

**Dynamics of Foreign Trade in Middle-Income Economies : An Analysis of the Impact of Economic, Technological, and Institutional Transformations
– An Econometric Study during the Period 1997-2023**

ZOUGGARET Nadia ^{1♦}, HAMIOUD Ammar ²

¹ University of Mustapha Stambouli Mascara, (Algeria), nadia.zouggaret@univ-mascara.dz

² University of Mustapha Stambouli Mascara, (Algeria), ammar.hamioud@univ-mascara.dz

Received: 20/09/2025

Accepted: 07/11/2025

Published: 25/11/2025

Abstract:

This study seeks to ascertain the influence of economic, technological, and institutional factors on foreign trade in a sample of 16 middle-income countries from 1997 to 2023, utilizing panel data with EViews 10 and R. Cointegration tests and a vector error correction model (VECM) were utilized, revealing a negative and statistically significant long-run coefficient ; however, it was disregarded due to diagnostic complications. Consequently, the PMG and subsequently the PMG-Robust models were utilized to ascertain the reliability of the results.

The findings revealed that GDP per capita was the sole statistically significant variable, demonstrating a negative long-term impact and a positive influence of its movingaverage on trade. On the other hand, the internet, mobile phones, corruption, and foreign direct investment had no noticeable effect. It led to the importance of institutional and domestic economic policies for encouraging international trade.

Keywords: Foreign trade, Economic growth, Foreign Direct Investment, Internet Lines, Corruption.

JEL Classification: F14, O47, F21, L86, D73.

♦ Corresponding author

1. Introduction:

Foreign trade is seen as one of the most important parts of economic growth and sustainable development in middle-income countries. This is because it is a key way to boost productivity, share technology, and get domestic products into more markets, all of which help raise national income and improve living standards. Foreign trade also helps the balance of payments and cuts down on trade deficits, which makes the economy more stable and makes the country more competitive on the world stage. Economic studies show that levels of foreign trade are not only affected by natural resources or the size of the domestic market. They are also affected by a number of economic factors, such as GDP per capita and foreign direct investment, as well as technological factors, such as the growing use of the internet and mobile phones, and institutional factors, such as the quality of governance and the effectiveness of anti-corruption measures. These factors interact with each other in a complicated way, so it's important to know how they affect foreign trade in order to make good economic policies.

Foreign trade is very important, but middle-income countries face many problems that could make it less effective at helping the economy grow as planned. Some of these problems are that some countries are more developed than others, and that some economies depend on their own markets, which makes it hard for them to join global markets. Additionally, foreign investment and technological advancement do not consistently exert a direct influence on the augmentation of exports and imports, as the results of these factors may be swayed by national economic policies or ineffective institutions. Also, the institutional environment is very important for foreign trade because corrupt practices can make trade less efficient and raise the costs of doing business. So, it is important to look into and understand how economic, technological, and institutional factors affect foreign trade. This will help us make policies that will help economic integration and make businesses more competitive in international markets.

1.1 Study Problem:

Foreign trade is very important for economic growth, but middle-income countries have a lot of problems that could make it harder for them to take full advantage of trade opportunities. Different levels of economic development, dependence on domestic markets, limited effects of foreign direct investment and technology, and weak institutional environments can all affect how foreign trade grows in different ways. The research problem consists of determining the economic, technological, and institutional factors that affect foreign trade in middle-income countries.

The subsequent sub-research questions arise from the research problem:

- How much does GDP per capita affect trade with other countries in middle-income countries ?
- How do foreign direct investment inflows change the way countries trade with each other?
- What part do technological factors, like how many people use the internet and how many people have mobile phones, play in making foreign trade better?

-What effect do the quality of institutions and the effectiveness of anti-corruption measures have on levels of foreign trade?

-Do economic, technological, and institutional factors work together to affect foreign trade?

1.2 Study Hypothesis:

The research hypothesis is as follows:

Economic, technological, and institutional factors significantly affect the level of foreign trade in middle-income countries.

1.3 Significance of the Study:

This study is important for several reasons:

-It enriches knowledge regarding the relationship between economic, technological, and institutional factors and foreign trade, particularly in middle-income countries.

-It provides practical recommendations for policymakers to enhance foreign trade and improve the trade balance.

-It helps understand the factors affecting countries' ability to benefit from foreign trade to achieve sustainable development.

1.4 Study Objectives:

This study aims to achieve the following objectives:

-To analyze the relationship between GDP per capita and foreign trade.

-To examine the impact of foreign direct investment on foreign trade.

-To assess the role of technological factors in promoting foreign trade.

-To investigate the effect of institutional quality and anti-corruption measures on foreign trade.

-To provide an integrated framework illustrating the interaction between economic, technological, and institutional factors in influencing foreign trade.

2. Literature Review and Theoretical framework of the study:

2.1 Literature Review:

2.1.1. The study by Gimba et al. (2025):

This study titled "Exploring the relationship between trade openness and economic growth in Nigeria: The moderating effect of exchange rate volatility" aimed to investigate the impact of imports and exports on economic growth, with exchange rate volatility serving as a moderating variable in Nigeria. The Central Bank of Nigeria's Statistical Bulletin says that it used quarterly time series data from 2002 to 2022. The study employed an ex-post facto design to examine the impact of exchange rate fluctuations on the relationship between trade openness and economic growth. It achieved this by employing the ARDL model, TGARCH, unit root test, and cointegration test. The Johansen cointegration test results showed that cointegration was present at the 0.05 level of significance.

