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The Impact of International Trade on Income Inequality: The Case of Germany

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Abstract

This study investigated how international trade (IT) influenced Germany's income inequity (IINQ) between 1990 and 2021. It used time series data to achieve its objectives. The study performed a series of tests to demonstrate that the unit root and cointegration tests can address non-stationary (NS) problems and verify relationships across time. The study used Augmented Dickey-Fuller and Phillips-Perron tests and found that all variables used in the study integrated at the first difference. Moreover, the Johansen Cointegration test "suggests a long-term association between the variables" used in the study. The study also employed the Vector Error Correction Model (VECM) to "determine the long and short-term" consequences of international trade (IT) on income inequality (IINQ). The study found a long-term and short-term association between international trade (IT) and income disparity (ID) in Germany. Using the GINI index, the study documents that the effect on international trade (IT) has diverse impacts on different income strata. Moreover, we found that increasing Exports (EXPs) exacerbate economic disparity (DS), and increasing imports (IMPs) promote income inequality (IINQ). Aside from that, test coefficients have revealed that exports (EXPs) and imports (IMPs) promote income inequality (IINQ) via the Gini index. Furthermore, the "CUSUM and LM tests" have shown that the model is stable and has no serial correlation. Germany's policymakers can use the findings to reduce income disparity (IDS) caused by international trade (IT).

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Keywords: *Exports (EXPs) import (IMPs), income inequality (IINQ), Germany, VECM.*

Introduction

International trade (IT) is important for the global economic system (GLC). Its openness significantly affects all countries globally (Luo, 2022). Extant literature suggests that international trade (IT) volume has significantly increased in the last four decades (Vătămănescu et al., 2020). According to an estimate, aggregate exports were 1.97 trillion USD in 1980, which reached 17.73 trillion USD in 2020 (World Bank data). Moreover, in the prevailing era of the global economy, it has become convenient to export and import goods and services virtually (Sampson, 2023). In this context, extant literature cites that International trade (IT) has multiple effects on a country's and global economies (GLEs) (Nathaniel et al., 2021). According to Yu (2023), international trade (IT) insignificantly affects economic growth in the short term. In the long term, it adversely affects economic growth (EG) and promotes income disparity (ID). In contrast, other researchers believe international trade (IT) positively affects economic growth (EG) and reduces income disparity (ID) (Kumari et al., 2023). Thus, we argue that a country's growth and sustainability profoundly depend on balancing international trade.

Furthermore, Semieniuk and Yakovenko (2020) observed that economic growth (EG) fluctuated significantly between 1980 and 2020. They found that the bottom 50% of economies captured 9% of global economic growth (GEG), while the top 1% captured 23% of global economic growth (GEG). Despite the benefits of international trade (IT), income inequality (IINQ) has become a serious issue in most countries (Takim & Gültekin, 2022). For example, current literature argues that the volume of international trade (IT) promotes problems of income inequality (IINQ) (Naanwaab, 2022). In contrast, Akyuz, Gueye, and Karul (2022) argue that the effect of international trade (IT) on different income strata is different. Generally, higher-income strata benefit more from income disparity (IND) than lower-income ones (Gordon, 2023; Engler & Weisstanner, 2021).

Many past studies have examined the association between international trade (IT) and income distribution (IND) and found inconsistent results (Ratnawati, 2020; Hussain et al., 2023). For example, many studies found that openness to international trade (IT) increases income inequality (IINQ) (Fatima et al., 2020). In contrast, other studies have identified that "international trade (IT) reduces inequality (IINQ). Moreover, past studies have also related the association between "international trade (IT) and income inequality (IINQ)" with talents in a country. For example, Flaherty and Rogowski (2021) found that international trade (IT) exacerbates income disparity (IND) in nations where talent is rare. However, countries with abundant skilled labor do not face the problem of income inequality (IINQ) (Dorn et al., 2022). Similarly, while examining the

association between international trade (IT) and income disparity (IND), many studies have related this association to the political system in a country. For instance, Ghauri et al. (2021) highlighted that the political system is critical in determining the impact of "international trade (IT) on income inequality (IINQ)." Their research documents that international trade (IT) increases economic disparity (IND) in autocratic regimes. In contrast, the literature documents that in democratic societies, "international trade (IT) reduces income inequality (IINQ)" (Ratnawati, 2020). Moreover, Amar and Pratama (2020) maintain that increased "foreign trade in short-term increases income inequality (IINQ) and in the long-term it decreases income inequality (IINQ)."

Despite the availability of an abundance of research on the Impact of "international trade (IT) on income inequality (IINQ)," this research significantly differs from many past research studies:

1. It presents how international trade (IT) influences "income inequality (IINQ) in a high-income (IN) country," Germany.

2. Secondly, this study employs the innovative Vector Error Correction Model (VECM). This sophisticated analytical tool provides a comprehensive understanding of the long-term and short-term consequences of international trade (IT) on income inequality (IINQ).

