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The Effects of the Sino-Congolese Bilateral Trade on Economic Growth: The Case of the Democratic Republic of the Congo

LOHALO A. Nancy
University of International Business and Economics (UIBE), Beijing, China

Abstract: *Over the last few years, Sino-Congolese relations have evolved towards a strategic partnership in which China has become DR Congo's largest trading partner and primary export market. Studies have previously demonstrated that trade constitutes a powerful determinant of growth, employment, and economic prosperity. Given the recent economic prominence of China and leading status in the Global South, it is plausible to assume that trade is likely to positively impact DR Congo's growth and influence the country's pattern of trade. Consequently, this study aims to contribute to the growing body of research investigating the effects of trade with China as a leading partner on growth in developing countries. As a resource-abundant country, DR Congo's exports remain highly concentrated on commodities, precisely copper and cobalt, and manufactured products represent primary imports. Following the empirical analysis carried out using an Autoregressive Distributed Lag (ARDL) model from 2000 to 2018, evidence shows that DR Congo's exports to China are positively associated with the country's economic growth. Comparatively, imports from China and DR Congo's growth exhibit a negative relationship, partially explained by the expenditure nature in the gross domestic product tabulation. Robustness checks further validate the positive implications of exports and suggest that imports are most likely to influence DR Congo's growth through indirect channels such knowledge transfer.*

Keywords*: Autoregressive Distributed Lag (ARDL); Growth-By-destination; Export-Led Growth; Sino-Congolese Trade.*

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I. Introduction

In early 2021 China and the Democratic Republic of the Congo signed a Memorandum of Understanding (MoU) regarding the Belt and Road Initiative (BRI). In doing so, DR Congo has become the 45th African country to officially participate in the global initiative. This marks a new turning point in what is considered strong relations between both economies. Indeed, over the past two decades, the (diplomatic) relations have evolved to a strategic partnership, in which both parties cooperate on multiple projects mostly invested in DR Congo and support each other (win-win). Consequently, besides constituting a major investor, China has become DR Congo's first trading partner and leading export market to a staggering majority. Trade-growth relations can be highly complex and produced mixed results based on various factors, including a country's development level. As a part of LDCs, DR Congo's main exports remain highly concentrated on commodities, low-value-added products.

Given the significance of China in DR Congo's trade, it would be interesting to investigate whether trade positively influences the country's economic growth to the extent possible, considering the complexity and versatility of growth models. With the new dimension of the Sino-Congolese partnership following the BRI agreement, it is essential to re-evaluate trade relations in order to identify what should be executed to strengthen them, revitalize them under the initiative, creating a possibly more efficient and sustainable environment that will result in furthering DR Congo's level of (global and regional) integration and trade composition (value-added), while maintaining win-win partnership. Ultimately, it should be associated with comprehensive trade reforms to reach efficiency and sustainability.

II. Brief Overview of Previous Research

2.1 International Trade and Least Developed Countries (LDCs)

The effect of international trade on a nation's growth has long been one of the most debated topics in economics. Consequently, there has been vibrant literature concerning the effect on least developed countries (LDCs). Previous work has demonstrated that trade impacts LDCs in different ways compared to developed and emerging nations. Earlier views argued that growth resulted from an expansion of land used to produce primary goods for developed economies, applying relatively basic technologies (Caves, 1965). From a general perspective, River-Batiz and Romer (1991) have suggested that a larger global economy constitutes a source for

global technological progress given two facts: 1) it implies a larger stock of knowledge (non-rival), promoting Research and Development (R&D); 2) it introduces a "Schumpeterian" mechanism, consisting of increasing rents of patents ideas (monopoly holders) through larger market access, using international trade to exploit the market, promoting innovation, resulting in increasing economic growth. The vast majority of LDCs rely on primary goods as main export and manufactured products as main import, making them vulnerable to external shocks (World Bank, 2018) and trapped in lower value activities. China constitutes an important market for many LDCs, and, over the years, has become an important partner for sustainable development. China's relations with LDCs are not limited to trade but involve technological transfer, knowledge diffusion, and resources exchange, with stakeholders joining forces to create sustainable solutions (Jenkins, 2019).

2.2 Growth-by-Destination

Growth-by-destination emphasizes the role of trade on a nation's economic growth. It indicates that the destination of exports has significant implications, particularly in the presence of major trade partners. Growth-by-destination of exports may strongly affect a country's trade patterns, resulting in transformative effects on development. To benefit from international trade, Ricardo suggested specialization based on comparative advantages instead of diversification of exports. Although most LDCs located in Africa have a comparative advantage in primary goods, diversity amongst the countries regarding the composition of primary exports prevails and may be exploited in the future for further trade integration. Recent empirical studies have demonstrated that the Prebisch-Singer hypothesis – indicating that the relative price of commodities relative to manufactured goods following a downward secular trend – partially validates the existence of a negative trend (Arezki et al., 2013; Aslan & Nazlioglu, 2018).

China's economic emergence has generated a growing body of research exploring the growth effects of bilateral trade in specific regions or countries. In recent years, China has become a crucial partner in the South-South cooperation, even more so for LDCs in Africa. The country constitutes a central force regarding trade and investment and continues to revitalize the Global South, precisely where the declining effectiveness of the North-South cooperation prevails (Zhang, 2015; Lin & Wang, 2017).

From an empirical perspective, Baliamoune-Lutz (2010) investigated the growth effects of Africa's trade with China by performing a Generalized Method of Moments (GMM) analysis. The author drew a clear distinction between import-led and export-led growth while controlling for export concentration. Evidence indicated that imports from China had positive effects on economic growth. Although there was no exhibition of unconditional growth from exports to China, findings showed that concentrating on specific products (export concentration) appeared more beneficial. Furthermore, Mullings and Mahabir (2018) have demonstrated that the most robust causes for Africa's recent economic growth are primary associated with the private sector and foreign direct investment. The study indicated that Africa's bilateral trade with China has played a pivotal role, particularly in resource-abundant and non-landlocked countries. Empirical methods applying the GMM estimator, allowing for endogeneity amongst trade and growth, exhibit robust evidence of trade's positive effects on Africa's economic growth.

2.3 Export-Led Growth

From a mathematical perspective, there is a positive association between exports and gross domestic product, given the way the latter is commonly computed. Export-led growth implies that export represents a major determinant of economic growth. Since the 1960s, economists have extensively investigated this relationship, and many have concluded that exports can promote growth in developed and developing countries through various channels under specific conditions. In that sense, Dufrenot et al. (2010) have suggested that trade's positive influence on Africa's growth equally depends on socio-economic, political and institutional factors within the countries. Similarly, East Asian countries have proven that appropriate export-led growth policies supported broader access to international markets, resulting in higher global integration. Real and sustainable gains occurred when the composition of export shifted from raw materials to higher value-added products.

