively used factors. Meanwhile, the factor–price equalization theorem assumes that both countries involved in trade face the same commodity prices and production techniques and produce the same two goods. This theorem posits that the existence of international trade in commodities allows the prices of identical production factors to be equalized across the involved countries. Meanwhile, when the relative goods prices are controlled for, Rybczynski theorem posits that if the supply of an abundant factor in a country increases, then the yield of the commodity that intensively uses the factor tends to increase [22]. Aggregate economic efficiency theorem explains the changes in prices resulting from specialization and trade exchange. These changes motivate each country to generate more exports and fewer imports so that a greater welfare is attributable to the improved production and consumption efficiency resulting from the changes in prices [22].

3.2. Unit Root Test, Cointegration, Vector Correction Model (VECM), and Granger Causality Test

(1) Unit root

Before estimating the dynamic relationship, the order of integration (i.e., the stationarity properties of an individual variable) of all variables must be identified. If a non-stationary time series tend to have a unit root, then a spurious relationship among these variables tends to be revealed in a regression analysis, hence leading to invalid causality. A unit root test should therefore be performed under the framework of regression analysis. Based on the augmented Dickey–Fuller (ADF) test, the introduction of lagged terms enables the variables to capture the omitted dynamics and eliminate the biased standard errors. The ADF test needs to assume that the error process has equal statistical variances; however, the asymptotic distribution of unit root test statistics remains unchanged despite the heteroscedasticity. To test for a unit root or non-stationarity, the ADF test is performed using Equation (1):

$$\Delta z_t = u + \gamma z_{t-1} + \beta \mathrm{t} + \sum_{j=1}^{k} \Phi_j \Delta z_{t-j} + e_t \quad (1)$$

where e_t is an error term that is assumed to be stationary with a zero mean and a constant variance. Under the null hypothesis of the existence of a unit root, McKinnoncritical values are used for testing on the coefficients of z_{t-1}.

Zivot and Andrews [23] proposed an improved unit root test that considers structural breaks. In this study, a structural break with an unknown break date is assumed. These authors also noted that all locations of data are likely to be breakpoints, and all T statistics that test $\alpha = 1$ $\left(\alpha = \hat{\alpha}^A, \hat{\alpha}^B or \hat{\alpha}^C\right)$ are calculated through ADF cycle tests. The minimum $t$value is chosen as the corresponding λ value ($\lambda = T_B/T$, T_B time of structural breakpoints), where the estimated break date is obtained through $t_{\hat{\alpha}^i}\left[\hat{\lambda}_{inf}\right] = {}^{inf}_{\lambda \in \Lambda} t_{\hat{\alpha}^i}(\lambda)$. Given that the null hypothesis of a unit root is $y_t = \mu + y_{t-1} + e_t$, the regression equations used for testing a unit root are listed as follows:

$$y_t = \hat{\mu}^A + \hat{\theta}^A DU_t\left(\hat{\lambda}\right) + \hat{\beta}^A t + \hat{\alpha}^A y_{t-1} + \sum_{j=1}^{k} \hat{c}_j^A \Delta y_{t-j} + \hat{e}_t, \quad (2)$$

$$y_t = \hat{\mu}^B + \hat{\beta}^B t + \hat{\gamma}^B DT_t^*\left(\hat{\lambda}\right) + \hat{\alpha}^B y_{t-1} + \sum_{j=1}^{k} \hat{c}_j^B \Delta y_{t-j} + \hat{e}_t, \quad (3)$$

$$y_t = \hat{\mu}^C + \hat{\theta}^C DU_t\left(\hat{\lambda}\right) + \hat{\beta}^C t + \hat{\gamma}^C DT_t^*\left(\hat{\lambda}\right) + \hat{\alpha}^C y_{t-1} + \sum_{j=1}^{k} \hat{c}_j^C \Delta y_{t-j} + \hat{e}_t, \quad (4)$$

where $\lambda = T_B/T$, T_B is the time of structural breakpoints; when $t > T\lambda$, $DU_t(\lambda) = 1$, and $DU_t(\lambda) = 0$ if otherwise; when $t > T\lambda$,$DT_t^*(\lambda) = t - T\lambda$ and 0 if otherwise. $\hat{\lambda}$ refers to the estimated value at break fraction. The number of extra regressors k is the number of the kth order lag, which is determined by the significance of t statistics. The criterion is that t-statistic on $\hat{c}_j^i(i = A, B, C)$ is less than 1.6 in absolute value if $j > k$, whereasthe t-statistic on $\hat{c}_k^i(i = A, B, C)$ is more than 1.6 when $j = k$. The critical value of asymptotic normal distribution at the 10% significant level is 1.6.