Furthermore, ARDL analysis revealed that exports exerted a positive and significant impact on economic growth, even amidst fluctuating exchange rates. Conversely, imports exerted a detrimental and significant impact. The study proposed the removal of stringent trade tariffs to improve business operations and protect domestic production, alongside efforts to unify the official and unofficial foreign exchange trading markets in Nigeria.(Gimba et al., 2025)

2.1.2. The study by Choi et al. (2023):

This study titled "How Mobiles Affect International Trade, Foreign Direct Investment, and Economic Growth: A Comparative Analysis Based on Income Level" Aimed to explore the intricate relationship between mobile phone usage, international trade, foreign direct investment (FDI), and economic growth, employing panel data from 160 countries, including 59 high-income, 55 middle-income, and 46 low-income nations from 1990 to 2018. The study employs a panel vector autoregressive (VAR) model to investigate causal relationships among economic variables and utilizes the generalized method of moments (GMM) technique to address endogeneity issues, while verifying the stationarity of variables through unit root tests. The findings indicated that increased mobile phone usage significantly enhances economic growth in middle-income nations, exerts a greater positive impact on foreign trade in low-income nations, and influences FDI inflows more substantially in high-income nations. There was a two-way cause-and-effect relationship between FDI and the number of people who used mobile phones in all groups of countries. Using a cell phone had a direct effect on trade in and out of poor countries. The research indicates that enhancing mobile infrastructure can stimulate international trade, attract investments, and foster economic growth, contingent upon countries' income levels.(Choi et al., 2023)

2.1.3. The study by Cooray et al. (2020):

This study titled "Corruption and Assortative Matching of Partners in International Trade" sought to examine the influence of a country's corruption level on the characteristics of its trading partners, particularly regarding the effects of corruption on bilateral trade relationships. The research utilises a substantial sample of 193 United Nations member states from 1996 to 2014 and applies the gravity model of trade flows, employing rigorous estimation methods such as Poisson Pseudo-Maximum Likelihood (PPML) to mitigate sample selection and heteroscedasticity challenges. The results demonstrate negative assortative matching in international trade, indicating that countries with high levels of corruption are more likely to engage in trade with countries exhibiting lower levels of corruption, rather than with other highly corrupt nations. The study also shows that countries that have signed the OECD Anti-Bribery Convention tend to trade more with corrupt countries than countries that have not signed it. This shows that they can deal with corruption through international legal systems. The findings indicate that corruption levels in both exporting and importing countries adversely affect trade volumes, and that these factors influence one another. These findings are validated by robustness checks employing alternative data sources and control variables, highlighting the importance of anti-corruption initiatives and international agreements in mitigating the effects of corruption on trade, while cautioning against the extrapolation of results across varied institutional contexts. (Cooray et al., 2023)

2.1.4. The study by Kang (2020):

The title of this study is "A Study on the Effect of the Internet and Mobile Phones on Trade in Services Using the Modified Gravity Model". It aimed to examine how mobile phones and the Internet influenced South Korea's service trade between 1990 and 2018. It relied on a 29-year annual time-series dataset that included factors such as population, trade openness, economic size, and the spread of Internet and mobile phone use. Using a modified gravity model and ordinary least squares (OLS) regression, the study assessed the role of information and communication technology in service trade, covering both imports and exports. The findings show that mobile phone and Internet use had a significant positive effect on service trade. For instance, a 10% increase in Internet users was associated with a rise of about 0.29% to 0.33% in service trade. When people use their phones, the effect is even stronger. Additionally, GDP and trade openness exert significant positive influences, whereas the impact of population remains ambiguous. The study underscores the significance of information and communication technology in enhancing service trade and recommends that subsequent research employ more granular data and investigate the technology's impact in nations with diverse income levels. (Kang, 2020)

2.1.5. The study by Rahman & Grewal (2017):

This study titled "Foreign direct investment and foreign trade in BIMSTEC panel causality analysis" aimed to empirically determine the causal relationship between foreign direct investment (FDI) and foreign trade (exports and imports) among BIMSTEC nations. The sample consisted of the seven BIMSTEC countries and employed balanced panel data spanning from 1980 to 2015. The methodology was implemented through causality analysis on panel data, including unit root tests, assessment of cointegration via the Kao test, and estimation of a VAR model with the optimal lag length determined. Then, the Toda and Yamamoto method was used to find causality without being affected by integration issues.. The results showed clear evidence of a two-way causal relationship between FDI inflows and trade (both exports and imports) in the BIMSTEC region. In other words, FDI and imports affect exports and, at the same time, exports and imports influence FDI inflows. These insights are particularly useful for policymakers and researchers who want to better understand how the region's economy functions. (Rahman & Grewal, 2017)

Based on previous studies, The current study analyses the impact of economic, technological, and institutional factors on the volume of foreign trade in 16 middle-income countries from 1997 to 2023, employing panel data. Our research examines trade volume in relation to GDP per capita and institutional factors, contrasting with Gimba et al. (2025), which associated trade with economic growth in Nigeria. In the same way, Choi et al. (2023) identified a positive correlation between mobile phone usage, foreign direct investment (FDI), and trade, our findings indicate no significant influence of these variables in middle-income nations. Cooray et al. (2020) posited that corruption diminishes trade; however, our study found no such correlation, highlighting the specific institutional context. Similarly, a favourable impact of technology on service trade was indicated by Kang (2020), though this result was not corroborated in the present study. Moreover, Rahman and Grewal (2017) found evidence of a two-way causal link between FDI and trade, but our study did not observe

a similar effect. The reliability of our results was strengthened by using the PMG-Robust model, which performed better than traditional approaches like ARDL, VAR, and OLS. Overall, it was shown that institutional factors and the capacity of domestic economies to support trade in middle-income countries are more influential than the adoption of new technologies or foreign investment.