3. Lastly, this study takes a comprehensive approach by examining the association between international trade (IT) indicators and income disparities (INDs). This analysis is based on data collected over a period from 1990 to 2021, allowing for a thorough understanding of the trends and patterns in the relationship between international trade (IT) and income disparities (INDs).

Literature Review

Several esteemed scholars have dedicated their research to examining the intricate relationship between "income inequality (IINQ) and trade openness (TO)." Their work, which we will now summarize, is a testament to the importance and complexity of this topic.

Aradhyula et al. (2007) examined the influence of "international trade (IT) on income (IN) and income inequality (IINQ)." They found that international trade (IT) has a diverse impact on a country's different income strata. It increases income inequality, and the standard of living of poor income strata goes beyond the subsistence level. On the contrary, the affluent class benefits more as their disposable income significantly

increases. Their Panel Data Model comprised developed and developing countries between 1985 and 1994. The results indicate that "international trade (IT) increases income inequality (IINQ)" in both types of countries. However, income inequality (IINQ) in developing countries would be high and nominal in developed countries. In contrast, Wan, Lu, and Chen (2007) found that "foreign trade affects income inequality (IINQ)" in China. The article examined "income distribution (ID) and international trade (IT) data" from 1978 to 2005. The study documents that both imports (IMPs) and exports (EXPs) reduce income inequality (IINQ). The study also underlined that exports (EXPs) reduce "income inequality (IINQ) more profoundly than imports (IMPs)."

Based on the dynamic specification, Meschi and Vivarelli (2009) have examined the "impact of income inequality (IINQ) in 65 developing countries". The study used a data set of 19 years (i.e., 1980 to 99). It documented that imports (IMPs) and exports (EXPs) from developed countries adversely affect income distribution (ID) in developing countries. Similarly, other studies exploring the association between international trade (IT) and income distribution (ID) have highlighted the complex role of skilled labor (Liang, 2024). These studies underscore that the prevalence of skilled labor in developed countries, and to a lesser extent in middle-income countries, contributes to their relatively lower income inequality (IE). This complexity underscores the need for further research and understanding.

Bensidoun et al. (2011) investigated "the relationship between international trade (IT) and income inequality (IINQ)." They used GINI fluctuation at 4-year intervals (not overlapping) corresponding to variations in trade factor composition. The study did not consider production elements such as non-educated workers, other workers, and physical capital. The study cites that the consequences of trade openness (TO) on income inequality (IINQ) are trade factors, including the country's endowment. Moreover, researchers assert that skilled labor is an important antecedent to income disparity (IND) (Ghosh et al., 2023). The number of skilled laborers in developed countries is higher than in developing countries. Therefore, income disparity in developed countries is lesser than in developing countries (Liang, 2024). Furthermore, these studies argue that skilled labor in middle-income (MI) countries is comparatively higher than in the lower economies. Therefore, income disparity (IND) in middle-income (MI) countries is lower than in lower-income economies (Erkisi, 2023).

In this context, extant literature cites that raising the capital content of trade (CCT) reduces income disparity (IND) in developed countries and increases in developing countries (Chen et al., 2023). Thus, we argue that changes in the "capital content of trade (CCT) have different effects on income disparities (INDs) of developed and developing

countries (Zreik, 2023). Moreover, Demir et al. (2012) maintain that past studies found inconclusive results on the association of "trade openness (TO) and income inequality (IINQ) in developing countries." For example, some studies found that when exports (EXPs) exceed a threshold level, it reduces income inequality (IINQ) (Makhlouf, 2023). On the contrary, when the exports (EXPs) of a country are below the threshold level, it enhances income inequality (IINQ) (Nam et al., 2024). Franco and Gerussi (2013) explored the impact of "direct investment inflows on income inequality (IINQ)" in 17 transition countries using a 16-year data set (i.e., between 1990 and 2006). The authors used fixed-effect and random-effect models in their study. The study cites that trade with industrialized nations has a greater impact on income distribution in transition countries than foreign direct investment (FDI). Similarly, Kim et al. (2021) believe that market institutions and macroeconomic variables "impact income disparity (IND)." Reyes-Heroles et al. (2020) maintain that reducing tariffs and other trading barriers is important for increasing global trade (GT). However, trade liberalization (TL) has different impacts on different countries on different aspects of the economy, including inequality (IE) indicators (Muradovna, 2020). Given its importance, many past studies have examined the effect of "distribution of income (IN) and economic growth (EG)" on global trade (GT) (Ghodsi, 2020). For example, some studies document that apart from trade barriers, increasing GDP also significantly contributes to global trade (GT) (Dhingra et al., 2023). Moreover, Wang, He, and Chen (2023) believe trade liberalization (TL), high-income growth (HING), and literacy are significant precursors of income inequality (IINQ). An increase in these factors individually and collectively reduces income inequality (IINQ) (Jin et al., 2024).