On the other hand, the way exports impact growth involves multiple aspects. Overall, export growth increases trade volumes, which is likely to result in higher income that can constitute a source of re-investment. Furthermore, inward FDI allocated to specific export sectors such as mining can influence the labor market by creating jobs and labor productivity by stimulating output growth through a multiplier effect (Kemp-Benedict et al., 2018). Modern theories such as Romer (1986) focus on dynamic gains from trade that expand a nation's production possibility frontier (outward shift). Similarly, export growth generates greater capacity utilization and promotes resource allocation, increasing the TFP, hence, the nation's wellbeing. Experts have shown that trade (export and import) constitutes a vector of technological transfer and innovation. In that regard, exports can lead to technological advancement and knowledge diffusion, stimulating firm competitiveness and innovation. In many instances, it fuels entrepreneurship and emphasizes learning by doing. The learning-by-

doing theory demonstrates that experience from good and service production improves productive efficiency, impacting economic growth.

As stated earlier, Ricardo emphasizes specialization instead of diversification. Recent empirical studies have found that the growth effects of Africa's trade with China are more beneficial when countries engage in export concentration, that is, focus on specific products rather than diversifying the composition sold abroad. Nonetheless, Baliamoune-Lutz and Ndikumana (2007) have found that export concentration in primary commodities is associated with conflict and insufficient institutional and policy reforms.

Gravity models have been helpful to observe the patterns of trade. Countries with similar sizes, in term of gross domestic product (GDP), tend to have stronger relationships in both exports and imports, implying that larger economies tend to spend more on imports and have more income from other nations given the diversification of domestic production (Krugman et al., 2012). Baliamoune-Lutz (2010) stated that China remains a developing country based on per capita income, where the demand for raw materials is most likely to stay relatively high in the near future. However, China represents a pivotal partner for a large number of African countries, and other sectors are multiplying larger scale cooperation projects, contributing to revitalizing economies.

III. Sino-Congolese Economic Relations

3.1 Sino-Congolese Strategic Partnership

Over the years, China has built several relatively solid bilateral relations across the African continent, including the Democratic Republic of the Congo. Prior to becoming a Belgian colony, DR Congo signed its first treaty with China at the end of the 19th century, which officially symbolized the beginning of their relations. Since 1972, both countries have maintained peaceful diplomatic ties and gradually developed a partnership, notably rising from smaller Chinese financial support dedicated to investments, (symbolic) infrastructure, and financial aid. In 2007, the Sino-Congolese Convention - a resources-for-infrastructure deal amounting to US$ 6 billion and associated closely with infrastructure and mining development - redefined the connection between the countries. As a result, both partners established a mining joint venture, Sicomines. From a Congolese perspective, the ultimate objective was to stimulate the economy and employment through infrastructure development. This emblematic step in China-DR Congo relations marked a shift towards a strategic partnership that benefits both parties rather than a donor-recipient dynamic. In recent years, despite a slowdown in Sicomines projects, China and DR Congo have maintained a joint commitment to work together on multiple areas, such as telecommunications, agriculture, energy, and infrastructure. DR Congo's official participation to the Belt and Road Initiative in 2021 constitutes a new chapter in the strategic partnership forged on common interests and deep personal connections (Kabemba, 2016). Studies have demonstrated that trade constitutes an engine of sustainable development given that it can stimulate growth and employment, as well as contribute to economic prosperity.

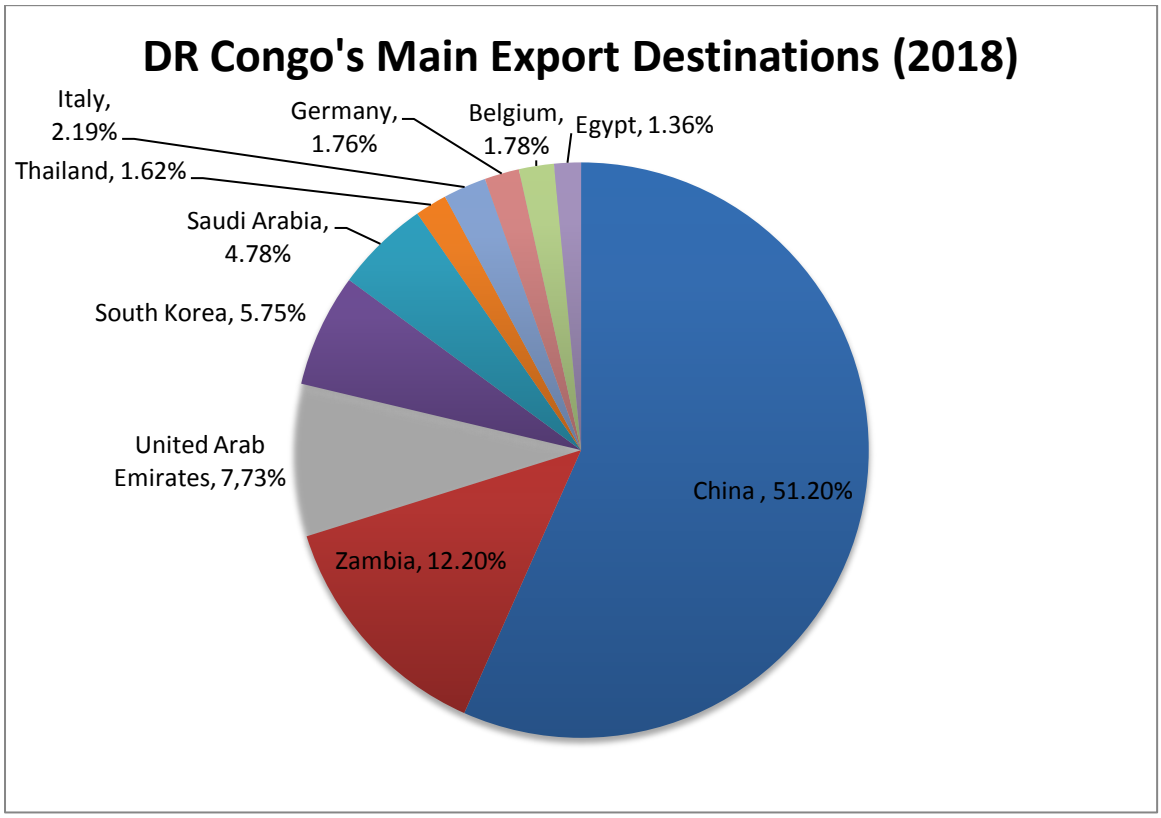

Figure (1): DR Congo's Main Export Destinations in 2018
Source: Observatory of Economic Complexity (OEC)

Over the past few years, the Sino-Congolese bilateral trade increased rather significantly, to the extent of China becoming the principal single-country market for Congolese exports, in addition to imports. In 2018, China represented 51.2% of the total exports, followed by the neighboring economy Zambia (12.2%) and the United Arab Emirates (7.73%). Figure (1) demonstrates the significance of the Sino-Congolese bilateral trade, specifically from a Congolese perspective. Given that China makes up for more than half of total exports, the argument of direct impact on economic growth is further plausible. As stated earlier, DR Congo's main imports in 2018 originated from China (23.7%), South Africa (17.1%), and Zambia (11.5%).