For the traditional unit root test, the structural breakpoints tend to be ignored, which leads to spurious regression; however, the Zivot–Andrews unit root test is used to test the endogenous structural unit root, based on the null hypothesis of y_t being a unit root. Three different models exist:

$$\text{Model A}: \ \Delta y_t = \hat{\mu}^A + \hat{\theta}^A DU_t\left(\hat{\lambda}\right) + \hat{\beta}^A t + \hat{\alpha}^A y_{t-1} + \sum_{j=1}^{k} \hat{c}_j^A \Delta y_{t-j} + \hat{e}_t, \quad (5)$$

$$\text{Model B}: \ \Delta y_t = \hat{\mu}^B + \hat{\beta}^B t + \hat{\gamma}^B DT_t^*\left(\hat{\lambda}\right) + \hat{\alpha}^B y_{t-1} + \sum_{j=1}^{k} \hat{c}_j^B \Delta y_{t-j} + \hat{e}_t, \quad (6)$$

$$\text{Model C}: \Delta y_t = \hat{\mu}^C + \hat{\theta}^C DU_t\left(\hat{\lambda}\right) + \hat{\beta}^C t + \hat{\gamma}^C DT_t^*\left(\hat{\lambda}\right) + \hat{\alpha}^C y_{t-1} + \sum_{j=1}^{k} \hat{c}_j^C \Delta y_{t-j} + \hat{e}_t \quad (7)$$

In the empirical studies, Model C is assumed to be superior to Models A and B because the majority of variables have an increasing trend over time. Their results are more robust.
(2) Cointegration test and VECM model

While assuming the causality between international trade and economic growth, a cointegration test should be conducted prior the Granger causality analysis. The Engle-Granger test evaluates the cointegration between two variables; however, for multiple variable regression, the cointegrated relationship between trade and growth is checked by Gregory–Hansen cointegration test when controlling for structural breaks. Granger's representation theorem posits that if multiple variables are cointegrated, then an error correction mechanism (ECM) model that represents their dynamic connection exists. If the first differences of two variables are stationary but their levels are non-stationary, then these variables are cointegrated. Under a statistically established cointegration, the residuals can be used to formulate the dynamic ECM, which is used to study the long- and short-term causality between trade and GDP growth. According to Engle and Granger [24], to prove the causality from trade to GDP growth, all coefficients of the lagged differences of export and import growths are jointly significant. At the same time, the coefficient of the one-period lagged error term from Equation (2) is statistically significant.

$$ECT_{t-1} = \theta_{t-1} = LnGDP_{t-1} - \alpha Lnexport_{t-1} - \beta Lnimport_{t-1} \quad (8)$$

Following cointegration theory, the VECM is specified with (p) lags; however, the model is estimated with ($p-1$) lags. By computing the maximum likelihood estimates in multivariate ECM, models can elaborate on howvariables respond to shocks when temporarily deviating from long-term dynamics.

$$\Delta z_t = \sum_{i=1}^{p-1} \delta_i \Pi z_{t-i} + \Pi z_{t-1} + \varepsilon_t \tag{9}$$

where z_t is an (n × 1) column vector of k variables, μ is an (n × 1) vector of constant terms, δ and Π represent coefficient matrices, z_{t-1} is the lagged error correction term (ECT), Δ is a difference operator, i denotes lag length, and $\varepsilon_t$is the random error term. The coefficient matrix Π is known as the impact matrix that contains information about the long-term relationships among the variables. Before using the Johansen VECM model, the order of integration of the variables is tested. On the one hand, the VAR system can be used when Rank (Π) = $r_0 = k$, which indicates that the full rank of the matrix (Π) has the stationary vector process z_t. On the other hand, the null matrix Π, which is designated as Rank (Π) = 0, implies that the non-stationary z_t is non-cointegrated; therefore, the VAR portrayal of the involved variables can still be used only if these variables conduct the first difference. Meanwhile, 0 < Rank (Π) < k suggests that z_t series is non-stationary yet cointegrated.The empirical implication of variables being cointegrated is that the involved variable temporarily deviates from the long-run equilibrium due to shocks; however, these variables stick to the long-run equilibrium throughout the entire period. In this study, two maximum cointegrating equations exist consequently. Πz_{t-1} contains information on the term of ε_t derived from the equation, which leads to either a temporary difference from the long-run equilibrium or the equilibrium state. The estimated coefficients of the lagged variables δ_i can capture the fluctuations resulting from short-term shocks. The VECM based on the VAR model focuses on the characteristics of time series and passes the diagnostic tests. Under the framework of the time series, the estimated models must be free from autoregression, while the residuals obtained from this estimation regression are supposed to be stationary, follow a normal distribution, and have the same variance; therefore, the VEC model is presented in Equations (10) in first differences:

$$\Delta \ln GDP_t = \alpha_1 + \sum_{i=1}^{k-1} \delta_{1i} \Delta \ln GDP_{t-i} + \sum_{i=1}^{k-1} \beta_{1i} \Delta \ln export_{t-i} + \sum_{i=1}^{k-1} \varphi_{1i} \Delta \ln import_{t-i} + \lambda_{LGDP} ECT_{t-1} + v_{1t} \tag{10}$$

where $k-1$ equals to lag length minus 1, φ_i, β_i, and δ_i are the short-term coefficients, and λ_i and ECT_{t-1} denote the speed of the adjustment parameter, which lies between 0 and 1, and the ECT, which is the lagged value of the residuals from the estimation of cointegrated regression, respectively.

However, with a break in any series, Gregory and Hansen [25] designed a test for cointegration when controlling for structural breaks. The null hypothesis of the Gregory and Hansen test is that no cointegration exists at the break point in an unknown date against the alternative hypothesis of cointegration at the break point. This rejection of the null hypothesis implies that the linear combination of variables shows the long-run stable relationship. The following equations are the cointegration models:

$$\text{Model 1}: \ \mathrm{Y_t} = \alpha + \gamma \mathrm{DU_t} + \beta \mathrm{X_t} + \varepsilon_\mathrm{t}, \tag{11}$$

$$\text{Model 2}: \ \mathrm{Y_t} = \alpha + \gamma \mathrm{DU_t} + \eta \mathrm{t} + \beta \mathrm{X_t} + \varepsilon_\mathrm{t}, \tag{12}$$

$$\text{Model 3}: \ \mathrm{Y_t} = \alpha + \gamma \mathrm{DU_t} + \beta_1 \mathrm{X_t} + \beta_2 \mathrm{X_t DU_t} + \varepsilon_\mathrm{t}, \tag{13}$$

when $t > T_B$, $DU_t = 1$, and $DU_t = 0$ if otherwise. T_B is the break date.

(3) Granger causality test

Granger [26] argued that the VECM model can be used if the variables have a cointegrated relationship. The Granger causality test that follows the chi-distribution with p degree of freedom is based on the null hypothesis that all estimated coefficients are 0 and on the alternative hypothesis of non-zero coefficients. Rejecting the null hypothesis suggests the existence of unilaterally directional links from one variable to another. Specifically, the null hypothesis (H_O : the coefficient of an independent variable equals 0) highlights that the independent variables fail to explain the changes in the dependent variable. For the joint causality test, the variables fail to jointly explain the explained variable if they support H_O (i.e., all coefficients are 0). In sum, the existence of a long-run link allows the identification of one or more Granger causalities; however, the stably permanent relationship cannot be inferred from the existence of a Granger causal relationship because of the short-term Granger causality test.

4. Data and Methodology Historical Annual Data

Historical annual data on the real GDP, exports, and imports of China are obtained from the World Bank national accounts data and the OECD National Accounts data files, which cover the years 1986 to 2020. As known, Granger causality is a phenomenon that requires a long period to be observed in order for complete interaction effects to take place several years later; therefore, annual data are used instead of quarterly ones. The real GDP growth (GDP; expressed in USD and calculated in 2010 base year) and the real exports (EX) and real imports (IM; both of which are based on CPI 2010 = 100 and expressed in USD) data are transformed into natural logarithm forms. Causality analysis is performed to check whether exogenous events affect exports and imports than GDP. The shocks in trade are inferred to have a higher likelihood of affecting the trade variables instead of GDP. The fluctuations in imports are greater than those in exports. Table 1 shows that three pairwise variables have statistically significant and positively high correlation coefficients. These high correlation coefficients that shed light on the pairwise variables are likely to also have high linear correlation; however, the highly linear correlations between two variables do not indicate that a causality must exist among real exports (Exports), real imports (Imports), and real gross national product growth (GDP), which represents economic growth. In other words, the model might be mis-specified. Multicollinearity also makes it difficult to interpret of model and leads to an overfitting problem as well. When multicollinearity occurs, change in one variable would result in change to another and there also exists a significant fluctuation in the model results. The effective method of solving the correlated variables is to transform the variables but still maintain variables' feature; furthermore, we need to conduct unit root test, cointegration test, and Granger causality Wald test must be used to determine the direction and strength of the causality between international trade and growth.