Pradhan and Mahesh (2016) investigated the effects of "trade openness (TO) on income inequality (IINQ)" in "BRIC countries, specifically Brazil, the Russian Federation, China, and India." The study documents that increased trade as a percentage of GDP contributes to "income inequality (IINQ)" in these nations. Similarly, Meschi and Vivarelli (2009) utilized an LSDV (Least Square Dummy Variable) in a sample of 65 developing nations from 1980 to 1999. The findings support that potential and technological advancement differences affect international trade (IT). Barusman and Barusman (2017) investigated "how trade openness (TO) affects income distribution (IND) in the United States." The study used "import/GDP, export/GDP, and trade volume and time series data from 1970 to 2014." The study utilized two OLS estimations, one highlighting income disparity (IND) using the GINI index and the other focusing on the top 10% income share (IS). The study documented that international trade (IT) exacerbates income disparity (IND). It was also found that increased trade volume, in particular, contributes to income disparity (IND), as the top 10% of the wealthiest individuals earn more.

Furthermore, Agusalim and Pohan (2018) "examined the impact of international trade (IT) on income distribution (IND) in both the long and short term." The study used secondary data, with the GINI index as the measure of international trade and the Vector Error Correction Model (VECM). The study documents that trade openness (TO) has a small and negative impact on "short-run income inequality (IINQ)" in Indonesia. It also found that income disparity (IND) significantly reduces over time. Based on the "Forecast Error Variance Decomposition (FEDV), a study "established that trade openness (TO) insignificantly affects income disparity (IND) in Indonesia," but economic development promotes income disparity (IND). While examining how globalization affects poverty and income inequality (IINQ), Koffi et al. (2018) utilized the percentage of GDP represented by total imports (IMPs) and exports (EXPs) to gauge openness to international trade (IT) and the Gini index to measure income inequality (IINQ). They developed three models (a Naïve model, a Standard model, and an improved standard model) to assess the impact of each variable. The study found inconclusive results on the association between poverty and trade openness (TO). It also found that globalization promotes income disparity (IND). Moreover, the study documents that increased openness to international trade (IT) reduces poverty and income inequality (IINQ). However, the extent of this impact depends on the factors used in the models.

Xiong and Sun (2021) investigated the potential effect of "international trade (IT) on income inequality (IINQ) in China." The author used "home panel data and provincial statistics from 1988 to 2009" to study income inequality (IINQ) changes over time and estimate the effect of "international trade (IT) on income inequality (IINQ) with dynamic panel data." The study documents that foreign trade considerably influences income (IN) distribution among Chinese regions. The study also found that higher GDP and factor endowments are associated with lower income inequality (IINQ). In comparison, higher levels of exports (EXPs) and imports (IMPs) are associated with higher income disparity (IND). The study also shows that global trade (GLT) affects income disparity (IND). Wang et al. (2020) investigated the impact of "international trade (IT) on income disparity (IND)" in developing economies. The authors employed econometric estimates to determine the relationship between exports (EXPs) and imports (IMPs), foreign direct investment (FDI), GDP, unemployment, and income inequality (IINQ). The study used the Vector Error Correction (VEC) model to determine the "association between these antecedents and international trade (IT)." The study documents that a high import and export ratio of GDP has a smaller influence on income inequality (IINQ) in industrialized countries than in developing countries. International trade (IT) has a stronger impact on "income disparity (IND) in developing countries than developed countries."

Furusawa (2020) examined how "international trade (IT) affects wage and job

polarization." The study selected two countries with different abilities. They selected one country that has a high number of knowledgeable workers who can develop differentiated products. The other country it selected has a bulk of workers engaged in production. The study documents that in equilibrium, "ex-ante symmetric firms attract knowledgeable workers," which creates "heterogeneity in product quality." The study also asserts that firms producing high-quality products can benefit from market integration. Hartmann and Jüpner (2020) analyzed data from 116 nations' exports (EXPs) and imports (IMPs) from 1970 to 2010 to evaluate the relationship between import, export, and Gini. The selected countries' global trade (GT) and GDP in 2008 were 97.45% and 86.67%, respectively. The study documents that the types of products these countries traded promoted income inequality (IE). It also suggested that the core-periphery structure of global trade (GLT) affects income disparity (IND) between and within countries. It also cites that some middle-income (MIN) countries have benefitted from outsourcing products, resulting in significant income disparity (IND). It also found that successfully developed economies have high volumes of imports (IMs) and exports (EXs), which leads to significant income inequality (IIE). On the contrary, the study asserts that emerging countries face a twin development trap that prevents them from achieving equitable growth.