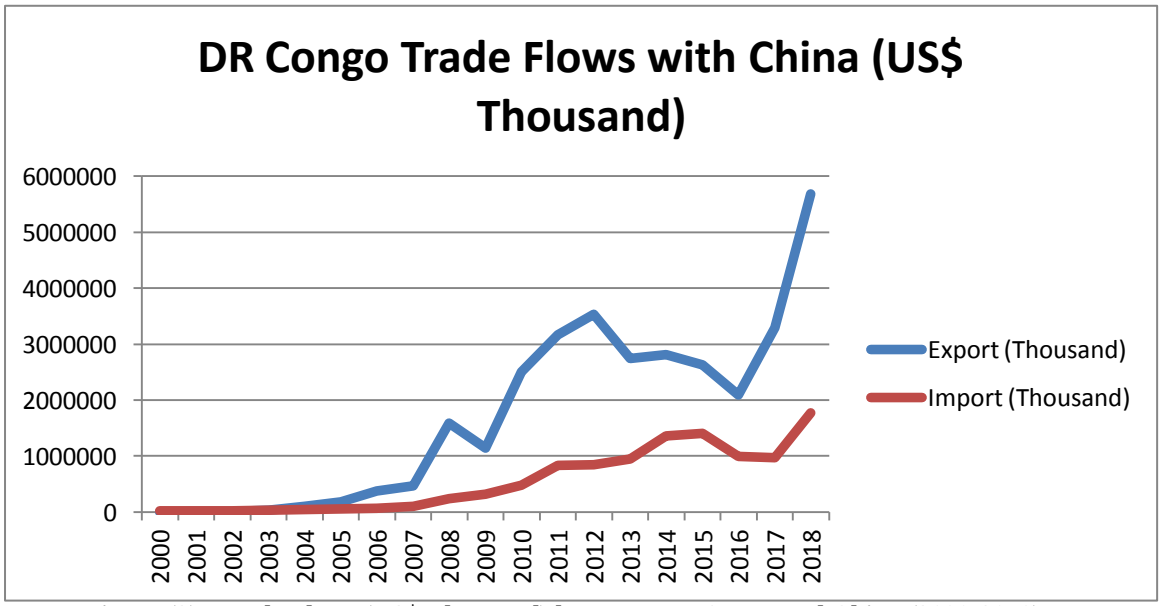

Figure (2): Trade Flows (US$ Thousand) between DR Congo and China (2000-2018)
Source: World Integrated Solution (WIS)

Figure (2) illustrates Sino-Congolese trade flows over the period 2000-2018. At first glance, the statement of dramatic increase has been confirmed, particularly in terms of export. It is essential to note that the composition of Congolese exports remains highly concentrated in primary resources, dominated by copper and cobalt. Indeed, DR Congo is the world's largest exporter of cobalt. The steady growth in exports to China originating in 2003 was disrupted by the financial crisis in 2008, before pursuing its initial path the following year and achieving nearly 55.09% growth by 2012. Nonetheless, we can observe a relatively sharp decrease in exports between the period 2012-2013, continuing until 2016. It appears that Congolese exports more than doubled in two years, experiencing substantial growth from 2016 to 2018, rising from US$ 2.08 billion to US$ 5.68 billion, nearly 70%. On the other hand, imports from China have increased at a relatively slower pace and represent a far less significant volume than exports, which indicates a positive balance of trade, hence, trade surplus. It is essential to note that a trade surplus can be beneficial when invested in economic development and, especially, maintained in the long run. Many LDCs may struggle to keep a constant trade surplus as the terms of trade behave negatively during recessions – higher prices for imported manufactured goods and lower prices for exported primary products (Krugman et al., 2012). In recent years, DR Congo main imports from China consisted of capital goods, machinery and electronics, intermediate goods, and consumer goods, hence, products with value-added. We can observe a relatively similar pattern to exports in terms of rapid expansion following the year 2016. Imports have increased nearly 45.28% in just a year, from 2017 to 2018.

3.2 DR Congo's GDP Growth

Figure (3) gives a graphical representation of GDP growth in DR Congo. Although there has been some notable progress over the past few years, the economic development of DR Congo reflects decades of instability. In 2019, the services sector contributed 35.37% of the GDP, compared to 19.18% in agriculture and 40.73% in industry (including construction). The latter is predominantly constituted of natural resource exploitation (mining), which makes up the vast majority of exports. Therefore, it attests to the lack of diversification in the economy. Furthermore, the shortcomings in terms of skilled labor and capital remain a major obstacle to this sector's development. If considered separately, the mining sector accounts for approximately 20% of the GDP. It is worth noting that the secondary sector (industry) represents 9.8% of total employment, while 'agriculture' and 'services' employ 64.3% and 25.9 of the labor force, respectively.

The GDP growth rate allows us to better understand how the economy has changed over the years. By nature, economic growth can be affected by numerous factors (including drop in commodity prices and delays in structural reforms), some stronger than others, or events (such as conflicts and global crisis). In 1998, DR Congo was hit by a devastating armed conflict, which resulted in disastrous socio-economic damages. Consequently, the economic activity was severely impacted, as reflected in Figure (3). The abysmal rate of -2.10 in 2001 corroborates the fact that the country had been greatly suffering from the war. From 2002, the economy started to make steady progress until it peaked in 2004 at a rate of 6.73%. Emerging countries such as China or India were largely responsible for the commodity boom occurring in DR Congo, lasting until 2008. The economy continued to fluctuate, alternating between ups and downs, before a sharp decrease of nearly 4% in 2009 compared to the previous year, reflecting the global financial crisis and the country's vulnerability to external shocks.