Table 1. Correlation Coefficient.

Variables	ln GDP	ln Export	ln Import
ln GDP	1.000	0.948	0.994
ln export		1.000	0.952
ln import			1.000

5. Estimations and Analytical Results

The integrated order of variables and their cointegration must be checked. The augmented Dickey–Fuller and Phillips–Perron tests are conducted to determine whether a variable has a unit root under the null hypothesis that this variable includes a unit root against the alternative hypothesis of a stationary variable. Neway and Kenneth [27] standard errors are considered in the Phillips–Perron test to deal with the serial correlation. The natural logarithm forms of all variable series present a unit root in both the ADF and Phillips–Perron tests, as shown in Table 2. While the critical value of ADF at level is −2.620 at the significance level of 10%, which is beyond the rejection rejoins, the critical value of ADF for the first difference is −2.662 at 10%. The null hypothesis, which posits that a unit root is present, is accepted at level yet is rejected for the first difference, hence designating those variables as being integrated of order 1. All variables are integrated of order 1, I

(1), which is consistent with the results of the Phillips–Perron test. The Zivot–Andrews unit root test is conducted because there exist breakpoints in time series. Conducting the Gregory–Hansen test for cointegration because of the structural break, the optimum lag lengths are decided according to the selection order criteria. The results of Gregory–Hansen test indicate a cointegration; therefore, a long-term relationship is observed between international trade (including exports and imports) and GDP. Despite short-term shocks that lead to movements in the time series, these time series tend to converge in the long run.

Table 2. Unit root results fromthe augmented Dickey–Fuller testand Phillips–Perron test.

ADF test:			
Variable	**Level**	**First Difference**	**Conclusion**
ln *GDP*	−1.287	−2.873 *	I (1)
ln *import*	−0.758	−3.726 ***	I (1)
ln *export*	−0.677	−3.144 **	I (1)
Phillip–Perron test:			
Variable	**Level**	**First Difference**	**Conclusion**
ln *GDP*	−1.667	−2.626 *	I (1)
ln *import*	−0.416	−74.077 ***	I (1)
ln *export*	−0.865	−4.765 ***	I (1)

* Significant at the 10% confidence level, ** significant at the 5% confidence level, and *** significant at the 1% confidence level. According to the McKinnon critical values, the critical values of ADF are −2.620 in level and −2.662 in first difference at 10%, whereas the critical values of the Phillips–Perron test are −2.619 in level and −2.620 in first difference at 10%.

Considering structural breaks, the Zivot–Andrews unit root test is conducted. In Tables 3 and 4, the Zivot–Andrews unit root test suggests that the null hypothesis of a unit root is rejected at 5% for all variables, indicating that three time series have a fractional stationary trend surrounding the breakpoints.

Table 3. Results of Zivot–Andrews model C.

Variable	T	T_B	k	$\hat{\alpha}$	$t_{\hat{\alpha}}$	$\hat{\theta}$	$t_{\hat{\theta}}$	$\hat{\gamma}$	$t_{\hat{\gamma}}$
$\ln GDP^C$	33	2015	2	0.597	6.346	0.052 *	3.070	−0.011 *	−4.787
$\ln export^C$	32	2003	1	0.653	5.688	0.39 *	3.11	−0.053 *	−5.66
$\ln import^C$	32	2003	1	0.7	8.494	−0.372 *	−4.395	−0.046 *	4.317

* significant at the 10% confidence level. The superscript letter c refers to results of Zivot–Andrews test based on Model C: $\Delta y_t = \hat{\mu}^C + \hat{\theta}^C DU_t(\hat{\lambda}) + \hat{\beta}^C t + \hat{\gamma}^C DT_t^*(\hat{\lambda}) + \hat{\alpha}^C y_{t-1} + \sum_{j=1}^{k} \hat{c}_j^C \Delta y_{t-j} + \hat{e}_t$.