2.2. Theoretical framework of the study:

2.2.1. Definition of Foreign Trade

Foreign trade is a sector of economics focused on how national and interconnected economies manage the allocation of finite resources to meet expanding human demands through trade exchanges, which occur in three forms: the transfer of goods, services, capital, individuals, and expertise from domestic entities to the global market.(Belhaoues et al., 2024)

Foreign trade reflects the economic links between individual economies and constitutes a segment of the nation.(Jenicek & Krepl, 2009)

Foreign trade refers to the global exchange of products, capital, and services. Numerous nations utilize worldwide trade for industrialization and advancement. Foreign trade can provide numerous consequences, including globalization, foreign industrial development, and enhanced transportation.(Perra Logistics, 2020)

Based on the above, foreign trade can be defined as an economic sector that studies how countries utilize their limited resources in the exchange of goods, services, and capital with the global economy, aiming to achieve economic development, openness to international markets, and the promotion of globalization and domestic industries.

2.2.2. Principal Advantages of International Trade

The Principal Advantages of Foreign trade are as follows:(Perra Logistics, 2020)

2.2.2.1. Economic Advancement and Progress:

Foreign trade is a significant catalyst for economic expansion. Accessing foreign markets enables countries to augment their output and promote their goods and services to a broader audience. This heightened demand can result in elevated production levels, employment creation, and a general enhancement of the economy. Furthermore, foreign trade fosters innovation and efficiency, as enterprises vie in a global marketplace.

2.2.2.2. Access to an Expanded Array of Goods and Services:

Foreign trade provides consumers with access to a wider array of goods and services that may be unavailable locally. This access augments consumer options, elevates living conditions, and promotes cultural interaction. A nation without the production of specific food items or technologies can import these goods to satisfy its populace's needs.

2.2.2.3. Optimal Resource Distribution:

International commerce allows nations to focus on producing commodities and services in which they possess a competitive advantage. This specialization results in a more effective allocation of resources, as nations concentrate on their most efficient production capabilities while importing items that are produced more efficiently in other regions.

2.2.2.4. Transfer of Technology and Knowledge:

Countries can share their knowledge and technology through trade. Companies and industries in developing countries can use new technologies and ways of doing things from more developed countries. These technologies and Knowledge led to the development of workers' skills, which increases the economic growth.

2.2.2.5. Stability and Security:

Trading with other countries can help a country's economy stay stable.

2.2.2.6. Enhancing Global Diplomatic Relations:

Trade between countries helps them work together and understand each other better. It creates interdependencies that could improve diplomatic ties and lower the chances of conflicts. Trade agreements and partnerships often make it easier for countries to work together on a wide range of issues, such as protecting the environment, education, and health care.

2.2.3. Challenges of Foreign Trade

Foreign trade provides several advantages, although it also poses specific challenges:(Perra Logistics, 2020)

2.2.3.1. Trade Imbalances:

When a country imports more than it exports, it can create trade deficits that hurt the economy's stability.

2.2.3.2. Cultural and Regulatory Obstacles:

Businesses may struggle to communicate and work with each other across borders due to differences in culture, language, and regulations.

2.2.3.3. Economic Dependence:

A country that depends heavily on trade with other nations could face risks if those countries experience economic difficulties.

2.2.4. The Relationship between Foreign trade and Other Economic Variables

Many economic factors have a relationship with foreign trade. The following elements explain how foreign trade is affected by economic growth, foreign direct investment, corruption as an institutional factor, and mobile phones as technological factors:

2.2.4.1. The Relationship between Economic Growth and International Trade:

Recent studies demonstrate that the relationship between economic growth and foreign trade is enduring, albeit varying by country and shaped by the economic context. One study asserts that trade openness in Laos facilitated long-term economic growth by enhancing export opportunities and reducing production costs, notwithstanding its detrimental short-term impacts (Phommouny & Shuquan, 2024).). Likewise, economic growth in Azerbaijan was identified as a catalyst for heightened exports and imports, whereas no causal link was detected in Italy (Akbulaev & Muradzada, 2023).). Moreover, exports were shown to have a positive impact on Nigeria's economic growth; however, imports had a negative impact, especially when exchange rates changed (Gimba et al., 2025). These results show that trade with other countries can help an economy grow, but the effect depends on the country's own economic situation.

2.2.4.2. The Relationship between Foreign Direct Investment and Foreign trade :

Foreign direct investment (FDI) is essential for making international trade happen, and the two things often work together. Evidence indicates a bidirectional causal relationship between FDI flows and trade (both exports and imports) in BIMSTEC countries, with FDI facilitating increased exports and imports, and conversely (Rahman & Grewal, 2017).). In BRICS countries, a long-term connection was found between FDI, trade openness, and GDP. There was also a two-way relationship between FDI and economic growth (Banday et al., 2021). These results demonstrate that FDI is not solely a mechanism to increase trade, but is also affected by the level of trade openness.