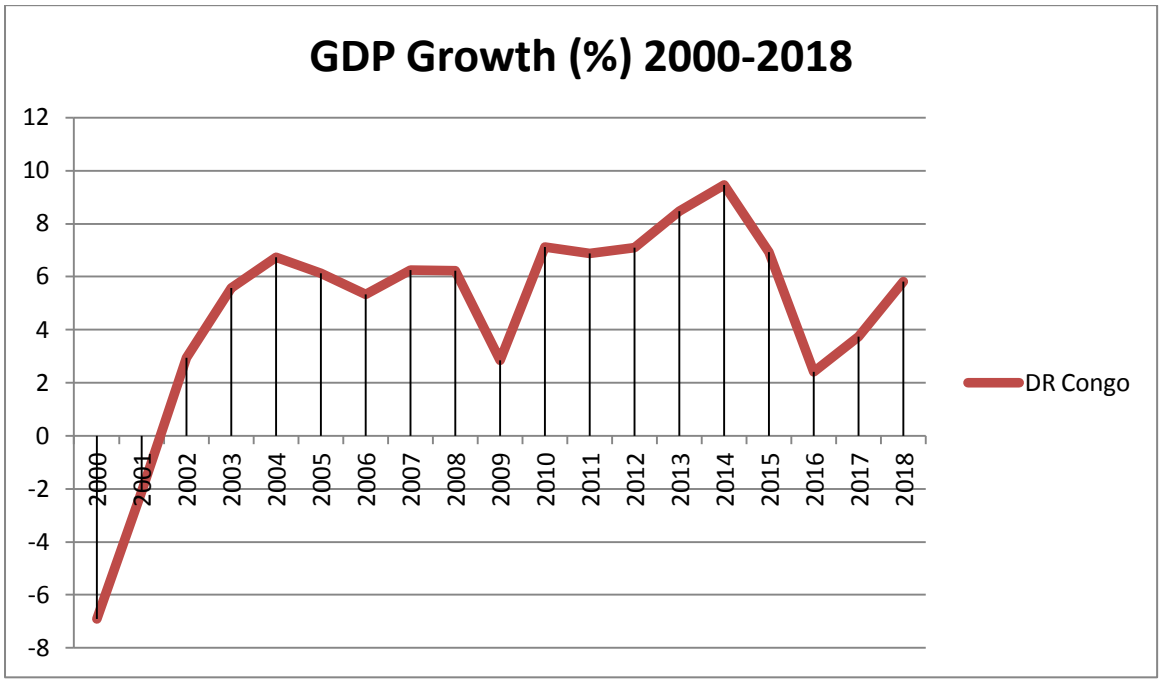

Figure (3): DR Congo's GDP Growth (%), 2000-2018

Source: World Development Indicators (WDI), World Bank

The economy quickly began to recover the following year, increasing by a nearly 5% growth rate. The second peak occurred in 2014, with the highest growth rate since 2000, reaching 9.47%. Comparatively, both exports and imports from China exhibited upward trends, and exports immediately decreased in 2015. From 2014-2016, the GDP growth rate declined dramatically, by approximately 7%.

Ultimately, both countries aim to build stronger economies together by supporting economic growth and eliminate trade barriers.

IV. Methodology

4.1 Data

This paper aims to investigate the effects of trade by a leading partner, China, on DR Congo's economic growth. Oftentimes, macroeconomic series such as GDP are reported less frequently, precisely quarterly instead of monthly. In time series, the principal characteristic is temporal ordering as it enables us to observe the changes over time, the aggregate effects of the past. Consequently, issues of correlation across time may occur, which indicates that special treatment should be applied. The entire sample comprises a total of 73 observations for the period 2000Q1 to 2018Q4. The study is carried out on a quarterly basis in lieu of annual to enable a comparatively significant period (T= 76 quarters instead of T =19 years) based on previous research suggesting that $30 \leq T < 100$ would ensure a superior performance (Chudik et. al, 2015). Macroeconomic series are often tabulated monthly, while GDP remains quarterly, which is less frequent. Time series, which are often used to observe aggregate effects, require special treatment because of the correlation across time of most series.

By definition, the gross domestic product (GDP) measures the total value of all goods and services produced within a country's borders (Krugman et al., 2012). Moreover, the size of an economy is highly correlated with the volume of its exports and imports. The dependent variable is given by the quarterly GDP in US$ dollars. Data describing the outcome variable came from the World Bank's World Development Indicators database. The World Bank database represents a reliable source for retrieving information due to its conformity to internationally approved standards and norms.

The independent variables associated with trade were retrieved from the World Bank's World Integrated Solution database. Export implies a movement from DR Congo to China, and import signifies the opposite. The indicators were initially reported in US$ dollars prior to their logarithmic transformations. Given the properties of time series and relatively short time span (from 2000 to 2018), annual data were adjusted to quarterly by using the econometric software Eviews10 under specific options. Furthermore, preliminary tests confirmed that the model does not suffer from structural breaks. Overall, we are expecting positive influence from trade with China, specifically in export.

Table no1: Descriptive Statistics and Correlation Matrix

Variables	Ln_GDP	Ln_Export	Ln_Import
Mean	23.768	13.075	12.237
Std. Deviation	0.321	2.469	1.704
Minimun	23.314	3.660	9.453
Maximum	24.310	15.738	14.628
Ln_GDP	1.000		
Ln_Export	0.846	1.000	
Ln_Import	0.939	0.912	1.000

Source: Author's calculations

The correlation matrix indicates no linear correlation amongst the variables, although they remain highly correlated. Given that correlation does not imply causality, the empirical analysis will determine the nature of the association amongst the variables.

4.2 Empirical Specifications

From a theoretical perspective, the Cobb-Douglas function has been widely used in multidisciplinary studies for decades, including labor, public finance, development, and growth, as it can be easily manipulated. Quantitative studies in international trade and growth have been applying the relative production function for an extensive period. The Cobb-Douglas production function is given by:

$$\boldsymbol{Y = AK^{\alpha}L^{\beta}}$$

where Y denotes the aggregate output, while K, L, and A represent capital, labor, and total factor of production (technology), respectively. The latter carries further implications associated with trade. Economists have demonstrated that trade constitutes a vector for technological transfer whether it originates from exports or imports. Imports may positively influence growth through numerous channels. In LDCs, imported ideas (through trade) from technologically advanced partners are considered major determinants of technological advancement as they promote knowledge transfer. Ultimately, exports and imports can represent incentives for local producers to engage in innovative activities. Studies have demonstrated that technological progress can only occur under the assumption that knowledge A increases, which justifies growth in the long run.

Empirically, this paper uses an ARDL model to investigate the influences of trade on DR Congo's economic growth. The Autoregressive Distributed Lag (ARDL) models combine the following characteristics: autoregressive (AR) and distributed lag (DL) models, hence, employ a combination of endogenous and exogenous variables. By nature, they are dynamic models; such models notably consider temporal dynamics in analyzing variables, improving projections and policy effectiveness. Furthermore, the ARDL technique is considered more efficient in the presence of smaller and finite samples and can generate (long-run) unbiased results.