Table 4. Zivot–Andrews unit root test.

Variables	t-Statistic (A Structural Break in the Intercept)	t-Statistic (A Structural Break in the Trend)	t-Statistic (A Structural Break in the Intercept and Trend)	Break Point
ln *GDP*	−6.012 (2000)	−6.072 (2015)	−7.128 (2015)	2015
ln *export*	−6.415 (2015)	−6.311(2013)	−6.331(2015)	2015
ln *import*	−5.703(2002)	−4.207(2012)	−5.65(2002)	2002

The regression using 35 observations is more likely to cause bias and wrong inferences if the breakpoint is ignored in the model. With a break in any series, Gregory and Hansen [25] designed a test for cointegration when controlling for structural breaks. The

Z_t values from Gregory–Hansen Models in Table 5 suggest that a break is evident in 2015 when a reform of the foreign exchange rate system occurred; therefore, the results of the Gregory–Hansen test for cointegration mean that a long-run relationship exists among economic growth, export, and import, as shown in Table 5.

Table 5. Results from Gregory–Hansen Models.

Gregory–Hansen Models	ADF		Z_t		Z_a	
	Statistic	Breakpoint	Statisti	Breakpoint	Statistic	Breakpoint
Intercept shift	−6.02 **	2013	−6.00 **	2015	−34.67	2013
Intercept shift with trend	−7.13 **	1998	−7.24 **	1998	−44.09	1998
Intercept shift with slope	−5.39	2015	−5.43 **	2015	−31.68	2015

** significant at the 5% confidence level.

Table 6 shows that the coefficient for adjustment (−0.665) is significant at a 1% significance level, and this rejection of the null hypothesis implies that the linear combination of variables indicates a long-run stable relationship. It implies that international trade contributes sustainably to economic growth in China. The long-term equilibrium link among the variables is represented by the error correct term (ECT). The ECT shows how much of the disequilibrium is being corrected. A negative coefficient indicates convergence, while a positive coefficient indicates divergence. The adjustment term to the long-term equilibrium is statistically significant at 1%, which suggests that the deviation from the long-run equilibrium would be adjusted at convergence speeds of 0.665. If the lag value of the GDP is currently below the equilibrium, then the reduction in GDP caused by a decrease in exports and imports would allow the system to recover the equilibrium at the speed of adjustment; therefore, a long-run relationship between economic growth and growth in export and import exists.

Table 6. Results of the ECM model based on the ARDL model.

Variables	$\ln GDP_{t-1}$	$\ln Export_t$	$\ln Import_t$	DU_t	$\ln Import_t{*}DU_t$	$\ln Export_t{*}DU_t$	$\Delta\ln Export_t$	$\Delta\ln Import_t$	Constant
Coefficient	−0.665 ***	0.710 ***	−0.028	36.19 **	−0.472	−1.149 **	−0.099	−0.036	9.120 ***
	−4.43	3.16	−0.13	2.60	−1.14	−2.057	−0.81	−0.32	4.06

***, **, and * indicate the rejection of the null hypothesis of 0 coefficients at the 1%, 5%, and 10% significance levels, respectively.

Table 6 shows that the breakpoint coefficient is statistically significant at 5%, implying that breakpoints have a significant effect on this model. The coefficient of the dummy variable DU_t is 36.19, which is statistically significant at a 5% significant level, while cross-terms between export, import, and dummy variable are −1.149 and −0.472. The remaining coefficients relate to the short-run dynamics of the model's convergence to equilibrium. The coefficient is of 0.710 statistical significance at a 1% significance level, thereby implying that growth in export leads to an economic boom in the short-run; however, the coefficient is−0.028, which suggests the absence of a significant effect of import growth on economic growth in the short-term.

The cumulative sums (CUSUM) of the recursive residuals are calculated to test for model stability with the dummies in the model. The graph of the CUSUM of the recursive residuals includes a 95% confidence band. The model is stable. Although the exact directions of causality are uncertain, the joint F-test provides information about the direction of Granger causality. Engle and Granger [24] stated that if multiple variables are cointegrated, then an ECM model must be developed, and the Granger causality can also be identified. For further statistical analysis, the estimation is subjected to robust diagnostic tests to identify the correct long-term relationship. The ECM model passes both normality and heteroscedasticity tests. In this study, based on Autoregressive Distributed Lag (ARDL) which is applicable for both non-stationary time series as well as for time series with a mixed order of integration where the Granger causality test is performed.