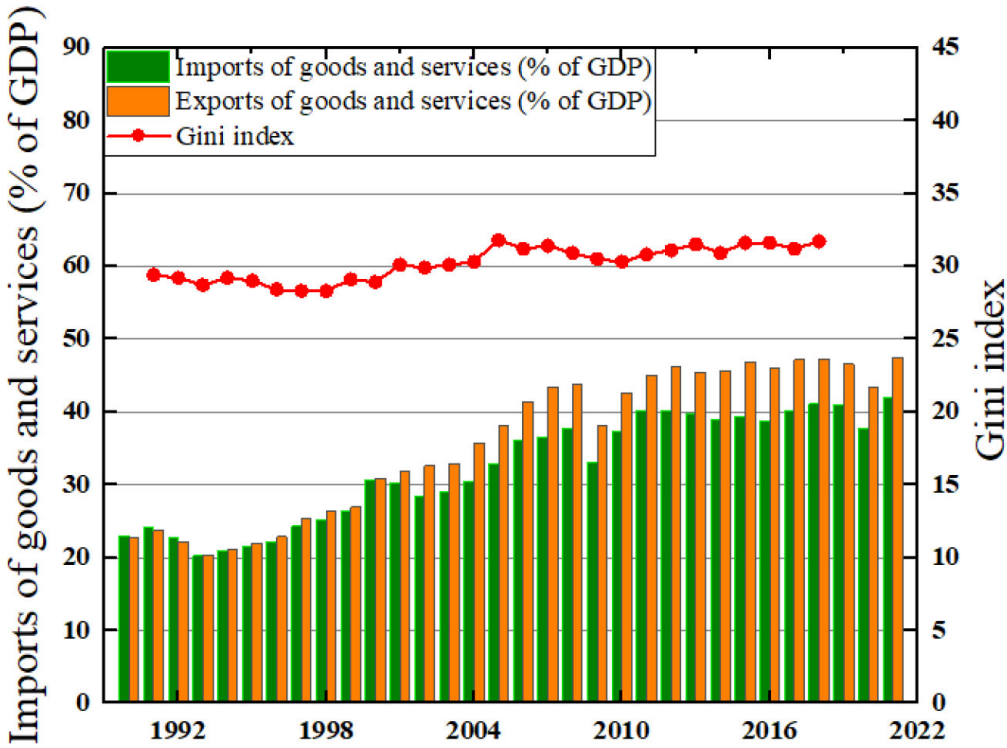
Lin and Fu (2016) regressed two trade cost variables (the Baltic Dry Index and the Price Index) and the GINI index, using data ranging from 1985 to 2012. The study used the "GINI index to assess income inequality (IINQ)." The authors argue that foreign direct investment (FDI) is low in autocratic countries. Democratic systems, on the other hand, attract a large amount of foreign direct investment (FDI) from developed countries and export more food and manufacturing products. As a result, there are low-income disparities (INDs) in the autocratic setup and high in the democratic setup. The authors also underscore that income disparities (INDs) significantly depend on the system's efficiency. Thus, we argue that income distribution (IND) across countries depends on the elements that produce the general equilibrium of production. Differences in the factors of production explain the income disparities (INDs) between countries. Ogundari and Onyeaghala (2021) investigated the impact of trade liberalization (TL) on income inequality (IINQ) in Africa. The study using a panel data model from 26 African countries over 14 years (1996-2010) concluded that trade liberalization (TL) has improved African income inequality (INQ).

Extant literature documents that 25% of global production (GLP) is exported to different countries in the prevailing era. Khan et al. (2023) assert that all nations can benefit from international trade (IT) by specializing in producing goods and services based on their unique factor endowments and strengths. Moreover, natural resources, land, labor, capital, technological development, and political considerations justify

international trade (IT), as these factors are distinct for each nation due to their differing characteristics (Alvarado et al., 2023). Consequently, international trade (IT) enables businesses to discover potential global markets (PGLs) for distributing their products and services (Appiah et al., 2024). It also allows consumers to access goods and services that are not locally available but obtainable from abroad. Even when goods and services are accessible locally, consumers may find optimal satisfaction through those obtained from abroad (Khan et al., 2023).

Growth of International Trade (GIT)

Figure 1 depicts imports (IMPs) and exports (EXPs) of goods and services as a percentage of Germany's GDP.



In 2021, Germany was the "world's fourth-largest economy" in terms of GDP (current USD). In the same year, Germany was the third-largest country in terms of imports (IMP) and exports (EXPs). Germany was the largest vehicle exporter in 2021, with a value of 117.6 billion euros, and the top importer of nitrogen heterocyclic compounds, with a value of 12.7 billion USD. Its trade in 2021 was 89% of the GDP, compared to 81% of GDP in the previous year. Germany's trade balance has been constantly positive in recent

years. Moreover, Germany's membership in international economic organizations such as the World Trade Organization (WTO) and the European Union (EU) supports and controls international trade (IT) through trade agreements. Germany has several trading partners worldwide, the most important of which are China and the United States.