The generalized ARDL (p,q,...,q) model can be written as follow:

$$\mathbf{Y_{it}} = \boldsymbol{\gamma_{0i}} + \sum_{i=1}^{p} \boldsymbol{\delta_i}\, \boldsymbol{Y_{t-i}} + \sum_{i=0}^{q} \boldsymbol{\beta_i}\, \boldsymbol{X_{t-i}} + \boldsymbol{\varepsilon_{it}}$$

$\mathbf{Y_t}$ is a vector, and $\boldsymbol{X_t}$ denotes variables that can be purely I(0), I(1), or co-integrated. I(0) implies stationary level variables, while I(1) implies first difference stationary variables (Pesaran et al., 1999). $\boldsymbol{\gamma}$ is the intercept, while $\boldsymbol{\beta}$and $\boldsymbol{\delta}$ stand for coefficients. The subscripts *p* and *q* are optimal lag orders, representing the lags for the dependent and explanatory variables, respectively. i = 1,…,k , and, in this particular situation, denotes the number of variables in the model. $\boldsymbol{\varepsilon_{it}}$ is the error term. To explore the relationship between economic growth and trade, the ARDL model is given by:

$$\boldsymbol{\Delta lnGDP_t = a_{01} + \sum_{i=1}^{p} a_{1i}\, \Delta lnGDP_{t-i} + \sum_{i=1}^{q} a_{2i} \Delta lnExport_{t-1} + \sum_{i=1}^{q} a_{3i} \Delta lnImport_{t-i} + e_t}$$

where $\Delta lnGDP_t$ denotes the dependent variable, the Congolese GDP, while $\Delta lnExport_{t-1}$ and $\Delta lnImport_{t-i}$ represent the independent variables, exports to China and imports from China. The model specified above is the short-run ARDL model, which has been determined by preliminary tests further described in the following section. Therefore, a_{1i} , a_{2i}, a_{3i} are the short-run coefficients. e_t is the error term.

V. Empirical Results

5.1 Augmented Dickey-Fuller (ADF) Test

Table no 2 illustrates the tabulated results for unit root detection applying the Augmented-Dickey Fuller (ADF) test to avoid inefficient results in the regression. This specific technique enables higher-order autoregressive processes following the inclusion of lagged changes of the variables as regressors to correct for potential serial correlation. A time-series requires that the statistical properties (of the process generating it) remains invariant across time; hence, stationarity constitutes a mandatory aspect. The null hypothesis indicates the presence of unit root in the variables (non-stationarity).

Table no2: Augmented Dickey-Fuller (ADF) Unit Root Test

Variable	ADF Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	Stationarity
Ln_GDP	-0.028	-3.546	-2.911	-2.590	No
Ln_Export	-2.693	-3.548	-2.912	-2.591	No
Ln_Import	-0.757	-3.546	-2.911	-2.590	No
D(Ln_GDP)	-3.724	-3.548	-2.912	-2.591	Yes → I(1)
D(Ln_Export)	-5.908	-3.549	-2.912	-2.591	Yes → I(1)
D(Ln_Import)	-3.408	-3.548	-2.912	-2.591	Yes → I(1)

Source: Author's calculations

In statistical hypothesis testing, the null hypothesis of non-stationarity is rejected if the Test Statistic (t-stat) is inferior to the Critical Values. At level, the absolute value of Ln_Export exhibits a test statistic (t = -2.693) inferior to the critical value (5%) (c = -2.912), which implies that the null hypothesis cannot be rejected. ADF test results for the remaining variables demonstrate that both Ln_GDP and Ln_Import remain non-stationary at level, with lower (absolute) t-statistic value. Following the inclusion of time trends, that is the first difference, the t-static for the variable Export becomes greater than 5% critical value; hence, the alternative hypothesis can be accepted. Similarly, evidence shows that Ln_GDP and Ln_Import are stationary at first difference, given the superior value of the t-statistics, and the significance of the MacKinnon p-value that further validates the results.

The graphical representation (Figure 4) reveals that there is a relatively strong upward trend for the variable ln_Export over the period 2000Q1 to 2018Q4, as well as for the variable quantifying imports to a certain extent. Alternatively, ln_GDP appears to have a relatively stable and possibly slower upward tendency, perhaps due to the logarithmic transformation.

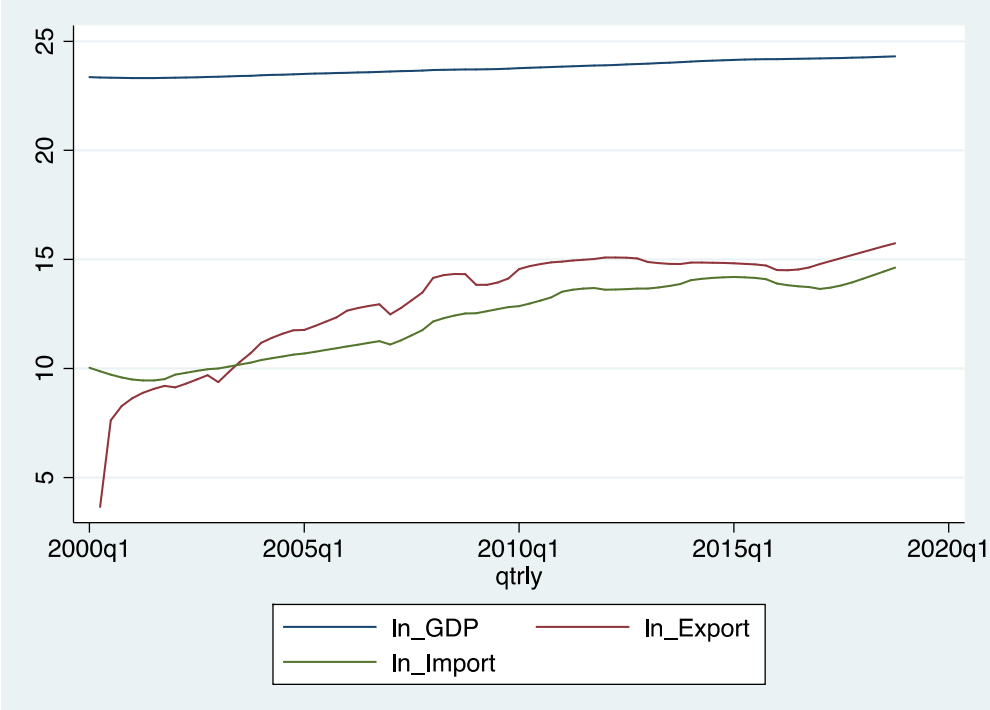

Figure (4): Trends of gross domestic product, exports and imports (2000Q1 – 2018Q4)
Source: Author's calculations from the World Bank's WDI and WIS

5.2 ARDL Bounds Cointegration Test

The unit root tests reveal that the variables are integrated at first difference. Following this analysis, the bounds test, developed by Pesaran, Shin, and Smith (2001), is required to investigate whether the variables exhibit cointegration. In the first instance, the optimal lag structure used to estimate the bounds cointegration test in Stata has been initially retrieved on the basis of the Bayesian Information Criterion (BIC) and exhibits the following structure: ARDL (2,2,1) for Ln_GDP, Ln_Export, and Ln_Import, respectively.