2.2.4.3. The Relationship between Corruption (Institutional Factors) and International Trade:

Corruption is seen as a main obstacle to smooth international trade, although its effect varies depending on how strong a country's institutions are. Higher levels of corruption had a negative effect on trade flows from countries with much corruption, but a positive effect on trade volumes from countries that signed the OECD Anti-Bribery Convention (Cooray et al., 2023). Corruption generally complicates international trade; however, bribery at customs can facilitate imports into nations with fragile institutions, despite undermining those institutions (de Jong & Bogmans, 2011). Tax-related corruption has been demonstrated to impact customs revenue, subsequently influencing foreign trade activities (Kurauone et al., 2021). Corruption undermines the institutional framework for trade; however, in specific contexts, it may result in the informal facilitation of trade through illicit channels.

2.2.4.4. The Relationship between Technological Factors and International Trade:

The internet and cell phones are two examples of modern technology that are very important for trade between countries. Cell phones made international trade a lot better, especially in countries with low incomes. It also helped foreign direct investment (FDI) and economic growth (Choi et al., 2023). Using the internet and cell phones in South Korea helped trade in services, like exports and imports (Kang, 2020). Studies on e-commerce have also shown that the internet made it easier for small, isolated countries to trade with the rest of the world and improved shipping and logistics services, which led to more trade. These findings demonstrate the significance of technology in enhancing the efficiency and scope of international trade.

2.2.4.5. The Combined Relationship of Foreign trade with Economic, Institutional, and Technological Variables:

Studies have examined the interrelated dynamics between foreign trade and economic, institutional, and technological factors. From 1971 to 2019, foreign trade, foreign direct investment (FDI), and financial development were all linked to economic growth in the Gulf Cooperation Council (GCC) countries. Trade and investment flows generally promoted growth, although exceptions were noted in Kuwait (trade) and Oman and Saudi Arabia (FDI) (Kahouli & Chaaben, 2022). In BRICS nations, a long-term correlation was identified among FDI, trade openness, and GDP, accompanied by bidirectional causality between FDI and trade

openness, and between FDI and economic growth (Banday et al., 2021). From a technological standpoint, mobile phone usage significantly facilitated trade in low-income nations, exerted a more pronounced impact on foreign direct investment (FDI) in high-income nations, and fostered economic growth in middle-income nations (Choi et al., 2023). This shows the importance of technological infrastructure for trade, investment, and growth all at the same time, however, the effects are different for people with different incomes.

2.2.5. Measurement Indicators:

This study relied on indicators to measure its variables, as shown in the following table:

Table 1. Study Variables and Measurement Indicators

Variable	Definition	source
Trade (% of GDP) (TRADE)	Trade encompasses the total of exports and imports of goods and services. This metric is represented as a percentage of Gross Domestic Product (GDP), which encompasses the total income generated from the production of goods and services within an economic territory over a specified accounting period.	World Bank
GDP per capita (current US\$) (GDPC)	Gross domestic product is the aggregate income generated from the production of goods and services within an economic territory during a certain accounting period. It can be quantified by three distinct methodologies: the consumption approach, the income approach, or the production approach. The primary indicator has been divided by the total population to obtain a per capita estimate. This metric is presented in nominal prices, indicating that no adjustments have been made for inflation or price fluctuations over time. This indicator is denoted in United States dollars.	
Foreign direct investment, net inflows (BoP, current US\$) (FDI)	Foreign direct investment refers to direct stock inflows into the reporting economy. It comprises the total of equity capital, retained earnings, and supplementary capital. Direct investment denotes a form of cross-border investment in which an individual from one economy exercises control or significant influence over the management of a business situated in another economy. Owning 10 percent or more of the ordinary shares of voting stock constitutes the criterion for creating a direct investment relationship. Data are expressed in contemporary U.S. dollars.	
Individuals using the Internet (% of population) (INDINTERNET)	Internet users are persons who have accessed the Internet from any location within the past three months. The Internet can be accessed by a computer, mobile phone, personal digital assistant, gaming console, digital television, etc.	

Mobile cellular subscriptions (per 100 people) (MOBILEC)	Mobile cellular telephone subscriptions refer to subscriptions for a public mobile telephone service that grants access to the Public Switched Telephone Network (PSTN) through cellular technology. The indicator comprises the quantity of postpaid subscriptions and the count of active prepaid accounts, defined as those utilised within the past three months. The indicator pertains to all mobile cellular subscriptions that include voice communication services. It excludes subscriptions using data cards or USB modems, public mobile data services, private trunked mobile radio, telepoint, radio paging, and telemetry services.	
Control of Corruption: Estimate (CONTCORRU)	The Control of Corruption measures perceptions of the degree to which public authority is utilised for personal benefit, encompassing both minor and major corruption, along with the "capture" of the state by elites and private entities.	

Source: Prepared by the authors based on World Bank data bank

3. Methodology:

3.1. Study Methodology:

To meet the goals of this study, test its hypotheses, and solve its research problem, a descriptive, analytical, and quantitative method was used.

3.2. Study Sample:

The study sample covers 16 countries: Argentina, Brazil, Colombia, Algeria, Egypt, Ghana, Indonesia, Jordan, Morocco, Mexico, Malaysia, the Philippines, Russia, Turkey, Vietnam, and South Africa.