The main results of the Granger causality Wald tests are consistent almost with the conclusions of the results of the ECM model. The causality between international trade and growth should be checked to determine the causal directions. In this study, the *F*-statistics from the Wald tests based on the ARDL model suggest the causal relation is robust in short-run. All possible causality among the variables can be inferred according to the results of the Granger causality Wald tests (Table 7). Given that China mainly relies on exports, a unidirectional causality between GDP and exports is observed, suggesting that the growth in exports leads to economic growth. Export expansion and promotion allow China to expand its economy in several ways, such as by accumulating national foreign currency earnings and attracting the inflow of foreign investment, enhancing its capacity utilization, improving its technological progress and total factor productivity, making a much greater use of economies of scale, generating more employment and increasing labor productivity, and allocating scarce resources effectively across the economy. GDP also has positive effects on imports, and imported machinery makes developing countries, especially emerging ones, achieve industrialization. Table 7 shows that exports and GDP jointly lead to imports. Exports and imports jointly leading to GDP growth highlights the importance of import inputs to export production and expansion. Evidently, international trade sustainably contributes to economic growth, and economic prosperity enables international trade to flourish in the world market.

Table 7. Results of the Granger causality Wald tests.

Null Hypothesis	F Statistic for Granger Causality Test	Direction of Causality
Imports fail to cause GDP	9.308 ***	Imports cause GDP
Exports fail to cause GDP	3.842 *	Exports cause GDP
Imports and exports fail to cause GDP	7.799 ***	Imports and exports jointly cause GDP
GDP fails to cause imports	4.387 **	GDP cause imports
Exports fail to cause imports	21.5 ***	Exports cause imports
GDP and exports fail to cause imports	23.245 ***	Exports and GDP jointly cause imports
GDP fails to cause exports	0.246	GDP fails to cause exports
Imports fail to cause exports	24.358 ***	Imports cause exports
GDP and imports fail to cause exports	11.958 ***	Imports and GDP jointly cause exports

* Indicates the null hypothesis of no causality is significant at the 10% confidence level, ** significant at the 5% confidence level, and *** significant at the 1% confidence level.

In the impulse response analysis, all eigenvalues lie inside the unit circle, hence implying that VAR satisfies the stability condition in Figure 1; however, one root approaches the unit circle, which suggests that some shocks are persistent. The impulse responses of the GDP, export, or import variables for forward 10 periods to the 1 standard deviation shock observed in GDP, exports, or imports are then plotted. The impulse response functions illustrate the behavior of variables with observed causality for each variable in China.

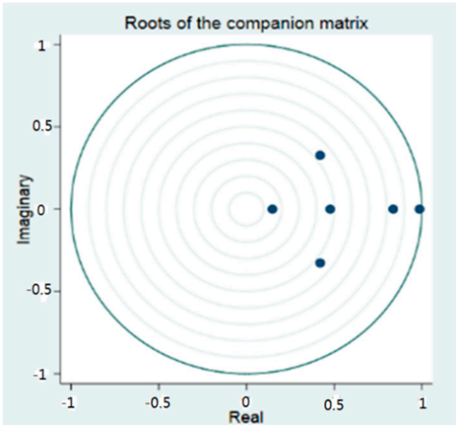

Figure 1. Roots of companion matrix.

The forecast error variance decomposition and prediction of an 8-quarter forward forecast reveal that 60.2%, 2.9%, and 36.9% of the forecast error variance are derived from GDP, imports, and exports, respectively, as shown in Figure 2. In other words, GDP is affected by itself, and exports contribute to economic growth. As illustrated in Figure 3, the forecast error variance decomposition suggests that exports account for 9.24% of the forecast error variance; meanwhile, GDP and imports significantly affect exports and account for 39.11% and 51.65% of the forecast error variance, respectively. Compared with GDP (40.82%), exports (42.72%) contribute to a greater fluctuation in imports, as shown in Figure 4.