Consequently, the conditional ARDL (p, q_1,q_2) model for the bounds cointegration test with three variables is written as:

$$\Delta lnGDP_t = a_{01} + b_{11} lnGDP_{t-i} + b_{21} lnExport_{t-i} + b_{31} lnImport_{t-i} + \sum_{i=1}^{p} a_{1j}\, \Delta lnGDP_{t-i}$$

$$+ \sum_{i=1}^{q1} a_{2j} \Delta lnExport_{t-i} + \sum_{i=1}^{q2} a_{3j} \Delta lnImport_{t-i} + e_{1t}$$

(where j = 1,2,3)

The null hypothesis criterion indicates no levels relationship, that is, the absence of cointegration amongst the variables. Furthermore, the null hypothesis is rejected if the F-value remains superior to the critical value I(1) regressors and is accepted if inferior to the critical value I(0) regressors. In this instance, the F-statistics accounts for 1.173, which is inferior to the value of I(0). H_0 cannot be rejected, confirming that there is no cointegration amongst the variables. Consequently, the Error Correction Model (ECM) should not be estimated, given the absence of long-run convergence. In this case, only the short-run ARDL model can be specified.

5.3 ARDL Empirical Results

Preliminary tests conducted on the time series sample consisting of ADF-test (stationary), bounds for cointegration test (no cointegration), Gregory-Hansen test (no structural breaks) have suggested that the appropriate approach is the short-run ARDL model (Adeleye et al., 2017). Empirical results for ARDL estimation are reported in Table no 3. As previously stated, the model follows a specific structure, precisely ARDL (2,2,1), as a consequence of the Schwarz-Criterion test (using the command *varsoc* in Stata) where the optimal lags were retrieved.

Table no3: ARDL Empirical Results (Dependent Variable: Δln_GDP)

ARDL(2,2,1) regression

Sample: 2000q4 - 2018q4	Number of obs	=	73
	F(7, 65)	=	89439.61
	Prob > F	=	0.0000
	R-squared	=	0.9999
	Adj R-squared	=	0.9999
Log likelihood = 315.7326	Root MSE	=	0.0034

ln_GDP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ln_GDP						
L1.	1.647235	.0753559	21.86	0.000	1.496739	1.797731
L2.	-.6541002	.0740314	-8.84	0.000	-.801951	-.5062493
ln_Export						
--.	.0044201	.0027669	1.60	0.115	-.0011058	.009946
L1.	-.0071589	.0032987	-2.17	0.034	-.0137468	-.000571
L2.	.0020487	.0010129	2.02	0.047	.0000258	.0040715
ln_Import						
--.	.0125668	.0057081	2.20	0.031	.0011668	.0239667
L1.	-.010139	.005433	-1.87	0.067	-.0209894	.0007114
_cons	.14641	.1050106	1.39	0.168	-.0633107	.3561306

Source: Author's calculations

In the first instance, evidence from the ARDL estimation indicates a positive and significant influence of exports to China on the Democratic Republic of the Congo's gross domestic product with regards to the second lag. Results show that a percentage point change in the first lag of Ln_Export is associated with a 0.007 percent decline in the gross domestic product at a 5% significance level. The second lag of Ln_Export indicates a positive association with economic growth at 5%, precisely a 0.002 percent increase, *ceteris paribus.* This implies that DR Congo exports to China are most likely to positively affect the country's GDP, which validates the initial hypothesis. Furthermore, previous research has found robust evidence of the positive influence of trade with China on Africa's economic growth, precisely on resource-abundant and 'maritime access' countries (Mullings & Mahabir, 2018), which characterizes DR Congo. Furthermore, the country's exports are highly concentrated on specific commodities (copper and cobalt), which appears more beneficial, according to Baliamoune-Lutz's (2010) findings.

Alternatively, results regarding imports from China show a negative coefficient at a 10% significance level. It implies that, in the short-run, the first lag can significantly influence changes in the Congolese gross domestic product, that is, a percentage change in imports decreases the GDP by 0.010 percent. In the GDP formula, 'import' represents an expenditure; hence, it is negatively associated with the gross domestic product. Nonetheless, as previously discussed, imports may positively impact economic growth through imported ideas (knowledge transfer) from technologically advanced partners (Rauch, 2010), promoting technological advancement, amongst other. Overall, the results are relatively consistent with previous research such as NguyenHuu and Karaman Örsal (2020) and Baliamoune-Lutz (2010).

5.4 Diagnostic Tests

A series of diagnostic test have been conducted to validate the viability of the ARDL model employed in this paper. Precisely, the various tests conducted have investigated the normality of the model, as well as the higher-order correlation and omitted variables. Table no 4 illustrates the different outcomes of the diagnostic tests.

In the first instance, the Durbin-Watson (DW) test indicates no serial correlation amongst the variables. Similarly, the Breusch-Godfrey LM test for autocorrelation confirmed that the model does not suffer from serial correlation. In conclusion, diagnostic test results demonstrate that empirical findings are robust and reliable.

Table no4: Diagnostic Test Results

Specifications	**statistics/p-values**	**Conclusion**
Durbin-Watson (autocorrelation)	2.146/1.758	No autocorrelation
Breusch-Godfrey (autocorrelation)	0.622/0.430	No higher order autocorrelation
Jarque-Bera (normality)	28.61/6.10	Evidence of normality
Ramsey RESET (omitted variables)	11.65/0.000	Omitted variables

The Durbin-Watson test used d-statistics instead of p-values.
Source: Author's calculations

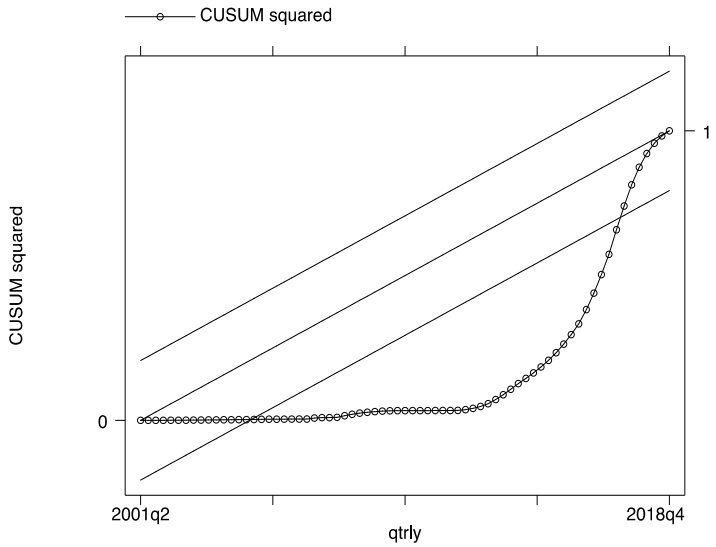

Figure (5): Plot for Model Stability at 5% Significance Level (CUSUMQ)
Source: Author's calculations

Figure (5) reveals that the model may lack of stability to a certain extent, as it does not lie precisely within the 5% significance level boundaries. Nonetheless, previous empirical tests indicated that the model did no exhibit structural breaks (see Appendix). Therefore, the model remains acceptable, and further robustness checks should be carried out.