3.3. Study Data:

The study data were obtained from the World Bank website, encompassing the years 1997 to 2023. Subsequently, data for the 16 selected countries were extracted and compiled into a single file in the form of panel data to conduct the study.

3.4. Statistical Methods and Tests:

EViews 10 software was used to perform the panel data unit root tests, cointegration tests, construct the error correction model, and conduct various diagnostic tests. Additionally, R software was used to generate the descriptive statistics of the study variables, build the PMG model and subject it to diagnostic tests, and subsequently construct the PMG-Robust model.

The following is a brief overview of the various tools and tests that were conducted.

-Descriptive Statistics: To determine mean, standard deviation, minimum, and maximum values for each variable.

-Unit Root Tests: Levin-Lin-Chu, ADF-Fisher, and PP-Fisher to examine the stationarity of variables.

-Cointegration Tests: Pedroni and Johansen Fisher to identify long-run equilibrium relationships among variables.

-Error Correction Models (ECM): To analyze long- and short-term relationships between foreign trade and influencing factors.

-PMG and PMG-Robust Models: For panel data analysis and to address heteroskedasticity and country-specific effects.

3.5. Variables:

-Dependent Variable: Foreign trade (TRADE) as a percentage of GDP.

-Independent Variables: GDP per capita (GDPPC), foreign direct investment (FDI), technological indicators (INDINTERNET, MOBILEC), and institutional quality/anti-corruption index (CONTCORRU).

4. Result and discussion:

4.1. Results:

4.1.1. Descriptive statistics:

Table 2 shows the descriptive statistics for the study variables in 16 middle-income countries from 1997 to 2023. The average trade openness (TRADE) was about 68.78% of GDP, with a standard deviation of 39.98. This shows that there was a lot of variation in the sample. Foreign direct investment (FDI) inflows averaged 1.11×10^{10} USD, with a high standard deviation of 1.63×10^{10} . This included negative values (investment outflows) and maximum values that were more than 10^{11} USD. The average GDP per capita (GDPPC) was \$5154.6, with a standard deviation of \$3701.13. This shows that there are differences in levels of development. The average percentage of people who used the internet was 34.74%, with a standard deviation of 28.99. The average number of mobile subscriptions per 100 people was 78.67, with a standard deviation of 52.04. Lastly, the average control of corruption index was -0.35 with a standard deviation of 0.37, which shows that some institutions in the sample are still weak.

Table 2. Summary Statistics of Variables

Variable	Mean	Std. Dev.	Min	Max	Median
TRADE	68.78	39.98	16.44	220.41	2010
FDI	1.109×10^{10}	1.63×10^{10}	-3.98×10^{10}	1.024×10^{11}	5.11×10^9
GDPPC	5154.6	3701.13	253.75	15941.45	3902.38
INDINTERNET	34.74	28.99	0.00	97.70	29.45
MOBILEC	78.67	52.04	0.06	180.84	89.89
CONTCORRU	-0.35	0.37	-1.16	0.69	-0.39
Country	Argentina, Brazil, Colombia, Algeria, Egypt, Ghana, Indonesia, Jordan, Morocco, Mexico, Malaysia, Philippines, Russian Federation, Turkey, Vietnam, South Africa				
The period	From 1997 to 2023				

Source: Prepared by the authors using R 4.4.1 software

4.1.2. Unit Root / Stationarity Test:

Based on the results of panel unit root tests in table 3, it is evident that all study variables (TRADE, FDI, GDPPC, INDINTERNET, MOBILEC, and CONTCORRU) are non-stationary at level, as the probability values in most tests were greater than 0.05, indicating acceptance of the null hypothesis of a unit root. However, at the first difference, the variables achieved statistically significant probability values (0.0000) across the different tests, leading to the rejection of the null hypothesis and the acceptance of the alternative hypothesis of stationarity. The only exception is the control of corruption index (CONTCORRU), which showed significance at level under the Levin, Lin & Chu test; nevertheless, the ADF-Fisher and PP-Fisher tests did not confirm this, suggesting that it should also be considered non-stationary at level. Accordingly, all variables are integrated of order one I(1), which allows for proceeding to cointegration testing.

Table 3. Unit Root / Stationarity Test

Variable	Test type	At level I(0)		At 1 st difference I(1)	
		Statistic	prob	Statistic	prob
TRADE	Levin, Lin & Chu t	-0.71631	0.2369	-17.3843	0.0000***
	ADF-Fisher Chi-Square	25.4290	0.7883	294.142	0.0000***
	PP-Fisher Chi-Square	16.6943	0.9881	372.985	0.0000***
FDI	Levin, Lin & Chu t	-0.26268	0.3964	-16.7133	0.0000***
	ADF-Fisher Chi-Square	26.2805	0.7511	296.443	0.0000***
	PP-Fisher Chi-Square	38.1577	0.2097	586.675	0.0000***
GDPPC	Levin, Lin & Chu t	5.10604	1.0000	-9.25746	0.0000***
	ADF-Fisher Chi-Square	4.80268	1.0000	152.706	0.0000***
	PP-Fisher Chi-Square	3.56057	1.0000	241.085	0.0000***
INDINTERNET	Levin, Lin & Chu t	5.53224	1.0000	-5.00296	0.0000***
	ADF-Fisher Chi-Square	1.82096	1.0000	74.8045	0.0000***
	PP-Fisher Chi-Square	0.12462	1.0000	-5.83312	0.0000***
MOBILEC	Levin, Lin & Chu t	1.82760	0.9662	75.5625	0.0000***
	ADF-Fisher Chi-Square	8.81535	1.0000	129.330	0.0000***
	PP-Fisher Chi-Square	4.57558	1.0000		0.0000***
	Levin, Lin & Chu t	-1.73913	0.0410*	-14.3112	0.0000***