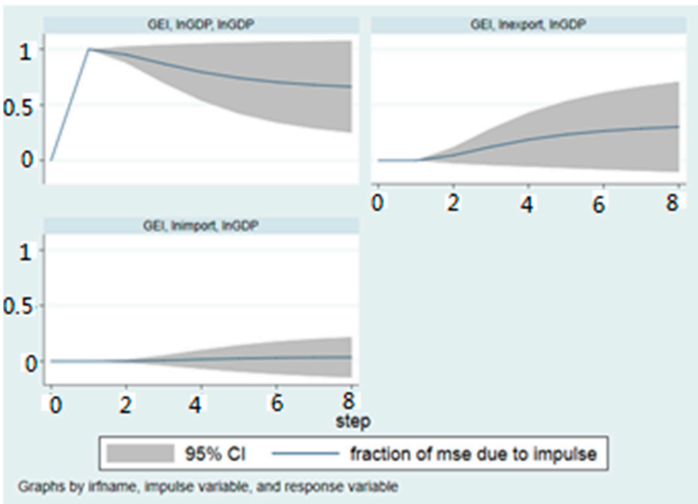

Figure 2. GDP's forecast error variance decomposition.

The implication of the impulse response functions is supported by the results of the VAR model and the Granger causality tests. When statistically significant impulse response functions are considered, the exports of China generate a positive response to shocks, and such impact turns into a negative response in the following periods. The impulse response function behavior of GDP to the change in the exports of China is positive in the first period and demonstrates a positive persistent trend.

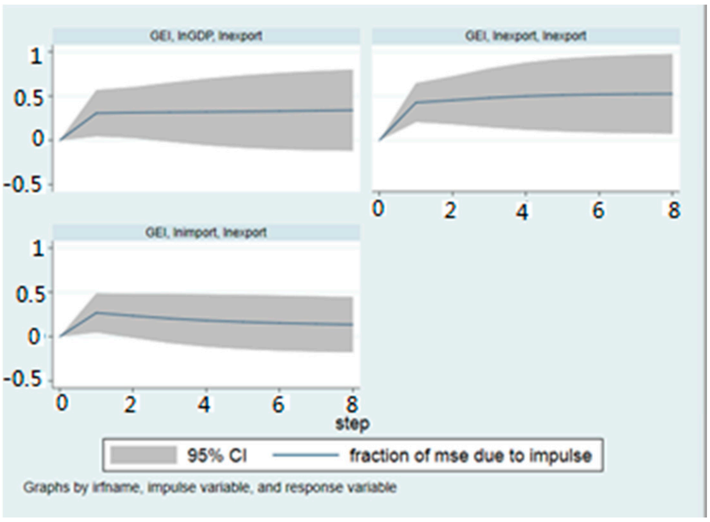

Figure 3. Export's forecast error variance decomposition.

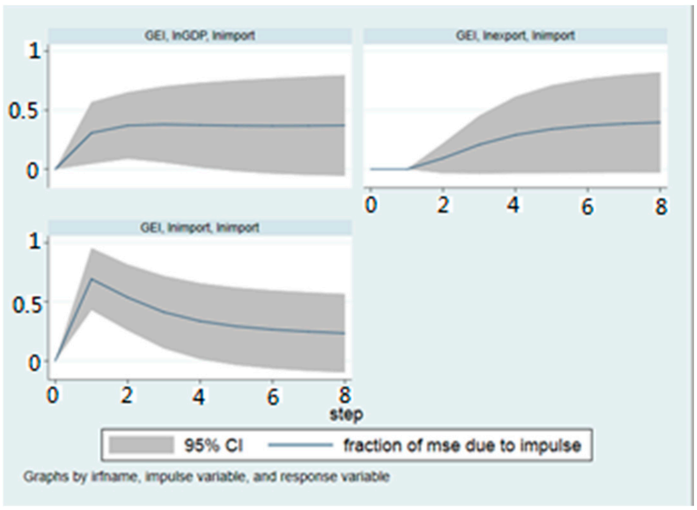

Figure 4. Import's forecast error variance decomposition.

6. Conclusions and Implication

We can infer that both GDP growth and increase in imports are driven by exports in China in the long-term. The test results reveal that exports facilitate GDP growth and that exports accelerate growth in the capability of imports in the long-run. The Granger causality Wald tests reveal short-run relationships among the variables as follows. First, the causality between GDP and exports is unidirectional, hence suggesting that exports area determinant of economic growth. Second, GDP growth fails to contribute to exporting production in the short-term. Third, the bidirectional causality from imports to GDP sheds light on the important influence of imports on economic prosperity. Fourth, the interaction between imports and exports corresponds to their bidirectional causal relationship. Fifth, the aforementioned variables demonstrate a joint causal relation from any two variates to the remaining variate, underscoring the importance of the interplay among variable pairs in the growth of the remaining variable.