VI. Robustness Checks

This study recognizes that the initial model, consisting of exports and imports as independent variables, may not precisely reflect the complexity of growth models. The main objective is to have a better understanding of a specific matter, that is, determine whether trade with a leading partner is beneficial or harmful to a country's (LDC) economic growth, and to what extent. According to the benchmark results, further tests are required to confirm the plausibility and robustness of the model.

Controlling for Institutions. In the last few decades, institutional quality has become a fundamental aspect of economic growth and trade relations. From a general perspective, low institutional quality limits foreign and domestic investments, as it most likely reflects poor economic performances and low protection levels (private property rights). In this sense, data from the World Bank's Country Policy and Institutional Assessment (CPIA) indicates that institutional quality barely changes over time, which has previously been demonstrated in related research. For instance, on a scale of 1=low to 6=high, the CPIA property rights and ruled-based governance rating stayed constant for DR Congo at 2 points over the period 2005-2019. Therefore, the study finds it unnecessary to control for institutional quality following its 'static' performance over the period 2000-2018.

Controlling for Capital and Labor. The study considers capital and labor as control variables, which is consistent with NguyenHuu and Örsal (2020), who simultaneously conduct robustness checks to investigate the consequences of omitted variables. The authors estimate labor and capital on the basis of population and capital stock, respectively. It is worth noting that previous studies have discovered a positive association between capital and growth, notably regarding imported machinery (Mazumdat, 2001).

Findings for the ARDL model are illustrated in Table no 4. Additional data (capital and labor) used in the robustness check displayed in the table below were retrieved from the Penn World Table version 10.0; the number of persons engaged (employment) represents a measure for 'labor' while the capital stock at constant US$ 2017 national prices quantifies 'capital'. Evidence exhibits a relatively different outcome in comparison to the previous analysis without any control variables (Table no 3). Overall, Ln_Export shows a positive and significant coefficient at a 5% significance level for the second lag. It implies that a percentage increase in exports is most likely to enhance the Congolese GDP by 0.002% in the short-run, ceteris paribus, which is consistent with the initial expectations. Surprisingly, imports from China appear to have little to no significance in the gross domestic product when controlling for labor and capital. Baliamoune-Lutz (2010) has demonstrated the opposite for Africa, indicating that imports from China positively influence growth in the sampled countries. A plausible explanation regarding this outcome could emanate from the fact that imports, which represent the expenditure component in the tabulated GDP, use various indirect channels when it comes to foster growth. It can translate into the forms of imported ideas and technological transfer, which can result in stimulating innovation and competition. Nevertheless, the ways domestic companies absorb these elements remain rather unclear, and, perhaps, other factors should be taken into account in order to find adequate solutions for DR Congo to further benefit from imports and trade in general.

Table no5: Results for Robustness Checks

Sample: 2000q4 - 2018q4 — Number of obs = 73
F(11, 61) = 38891.57
Prob > F = 0.0000
R-squared = 0.9999
Adj R-squared = 0.9998
Log likelihood = 304.15301 — Root MSE = 0.0041

ln_GDP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ln_GDP						
L1.	.9446155	.0323841	29.17	0.000	.8798595	1.009372
ln_Export						
--.	.0090989	.0037476	2.43	0.018	.0016051	.0165928
L1.	-.0057289	.0044671	-1.28	0.205	-.0146613	.0032036
L2.	.0026765	.0012632	2.12	0.038	.0001506	.0052024
ln_Import						
--.	.0166287	.0089702	1.85	0.069	-.0013083	.0345657
L1.	-.0103867	.0141627	-0.73	0.466	-.0387067	.0179334
L2.	-.003366	.0079186	-0.43	0.672	-.0192001	.0124681
ln_Capital						
--.	-.1010539	.2619641	-0.39	0.701	-.6248835	.4227756
L1.	.1502024	.2807917	0.53	0.595	-.4112753	.7116801
ln_Employment						
--.	1.439783	.3326351	4.33	0.000	.7746377	2.104928
L1.	-1.486544	.3265037	-4.55	0.000	-2.139428	-.8336591
_cons	.7493314	.4570933	1.64	0.106	-.1646831	1.663346

Source: Author's Calculations

VII. Conclusion and Policy Implications

In recent years, China has achieved economic prominence in the Global South, becoming a crucial partner for many countries, particularly in Africa. Consequently, there has been a growing interest in growth-by-destination trade involving China as a leading partner. This research represents an opportunity to enhance our understanding of trade relations in the China-Africa context and adopt appropriate responses accordingly. The historical overview has demonstrated that China and DR Congo bilateral relations have evolved towards a strategic partnership in which both nations collaborate according to a win-win philosophy, supporting each other in order to reach sustainable development, ultimately strengthening trade relations. In this sense, China has become a major trading partner for DR Congo, as for multiple developing countries, constituting the main export and import market.

This study investigated the effect of the Sino-Congolese trade on DR Congo's economic growth over the period 2000-2018. Pre-estimation observations - including the Augmented Dickey-Fuller (ADF) test for unit roots and the bounds test for cointegration - suggested that the short-run ARDL model was the most appropriate approach. The empirical analysis was based on the hypothesis that exports positively influence DR Congo's growth. Alternatively, it has been discussed that imports constitute an expenditure in the tabulated GDP; hence are more likely to be negatively associated with growth. Nonetheless, imports can positively influence the latter through various indirect mechanisms, including imported ideas which may not necessarily be captured in this paper's model.

Findings indicate that the short-run effects of exports to China remain positively associated with economic growth in DR Congo, even when applying additional controls in robustness checks. Robustness checks were carried out using labor and capital with regards to the Cobb-Douglas production function implications. Furthermore, the study found it unnecessary to control for institutional quality, which is a fundamental determinant of growth, following its 'static' performance over the period 2000-2018. Alternatively, imports produced mixed results, ranging from negative without control variables and insignificant when controlling the study.

The analysis demonstrated that the Sino-Congolese trade had positive implications regarding DR Congo's growth. Challenges policymakers are most likely to face would be maintaining a certain level of sustainability concerning economic growth and implementing policies that will promote exports while diversifying the domestic economy. They should equally consider implementing value-added-oriented measures to become less vulnerable to external shocks. Finally, the newly signed Belt and Road Initiative agreement between China and DR Congo constitutes an opportunity to revitalize and strengthen the bilateral relations.