CONTCORR U	ADF-Fisher Chi-Square	39.8030	0.1617	226.789	0.0000***
	PP-Fisher Chi-Square	41.6832	0.1175	354.265	0.0000***

*** significante at the 0.01 level, ** significante at the 0.05 level, * significante at the 0.1 level.

Source: Prepared by the authors using EViews 10

4.1.3. Panel Cointegration Tests:

The panel cointegration tests' results are shown in Table 4. The Pedroni test shows that the Panel PP and Panel ADF statistics are significant at the 5% level. The Weighted Panel PP, Weighted Panel ADF, Group PP, and Group ADF statistics are all significant at the 1% level. This means that the null hypothesis of no cointegration is false and the alternative hypothesis of a long-run equilibrium relationship is true. The Johansen Fisher test backs up this conclusion even more. The Trace and Max-eigen statistics are both very significant at the 1% and 5% levels for a number of cointegration ranks, which shows that there are more than one cointegration relationship between the variables. Because of this, the results show that there is a long-term relationship between the study variables, which means that the cointegration vector can now be estimated.

Table 4. Summary of Panel Cointegration Tests

Pedroni Test	Type			Statistic	Prob.
	Panel PP-Statistic			-2.075700	0.0190**
	Panel ADF-Statistic			-1.711445	0.0435**
	Weighted Panel PP-Statistic			-3.918173	0.0000***
	Weighted Panel ADF-Statistic			-3.979823	0.0000***
	Group PP-Statistic			-4.121260	0.0000***
	Group ADF-Statistic			-4.464148	0.0000***
Johansen Fisher Panel Cointegration Test	Hypothesized No. of CE(s)	Fisher Stat. (Trace test)	Prob.	Fisher Stat. (Max-eigen test)	Prob.
	None	535.90	0.0000***	304.30	0.0000***
	At most 1	276.60	0.0000***	151.10	0.0000***
	At most 2	150.70	0.0000***	95.45	0.0000***
	At most 3	79.84	0.0000***	52.65	0.0122**
	At most 4	54.17	0.0085***	46.64	0.0457**
	At most 5	50.24	0.0211**	50.24	0.0211**

*** significante at the 0.01 level, ** significante at the 0.05 level, * significante at the 0.1 level.

Source: Prepared by the authors using EViews 10

Table 5 also shows the results of the long-run cointegration estimates. These show that the independent variables have different effects on trade between countries. The variable MOBILEC(-1) has a strong and positive effect, with a t-statistic of 6.23 that is higher than the critical threshold of 1.96 at the 95% confidence level. However, the variable INDINTERNET(-1) exhibits a negative and statistically significant effect ($t = -2.035 < -1.96$). Other variables, such as foreign direct investment (FDI(-1)) and GDP per capita (GDPPC(-

1)), do not appear to be statistically significant, as their absolute t-statistics fall below the critical value of 1.96.

Table 5. Long-run Cointegration Estimates

TRADE(-1)	GDPPC (-1)	FDI(-1)	INDINTERNE T (-1)	MOBILEC(-1)
1.0000	-0.006571 (-0.25059)	3.70×10-9 (0.73223)	-9.627629 (-2.03503)	14.35703 (6.23252)
CONTCORRU (-1)	C			
190.8391 (1.11789)	-859.5306			

Values in parentheses are t-statistics

Source: Prepared by the authors using EViews 10.

4.1.4. Vector Error Correction Model:

After confirming the existence of a cointegration relationship among the study variables, and given that they are integrated at the first difference, an error correction model (ECM) was constructed and its equation is presented as follows:

$$D(\text{TRADE}) = C(1) * (\text{TRADE}(-1) - 0.00657141939379 * \text{GDPPC}(-1) + 3.69823007593\text{E-}09 * \text{FDI}(-1) - 9.62762902934 * \text{INDINTERNET}(-1) + 14.3570271965 * \text{MOBILEC}(-1) + 190.839148795 * \text{CONTCORRU}(-1) - 859.530590224) + C(2) * D(\text{TRADE}(-1)) + C(3) * D(\text{TRADE}(-2)) + C(4) * D(\text{GDPPC}(-1)) + C(5) * D(\text{GDPPC}(-2)) + C(6) * D(\text{FDI}(-1)) + C(7) * D(\text{FDI}(-2)) + C(8) * D(\text{INDINTERNET}(-1)) + C(9) * D(\text{INDINTERNET}(-2)) + C(10) * D(\text{MOBILEC}(-1)) + C(11) * D(\text{MOBILEC}(-2)) + C(12) * D(\text{CONTCORRU}(-1)) + C(13) * D(\text{CONTCORRU}(-2)) + C(14)$$

The error correction model related to the impact of the independent variables on the dependent variable, international trade, was re-estimated using the least squares method in order to extract the coefficient values and their significance, whether for the long-run relationship coefficient or the short-run coefficients, as presented in Table 6. The results showed that the long-run relationship coefficient is negative and statistically significant at 0.04, which confirms the cointegration result previously obtained. Moreover, the result indicates that the model is able to correct the error and the deviation that may arise in the model due to sudden changes, at a speed of 0.19%, with a significance level of 0.01.