Results and Discussion`

Descriptive Analysis

As previous studies suggested, the study performed descriptive analysis before empirical estimations (George & Mallery, 2018). The analysis is useful for identifying the research variables' properties and their statistical features. Table 1 depicts the summary of the results.

Table 1: Descriptive Statistics

	Exports (EXPs)	Imports (IMPs)	GINI
Mean	35.37649	31.74210	30.19286
Median	36.88647	31.76875	30.30000
Max	47.30105	41.13336	31.80000
Min	20.31344	20.26329	28.30000
Std. Dev.	9.904445	7.257865	1.153394
Skewness	-0.198311	-0.167930	-0.231266
Kurtosis	1.442874	1.507395	1.685442
Jarque-Bera	3.227439	2.925838	2.265664
Prob	0.199145	0.231559	0.322120
Sum	1061.295	925.2631	845.4000
Sum Sq. Dev	2844.843	1527.621	35.91857

The results indicate that the mean values of exports (EXPS), imports (IMPs), and GINI are 33.37649, 31.74210, and 30.19286, respectively. Considering these and other descriptive statistics, we have inferred that there are no issues related to the outliers and univariate normality.

ADF and PP Unit Root Tests

The review of prior literature suggests that examining the data's stationarity is appropriate, especially in a time series dataset (Mukhtarov et al., 2020). We applied the DF test (Dickey & Fuller, 1981) and the PP Test (Phillips & Perron, 1988) to identify the stationarity among variables, as recommended by Mukhtarov et al. (2019). Table 2 depicts ADF Unit Root Test results, and Table 3 depicts Phillips Perron Unit Root results.

Table 2. ADF Unit Root Test

	ADF at Level			ADF at First Difference		
Variable	**Values**	**T-stat**	**Prob**	**Test Values**	**T-stat**	**Prob**
Gini 1%	-3.699871			-3.711457		
Gini 5%	-2.976263	-0.964488	0.7511	-2.981038	-6.456093	0.0000*
Gini 10%	-2.627420			-2.629906		
EXPORT 1%	-3.679322			-3.689194		
EXPORT 5%	-2.967767	-0.675254	0.8377	-2.971853	-5.061645	0.0003*
EXPORT10%	-2.622989			-2.625121		
IMPORT 1%	-3.679322			-3.689194		
IMPORT 5% level	-2.967767	-0.620673	0.8510	-2.971853	-5.137833	0.0003*
IMPORT 10% level	-2.622989			-2.625121		

Table 3. Phillips Perron Unit Root Test

	PP at Level			PP at First Difference		
		T-stat	Prob		T-stat	Prob
Variable	Values			Values		
Gini 1% level	-3.699871			-3.711457		
Gini 5% level	-2.976263	-0.791666	0.8055	-2.981038	-6.459023	0.0000*
Gini 10% level	-2.627420			-2.629906		
EXPORT 1% level	-3.679322			-3.689194		
EXPORT 5% level	-2.967767	-0.641335	0.8460	-2.971853	-5.058552	0.0003*
EXPORT 10% level	-2.622989			-2.625121		
IMPORT 1% level	-3.679322			-3.689194		
IMPORT 5% level	-2.967767	-0.375684	0.9008	-2.971853	-5.466886	0.0001*
IMPORT 10% level	-2.622989			-2.625121		

The ADF Unit Root test results in Table 2 suggest that our variables are non-stationary at their levels but stationary at the first difference, supporting the null hypotheses. In addition, the results of the Philips-Perron Unit Root test presented in Table 3 also suggest that GINI, imports (IMPs), and exports (EXPs) are non-stationary at their levels but stationary at the first difference.

Lag Selection Criteria

Prior literature suggests selecting the number of lags before applying the Johansen Co-integration test. For this purpose, we applied the VAR Model to determine a suitable lag length based on the various lag length criteria (Agusalim & Pohan, 2018). Our results suggest that the best lag number is four.

Table 4: Lag Selection Criteria

VAR Lag Order Selection Criteria

Endogenous variables: GINI EXPORT IMPORT

Exogenous variables: C

Period: 1990 to 2019

Number of obs: 24

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-129.5559	NA	12.58918	11.04632	11.19358	11.08539
1	-85.93779	72.69684	0.709828	8.161482	8.750509*	8.317751
2	-79.54808	9.052084	0.920993	8.379007	9.409804	8.652478
3	-67.82032	13.68239	0.818707	8.151693	9.624260	8.542366
4	-44.38997	21.477828*	0.308696*	6.949164*	8.863502	7.457039*

*Indicates lag order selected

Cointegration Test

Prior studies suggest using a cointegration test to ensure "two or more non-stationary time series integrates and reach equilibrium in the long-term." The test also identifies "the degree of sensitivity of the two variables over a specified period." Refer to Table 5 for the results.