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Structural Break Test

```
. ghansen ln_GDP ln_Export ln_Import, break(level) lagmethod(bic)

Gregory-Hansen Test for Cointegration with Regime Shifts
Model: Change in Level                          Number of obs    =         75
Lags   =  0  chosen by Bayesian criterion       Maximum Lags     =          2

             Test       Breakpoint   Date        Asymptotic Critical Values
            Statistic                          1%          5%          10%
------------------------------------------------------------------------------
   ADF       -2.93          55       2013q3     -5.44       -4.92       -4.69
   Zt        -3.88          55       2013q3     -5.44       -4.92       -4.69
   Za       -18.11          55       2013q3    -57.01      -46.98      -42.49
------------------------------------------------------------------------------

. ghansen ln_GDP ln_Export ln_Import, break(trend) lagmethod(bic)

Gregory-Hansen Test for Cointegration with Regime Shifts
Model: Change in Level and Trend                Number of obs    =         75
Lags   =  2  chosen by Bayesian criterion       Maximum Lags     =          2

             Test       Breakpoint   Date        Asymptotic Critical Values
            Statistic                          1%          5%          10%
------------------------------------------------------------------------------
   ADF       -4.05          63       2015q3     -5.80       -5.29       -5.03
   Zt        -5.34          34       2008q2     -5.80       -5.29       -5.03
   Za       -29.28          34       2008q2    -64.77      -53.92      -48.94
------------------------------------------------------------------------------

. ghansen ln_GDP ln_Export ln_Import, break(regime) lagmethod(bic)

Gregory-Hansen Test for Cointegration with Regime Shifts
Model: Change in Regime                         Number of obs    =         75
Lags   =  2  chosen by Bayesian criterion       Maximum Lags     =          2

             Test       Breakpoint   Date        Asymptotic Critical Values
            Statistic                          1%          5%          10%
------------------------------------------------------------------------------
   ADF       -3.73          37       2009q1     -5.97       -5.50       -5.23
   Zt        -3.94          54       2013q2     -5.97       -5.50       -5.23
   Za       -24.79          54       2013q2    -68.21      -58.33      -52.85
------------------------------------------------------------------------------
```

Dickey Fuller Test

```
. dfuller ln_GDP, lags(1)

Augmented Dickey-Fuller test for unit root         Number of obs   =        74

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -0.028           -3.546            -2.911           -2.590
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.9561
```

```
. dfuller ln_Export, lags(1)

Augmented Dickey-Fuller test for unit root         Number of obs   =        73

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -2.693           -3.548            -2.912           -2.591
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0752
```

```
. dfuller ln_Import, lags(1)

Augmented Dickey-Fuller test for unit root         Number of obs   =        74

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -0.757           -3.546            -2.911           -2.590
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.8315
```

```
. dfuller d.ln_GDP, lags(1)

Augmented Dickey-Fuller test for unit root         Number of obs   =        73

                                 ---------- Interpolated Dickey-Fuller ----------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -3.724            -3.548            -2.912           -2.591
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0038

. dfuller d.ln_Export, lags(1)

Augmented Dickey-Fuller test for unit root         Number of obs   =        72

                                 ---------- Interpolated Dickey-Fuller ----------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -5.908            -3.549            -2.912           -2.591
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller d.ln_Import, lags(1)

Augmented Dickey-Fuller test for unit root         Number of obs   =        73

                                 ---------- Interpolated Dickey-Fuller ----------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -3.408            -3.548            -2.912           -2.591
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0107
```

Optimal Lag Length

```
. matrix list e(lags)

e(lags)[1,3]
       ln_GDP  ln_Export  ln_Import
r1          2          2          1
```

```
ARDL(2,2,1) regression

Sample: 2000q4 - 2018q4                         Number of obs     =         73
                                                R-squared         =     0.7670
                                                Adj R-squared     =     0.7420
Log likelihood =   315.7326                     Root MSE          =     0.0034
```

D.ln_GDP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ADJ						
ln_GDP L1.	-.0068653	.0048976	-1.40	0.166	-.0166464	.0029159
LR						
ln_Export	-.100528	.1137652	-0.88	0.380	-.3277329	.1266768
ln_Import	.3536262	.1539915	2.30	0.025	.0460839	.6611686
SR						
ln_GDP LD.	.6541002	.0740314	8.84	0.000	.5062493	.801951
ln_Export D1.	.0051102	.0027142	1.88	0.064	-.0003104	.0105309
ln_Export LD.	-.0020487	.0010129	-2.02	0.047	-.0040715	-.0000258
ln_Import D1.	.010139	.005433	1.87	0.067	-.0007114	.0209894
_cons	.14641	.1050106	1.39	0.168	-.0633107	.3561306

```
note: estat btest has been superseded by estat ectest
      as the prime procedure to test for a levels relationship.
      (click to run)

Pesaran/Shin/Smith (2001) ARDL Bounds Test
H0: no levels relationship                  F =  1.173
                                            t = -1.402

Critical Values (0.1-0.01), F-statistic, Case 3
```

	[I_0] L_1	[I_1] L_1	[I_0] L_05	[I_1] L_05	[I_0] L_025	[I_1] L_025	[I_0] L_01	[I_1] L_01
k_2	3.17	4.14	3.79	4.85	4.41	5.52	5.15	6.36

```
accept if F < critical value for I(0) regressors
reject if F > critical value for I(1) regressors

Critical Values (0.1-0.01), t-statistic, Case 3
```

	[I_0] L_1	[I_1] L_1	[I_0] L_05	[I_1] L_05	[I_0] L_025	[I_1] L_025	[I_0] L_01	[I_1] L_01
k_2	-2.57	-3.21	-2.86	-3.53	-3.13	-3.80	-3.43	-4.10

```
accept if t > critical value for I(0) regressors
reject if t < critical value for I(1) regressors

k: # of non-deterministic regressors in long-run relationship
Critical values from Pesaran/Shin/Smith (2001)
```

ARDL Bounds Cointegration Test

```
. regress Ln_GDP Ln_Export Ln_Import
```

Source	SS	df	MS	Number of obs	=	75
				F(2, 72)	=	443.43
Model	7.03128108	2	3.51564054	Prob > F	=	0.0000
Residual	.570839609	72	.007928328	R-squared	=	0.9249
				Adj R-squared	=	0.9228
Total	7.60212069	74	.102731361	Root MSE	=	.08904

Ln_GDP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Ln_Export	-.0213561	.0101738	-2.10	0.039	-.0416372	-.0010751
Ln_Import	.209588	.0148066	14.16	0.000	.1800715	.2391044
_cons	21.48198	.0822297	261.24	0.000	21.31805	21.6459

```
. ovtest

Ramsey RESET test using powers of the fitted values of Ln_GDP
       Ho:  model has no omitted variables
                  F(3, 69) =     11.65
                  Prob > F =      0.0000
```

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