Table 6. Estimation Results of Vector Error Correction Model (Dependent variable is TRADE)

	Coefficients	Std. Error	t-Statistic	Prob.
C(1)	-0.001970	0.000728	-2.703850	0.0072***
C(2)	-0.005051	0.050023	-0.100968	0.9196
C(3)	-0.231675	0.048827	-4.744811	0.0000***
C(4)	-0.000356	0.000451	-0.789879	0.4301
C(5)	-0.001169	0.000492	-2.377917	0.0179**
C(6)	-1.89E-12	4.59E-11	-0.041228	0.9671

	Coefficients	Std. Error	t-Statistic	Prob.
C(7)	4.73E-11	5.65E-11	0.837915	0.4026
C(8)	0.090294	0.095139	0.949075	0.3432
C(9)	0.132033	0.094352	1.399365	0.1625
C(10)	-0.009968	0.044513	-0.223933	0.8229
C(11)	-0.073163	0.045661	-1.602297	0.1099
C(12)	4.357112	3.614367	1.205498	0.2288
C(13)	-1.076390	3.645111	-0.295297	0.7679
C(14)	0.071059	0.650145	0.109297	0.9130
R-squared	0.109987	Sum squared resid	17575.90	
F-statistic	3.517234	S.E. of regression	6.892200	
Prob (F-statistic)	0.000034	Durbin-Watson stat	1.891806	

*** significant at the 0.01 level, ** significant at the 0.05 level, * significant at the 0.1 level.

Source: Prepared by the authors using EViews 10.

To verify the accuracy of the error correction model and its reliability, it underwent several diagnostic tests, revealing certain statistical issues. The findings of the Residual Cross-Section Dependence Test, as shown in Table 7, demonstrated the presence of cross-sectional dependence among the units (countries). The Breusch-Pagan LM test revealed that the statistic attained a value of 274.0733 with 120 degrees of freedom and a probability value of 0.0000, signifying the rejection of the null hypothesis of residual independence. The Pesaran scaled LM test corroborated the identical outcome, yielding a statistical value of 9.945388 and a probability of 0.0000. The Pesaran CD test, on the other hand, showed a value of 11.62731 with a probability of 0.0000, which makes the first conclusion even stronger.

Table 7. Residual Cross-Section Dependence Test of VECM

Test	Statistic	d.f.	Prob.
Breusch-Pagan LM	274.0733	120	0.0000
Pesaran scaled LM	9.945388		0.0000
Pesaran CD	11.62731		0.0000

*** significant at the 0.01 level, ** significant at the 0.05 level, * significant at the 0.1 level.

Source: Prepared by the authors using EViews 10

4.1.5. Results of the PMG Model and the PMG-Robust Model:

To tackle the diagnostic problems seen in the PANEL-VECM model, a PMG model was made, as shown in Table 9.

We ran diagnostic tests on the PMG model to make sure it was still valid. The results are shown in Table 8.

Table 8. Diagnostic Tests of PMG Model

Heteroskedasticity (Breusch-Pagan Test)			
Model	BP Statistic	p-value	Heteroskedasticity
PMG	57.011	5.03e-11	Exists
Cross-sectional Dependence (Pesaran CD Test)			
Model	z-value	p-value	CD Presence
PMG	0.252	0.8008	Does not exist

Source: Prepared by the authors using R 4.4.1 software

The Breusch-Pagan test results show that the PMG model has heteroskedasticity. The test statistic is 57.011 and the p-value is less than 0.01 (5.03e-11). This means that the homoscedasticity hypothesis is rejected and heteroskedastic errors are confirmed (Breusch & Pagan, 1979). The Pesaran CD test for cross-sectional dependence, on the other hand, showed a z-statistic of 0.252 and a p-value of 0.8008, which means that there was no cross-sectional dependence among the units in the sample (Pesaran, 2004). These tests show that we need to use the PMG-ROBUST model to solve these statistical problems (Pesaran et al., 1999) and get a model that we can trust. Table 9 shows the results of the PMG-ROBUST estimation.

Table 9. Results OF PMG Model (Common Correlated Effects Mean Groups) and PMG Robust Model Results

Results OF PMG Model (Common Correlated Effects Mean Groups)					
Coefficient	Estimate	Std. Error	z-value	p-value	Signif.
(Intercept)	8.8236	8.3098	1.062	0.288	
FDI	2.6664×10^{-10}	2.8747×10^{-10}	0.928	0.354	
GDPPC	-0.013905	0.004566	-3.045	0.00232	**
INDINTERNET	0.008237	0.15245	0.054	0.957	
MOBILEC	-0.03636	0.05908	-0.616	0.538	
CONTCORRU	0.83114	4.3464	0.191	0.848	
y.bar	0.86490	0.15268	5.665	1.47×10^{-8}	***
FDI.bar	6.6244×10^{-11}	1.7082×10^{-10}	0.388	0.698	
GDPPC.bar	0.005619	0.002102	2.673	0.00751	**
INDINTERNET.bar	0.20191	0.1881	1.073	0.283	
MOBILEC.bar	0.06837	0.07619	0.897	0.370	
CONTCORRU.bar	-1.4915	11.814	-0.126	0.900	
Total Sum of Squares	689030				
Multiple R ²	0.99369				
Residual Sum of Squares	4348.9				
PMG Robust Model Results					
Coefficient	Estimate	Std. Error	z-value	p-value	Signif.
(Intercept)	8.8236	8.3098	1.062	0.288	
FDI	2.6664×10^{-10}	2.8747×10^{-10}	0.928	0.354	