Table 5: Cointegration Test

Period (adjusted) : 1996 -2018

Number of obs: 23 after adjustments

Series: GINI EXPORTS (EXPS) IMPORTS (IMPS)

Interval of lags (At the first differences): 1 to 4

Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace test Statistic	0.05 Critical Value	Prob. **
None	0.823219	63.35182	29.79707	0.0000
At most 1	0.561580	23.49639	15.49471	0.0025
At most 2	0.178813	4.531114	3.841466	0.0333

3 cointegration equation at the 0.05 level is obtained from trace test

** indicates a non-acceptation of the hypothesis at 0.05 level*

***indicates the probability of MacKinnon-Haug-Michelis (1999)*

Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob. **
None	0.823219	39.85544	21.13162	0.0001
At most 1	0.561580	18.96528	14.26460	0.0084
At most 2	0.178813	4.531114	3.841466	0.0333

3 cointegration equation at the 0.05 level is obtained from the trace test

** * indicates a non-acceptation of the hypothesis at a 0.05 level*

*** indicates the probability of MacKinnon-Haug-Michelis (1999)*

1 Cointegrating Equation(s): Log-likelihood -35.44615

Normalized Cointegrating coefficients (standard error in parentheses)

LOG(GDP)	LOG(EXPORT)	LOG(IMPORT)
1.000000	0.874629	-1.439503
	(0.27179)	(0.37955)

Majavu and Kapingura (2016) and Chamalwa and Bakari (2016) used Cointegration Tests to demonstrate the long-term association between the variables. Table 5 utilizes the same strategy to show the long-term association between international trade (IT) and income inequality (IINQ). After confirming the presence of cointegration and a long-term association between the variables, we developed a Vector Error Correction Model (VECM), for the following three equations.

$$(1) \Rightarrow \Delta Gini_t = -0{,}419ECT_{t-1} - 0{,}336\Delta Gini_{t-1} - 0{,}211\Delta Gini_{t-2} - 0.688\Delta Gini_{t-3} - 0.662\Delta Gini_{t-4} + 0.834\Delta ExP_{t-1} + 0.411\Delta ExP_{t-2} + 0.761\Delta ExP_{t-3} + 0.459\Delta ExP_{t-4} - 0.782\Delta ImP_{t-1} + 0.394\Delta ImP_{t-2} - 0.782\Delta ImP_{t-3} - 0.376ImP_{t-4} - 0.599$$

$$(2) \Rightarrow Y_t = \beta_0 + \beta_1 X_t + \mathcal{E}_t$$

From that, we have: $Gini_t = 0{,}875ExP_t - 1{,}439ImP_t - 15{,}404 + \mathcal{E}_t$

$$(3) \Rightarrow ECT_{t-1} = 1{,}0000Gini_{t-1} + 0.875EXP_{t-1} - 1{,}439ImP_{t-1} - 15{,}404$$

Vector Error Correction Estimates

The Vector Error Correction (VEC) is similar to VAR for variables that are stationary in their differences. VAR also considers cointegrating relationships between two or more series variables. Table 6 summarizes the results.

Table 6: Vector Error Correction Estimates

Period: 1996 2018			
Obs: 23 after adjustments			
Standard errors in ( ) & t-stat in [ ]			
Cointegrating Equations:	**Cointegrating Equation1**		
GINI(-1)	1.000000		
EXP(-1)	0.874629		
	(0.27179)		
	[3.21807]		
IMP(-1)	-1.439503		
	(0.37955)		
	[-3.79263]		
	-15.40414		
Error Correction:	D(GINI)	D(EXP)	D(IMP)
CointEq1	-0.419216	1.159099	0.923058
	(0.09783)	(0.48862)	(0.47106)