The Gregory–Hansen test for cointegration method reveals a permanent equilibrium relation among GDP, exports, and imports. Empirical results suggest that export growth accelerates not only long-term economic growth but also the sustainable capacity to import in China. The export-oriented policy has statistically significant and positive effects on GDP growth, which is consistent with the conclusion of Emilio [28], who found that exports significantly influence economic growth in developing countries. The movement patterns of output, either in the short- or long-term can be explained by exports. On the basis of the analysis results, policymakers should continue its enforcement of the export-led growth policy due to its contributions to economic growth; however, this strategy also brings external shocks to a country, hence challenging policymakers who are enthusiastic about export-led growth policies. In the recent global crisis triggered by the COVID-19 pandemic, those countries across the world who have imposed lockdown policies to curb the spread of virus are now facing an international trade recession. This crisis has exposed the vulnerabilities of those countries that excessively rely on exports as a crucial channel for GDP growth; therefore, at the onset of the recent global economic crisis, policymakers should implement effective measures to buffer economies against negative exogenous shocks, such as by operating prudent countercyclical fiscal deficits, achieving a constrained fiscal expansion aimed at productive public spending, using large stocks of foreign exchange reserves to finance the economy [29], aiming for a deeper and wider regional integration, and promoting a greater trade-partner diversification [30]. These effective and efficient measures used during global crises provide policymakers with some approaches for mitigating the possible effects of negative shocks to GDP growth.

The estimated equations have important policy implications. The first cointegration equation imposed on normalization restrictions highlights a relationship between exports and GDP in the long-run. Export expansion contributes to imports because the foreign exchange reserves used to pay for Chinese imports continue to accumulate. As a critical determinant of growth, export expansion affects GDP growth through positive economic externalities. At the same time, GDP has a prominent role in export expansion, and growth-promoting exports allow a depreciation in the real exchange rate; therefore, the cheaper prices of goods and services triggered by currency depreciation lead to further export expansion. GDP is significantly affected by imports at the 1% level. Chinese imports enable domestic industries to obtain advanced technologies, tools, and machineries from developed countries. Economies can benefit from capturing international technology transfers and spillovers and increasing their profits from economies of scale and specialization, thereby facilitating their technological improvements and boosting their productivity. All these points are supported by the results of the VEC model; therefore, China, being involved in the global economy, relies heavily on the rapid economic growth of traded countries that generate demand for exports. Meanwhile, the long-term relationship between exports and growth suggests that China is dependent on export-led growth. The bidirectional causal relationship between imports and economic growth from Granger causality Wald tests indicates that economic growth promotes an increase in imports, and that imports contribute to economic growth. Imports allow for high productivity, capital formation and accumulation and economic growth due to technology and innovation transfer via the import channel; therefore, it is necessary for policymakers to design import-oriented policies, including lifting a range of restrictions and the less restrict Import Licensing Regulation.

Our findings related to the causal directions among exports, imports, and GDP offer some policy implications for international trade. On the basis of the empirical results, China should continue highlighting the importance of exports in its sustainable economic growth; indeed, China was the second economic entity in the past to economically isolate itself from other countries. Policymakers should continuously exploit the implications of the export expansion strategy for China's economic prospects, although countries that heavily rely on export as a vital channel for sustainably economic growth are vulnerable, especially during the global crisis and COVID-19 pandemic. There are some effective buffers against negative external shocks, such as application of countercyclical policies, deeper and more strengthened regional integration and wider diversification of trade partners, including the Regional Comprehensive Economic Partnership (RCEP). Economic growth allows for an export expansion, and the results of all models indicate that GDP is robustly associated with positive exports; therefore, domestic and trade reforms, including reducing trade tariffs, attracting foreign direct investment, and imposing constraints on imports, should be implemented. These reforms may also benefit economic growth. Trade is an engine of economic growth, and domestic demand and consumption effectively drive economic prosperity; therefore, in the face of potentially negative shocks or economic threats, the Chinese government has adopted the "dual circulation" strategy, which focuses on both internal and international circulation. That is, China implements the new dual circulation strategy containing both "external circulation" which refers to access to global demand as well as foreign capital and technology and "internal circulation" which means stocking domestic demand and domestically developed technology.

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