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CONTCORRU	0.83114	4.3464	0.191	0.848	
y.bar	0.86490	0.15268	5.665	1.47e-08	***
FDI.bar	6.6244e-11	1.7082e-10	0.388	0.698	
GDPPC.bar	0.005619	0.002102	2.673	0.00751	**
INDINTERNET.bar	0.20191	0.1881	1.073	0.283	
MOBILEC.bar	0.06837	0.07619	0.897	0.370	
CONTCORRU.bar	-1.4915	11.814	-0.126	0.900	
Total Sum of Squares	689030				
Multiple R ²	0.99369				
Residual Sum of Squares	4348.9				

*** significante at the 0.001 level, ** significante at the 0.01 level, * significante at the 0.05 level.

Source: Prepared by the authors using R 4.4.1 software

Based on Table 9, The results show that GDPPC and GDPPC.bar are the only variables that had a statistically significant effect on TRADE, which is foreign trade. GDPPC had a bad effect on TRADE, but GDPPC.bar had a good effect on trade as a percentage of GDP. On the other hand, other factors like FDI (net inflows of foreign direct investment), INDINTERNET, MOBILEC, and CONTCORRU did not have statistically significant effects. This means that they do not have a real effect on foreign trade in these middle-income countries.

The study's findings show that there is a wide range of connections between economic factors and foreign trade in middle-income countries. For instance, GDP per capita (GDPPC) has a negative effect on foreign trade, which means that as the economy grows, the amount of foreign trade as a share of GDP may go down. This means that countries with higher incomes may not need to rely on international trade as much because they focus more on their own markets.

GDPPC.bar has a positive effect on foreign trade, which is a sign of how temporary changes in income levels can boost international trade. This could mean that economic policies that help raise national income levels can also help make foreign trade more open, which would boost international trade.

on the other hand, CONTCORRU (corruption) does not have a statistically significant effect on foreign trade. This means that institutional factors like corruption might not be the main thing that affects foreign trade in middle-income countries. This result probably acheived due to some institutional changes that have been made that could have lessened the impact of corruption on trade with other countries.

Foreign trade isn't very affected by INDINTERNET, MOBILEC, or FDI (net inflows of foreign direct investment). This could mean that middle-income countries need more than just technology or foreign direct investment to boost trade with other countries. Instead, trade

relations with other countries may be more affected by domestic economic policies or the institutional environment.

4.2. Discussion:

The results of this study give a new vision about the factors that impact foreign trade in middle-income countries, including the distinctive roles of economic, technological, and institutional factors. Our study differed from others that focused on a single country or a group of people with different incomes. Instead, we looked at 16 middle-income countries from 1997 to 2023, which gave us a better understanding of the situation. Gimba et al. (2025) found that exports help Nigeria's economy grow while imports hurt it. Our results, on the other hand, show that GDP per capita is the only statistically significant factor that affects trade volume. This suggests that a country's overall economic capacity may be more important than trade openness itself. Choi et al. (2023) said that using mobile phones improves trade, foreign direct investment (FDI), and economic growth in countries with different income levels. However, our study did not find a significant effect of mobile phones or FDI on trade in middle-income countries. This suggests that technological and financial factors may have different effects depending on the situation. Cooray et al. (2020) showed that corruption has a negative effect on trade and affects the choice of trading partners. However, our results show that corruption does not have a significant effect, which suggests that middle-income countries may have different institutional dynamics or that other domestic policies lessen these effects. Kang (2020) also gives an overview of how to use the Internet and mobile phones for helping trade in services in South Korea. However, our study did not find the same effects, which supports the idea that technology's impact on trade may be different in different countries with different economies. Rahman and Grewal (2017) found that FDI and trade in BIMSTEC countries had a two-way relationship, but our analysis did not find any significant effect of FDI. This demonstrates that the middle-income countries we examined possess distinct economic and regulatory contexts. We checked the diagnostic problems and made the results more reliable by using the PMG-Robust model. This led to distinguishing our method from many previous studies that mostly used ARDL, VAR, or OLS models. These results show that in middle-income countries, foreign trade performance is more affected by how well the economy is doing at home and by institutional factors than by adopting new technologies or bringing in foreign direct investment (FDI).

5. Conclusion:

The current study found that the amount of foreign trade in middle-income countries from 1997 to 2023 is mostly affected by the economic growth, which is measured by GDP per capita. Foreign direct investment, Internet use, mobile phone subscriptions, and corruption levels did not have any statistically significant effects on trade. These results show that the economic and institutional situation in middle-income countries is different from that of other countries. This means that local economic policies and stable institutions are more important for trade than technology or foreign investment. Using the PMG-Robust model helped solve diagnostic problems and get more accurate results than using traditional models. The study

suggests that economic policies should focus on increasing productive capacity and making the institutional environment better to encourage international trade. It also says that adopting new technologies or attracting foreign investment may not have much of an effect unless they are supported by a strong economic and institutional framework. Also, the results show that there are more suggestions for future research to investigate what affects foreign trade in middle-income countries with different types of institutions and technology, especially how these factors interact with changes in the global economy.

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