	[-4.28509]	[2.37219]	[1.95954]
D(GINI(-1))	-0.335859	1.613842	0.621166
	(0.18406)	(0.91930)	(0.88625)
	[-1.82471]	[1.75552]	[0.70089]
D(GINI(-2))	-0.210618	0.303359	-0.454026
	(0.15769)	(0.78756)	(0.75925)
	[-1.33569]	[0.38519]	[-0.59799]
D(GINI(-3))	-0.688556	-0.570319	-1.697773
	(0.20291)	(1.01343)	(0.97701)
	[-3.39342]	[-0.56276]	[-1.73773]
D(GINI(-4))	-0.661883	-2.900398	-3.273507
	(0.21761)	(1.08686)	(1.04780)
	[-3.04157]	[-2.66859]	[-3.12417]
D(EXP(-1))	0.834198	0.111849	0.467078
	(0.15179)	(0.75811)	(0.73086)
	[5.49579]	[0.14754]	[0.63908]
D(EXP(-2))	0.410981	-1.569658	-0.812045
	(0.15898)	(0.79403)	(0.76549)
	[2.58510]	[-1.97683]	[-1.06082]
D(EXP(-3))	0.761593	0.357252	0.731774
	(0.12895)	(0.64402)	(0.62088)
	[5.90626]	[0.55472]	[1.17861]
D(EXP(-4))	0.459590	-0.546466	0.247904
	(0.16026)	(0.80040)	(0.77163)
	[2.86784]	[-0.68274]	[0.32127]
D(IMP(-1))	-0.782531	0.269212	-0.191609
	(0.16064)	(0.80230)	(0.77346)
	[-4.87144]	[0.33555]	[-0.24773]
D(IMP(-2))	-0.394561	1.336034	0.624329
	(0.14872)	(0.74279)	(0.71609)
	[-2.65302]	[1.79867]	[0.87185]
D(IMP(-3))	-0.781732	-0.374336	-0.566904
	(0.12499)	(0.62424)	(0.60181)
	[-6.25456]	[-0.59966]	[-0.94200]
D(IMP(-4))	-0.376365	1.097828	0.168058
	(0.16268)	(0.81251)	(0.78331)
	[-2.31351]	[1.35115]	[0.21455]
	-0.599320	1.206539	0.561169
	(0.16616)	(0.82987)	(0.80004)

As shown in Table 6, one of the most important values of the study is C (1), which represents the speed of adjustment. This value satisfy two conditions: (i) the equilibrium has be reached in the long run, and (ii) C (1) is negative and statistically significant. The results meet both discussed conditions. Thus, we have inferred that the equilibrium will be reached in the long run, along with two consequences. First, about 41% of the disequilibrium is corrected each period. Second, because C (1) is statistically significant, indicating that export (EXP) and import (IMP) Granger cause Gini in the long term, providing evidence of Granger causality between the independent regressors and the dependent variable. The long-run estimators indicate that exports (EXPs) boost Gini but reduce imports (IMPs).

Wald Test

Besides "the Lagrange Multiplier Test and the Likelihood-Ratio Test," the Wald test is an effective tool for hypothesis testing. Unlike the other two tests, it requires unrestricted model estimation. Table 7 depicts the Wald Test results.

Table 7. Wald Test

Wald Test			
T-Stat	Value	Df	Prob
F-stat	6.847772	(9,9)	0.0042
Chi-sq	61.62995	9	0.0000
H0 : C6=C7=C8=C9=C10=C11=C12=C13=C14=0			
Restriction(= 0)		Value	Std. Err.
C6		0.834198	0.151789
C7		0.410981	0.158981
C8		0.761593	0.128947
C9		0.459590	0.160256
C10		-0.782531	0.160637
C11		-0.394561	0.148722
C12		-0.781732	0.124986
C13		-0.376365	0.162682
C14		-0.599320	0.166157
Restrictions are linear in coefficients.			

As shown in Table 7, the null hypothesis states that exports (EXPs) and imports (IMPs) do not contribute to Gini. The chi-square statistic is significant at 5%, so we can reject the null hypothesis. Thus, there is evidence of short-run causality linking exports (EXPs) and imports (IMPs) to Gini using short-term VECM estimation. Agusalim and Pohan (2018)

argue that international trade (IT) has a considerable short-term impact on income inequality (IINQ). Imports (IMPs) negatively influence Gini, whereas exports (EXPs) have a favorable effect, consistent with Franco and Gerussi (2013).

Serial Correlation

We performed the serial correlation test to determine whether there is a correlation between the error term in the current period and the error term in some previous period. Table 8 summarizes the results of the Breusch Godfrey Serial Correlation LM test. The Serial Correlation Test Statistic is insignificant at the 5% level, implying that we cannot reject the null hypothesis. Therefore, we conclude that the serial correlation does not affect our empirical model.

Table 8: Serial Correlation

Breusch-Godfrey Serial Correlation LM Test:				
F-statistic Obs*R-squared	0.111505 1.883657	Prob. F(4,5) Prob. Chi-Square(4)		0.9730 0.7571
Dependent Variable: RESID Method: Least Squares Period:1996 2018 Number of Obs: 23				
Variable	Coef	Std. Er	T-Stat	Prob.
C1	-0.053913	0.167055	-0.322729	0.7600
C2	-0.132537	0.365925	-0.362198	0.7320
C3	0.037606	0.218093	0.172431	0.8699
C4	0.000151	0.298725	0.000504	0.9996
C5	0.032275	0.321305	0.100450	0.9239
C6	0.002724	0.233933	0.011645	0.9912
C7	0.060280	0.270720	0.222665	0.8326
C8	-0.003366	0.173741	-0.019375	0.9853
C9	0.110178	0.308847	0.356740	0.7358
C10	-0.037241	0.253086	-0.147148	0.8888
C11	-0.049720	0.244506	-0.203350	0.8469
C12	-0.004024	0.169116	-0.023792	0.9819
C13	-0.123708	0.316024	-0.391453	0.7116
C14	-0.012731	0.256172	-0.049699	0.9623
RESID(-1)	0.355199	0.679821	0.522489	0.6236
RESID(-2)	0.071621	0.594566	0.120460	0.9088
RESID(-3)	0.123120	0.597427	0.206083	0.8449
RESID(-4)	-0.238786	0.573222	-0.416568	0.6943
R-squared	0.081898	Mean dependent var		2.58E-16
Adjusted R-squared	-3.039648	SD dependent var		0.186510
SE of regression	0.374864	Akaike info criterion		0.914653
Sum squared resid	0.702615	Schwarz criterion		1.803301
Loglikelihood	7.481486	Hannan-Quinncriter.		1.138146
F-statistic	0.026236	Durbin-Watson stat		1.900831
Prob(F-statistic)	1.000000			

CUSUM Stability Test

The study used the CUSUM test to assess the stability of the coefficients of the multiple regression models. The result depicted in Figure 2 indicates that the blue line remains within the 95% confidence level thresholds and does not breach them. Therefore, the CUSUM test suggests that the model and parameters are stable during the sample period.

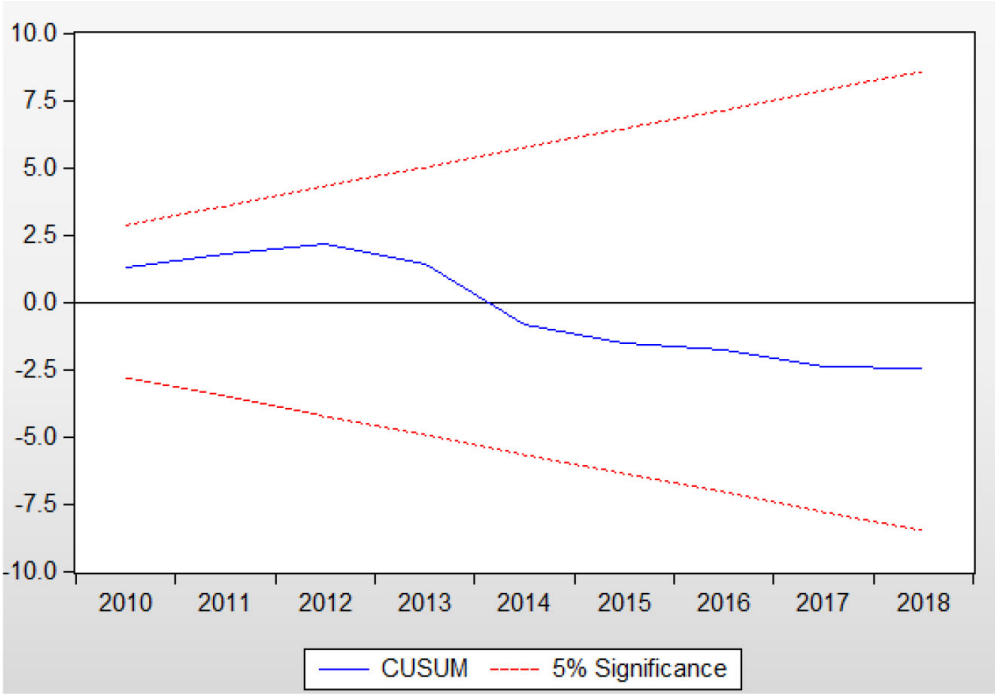


Figure 2. Cusum stability test

Discussion and Conclusion

International trade (IT) affects income inequality (IINQ) in several ways. For example, international trade (IT) helps economic development and generates economic activities, reducing income inequality (IINQ). Literature suggests that the major beneficiaries of exports (EXPs) are the upper-income (UIN) strata. In contrast, employees in lower-income (LIN) strata receive little or no benefits due to exports (EXPs) (Cabelkova et al., 2021). Moreover, professional competencies in an economy promote income disparity (IND) (Jeong, 2020).

Furthermore, Li and Zhu (2020) assert that due to the concentration of export-oriented firms in an economy, the wages for skilled workers are significantly higher than for low-skilled labor, promoting income inequality (IINQ). The above-discussed arguments align

with many past studies. For example, Helpman et al. (2017) and Aman et al. (2021) found that increasing exports (EXPs) reduces income inequality (IINQ). At the same time, many researchers believe that the effect of exports (EXPs) on income inequality (IINQ) may vary on many factors, including the nature of the goods exported, taxes, and policies.

Literature documents that an increase in the quantum of imports (IMPs) reduces income inequality (IINQ) (Kazemzadeh et al., 2022). Developed countries like China and the USA have a comparative advantage due to the size of the manufacturing units, which reduces their production cost. Thus, importing goods and services from such countries creates new markets and jobs, decreasing unemployment and income disparity (IND) (Carvalho & Gabriel, 2023).

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