IRAQI Academic Scientific Journals

KHAZAYIN OF ECONOMIC
AND ADMINISTRATIVE SCIENCES (Vol. 03) (No.03): P(37- 57)

خزائن للعلوم الاقتصادية والإدارية
KHAZAYIN OF ECONOMIC AND ADMINISTRATIVE SCIENCES
ISSN: 2960-1363 (Print)
ISSN: 3007-9020 (Online)

The Impact of Terms of Trade on Economic Growth in Selected European Economies: A Panel ARDL Analysis

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Abstract . This paper looks for identify the relationship between terms of trade and economic growth in six European economies (Austria, Czechia, France, Italy, Germany, and Poland) for the period 2000-2023. For this purpose, the researcher uses the Panel ARDL methodology and identifies the short- and long-term effects. The paper suggests there is a significant positive effect of terms of trade on economic growth in the long term, which support the hypotheses of trade-driven growth in Europe's economies. The study finds the positive and significant long-run impact of terms of trade on GDP per capita growth is across alternative lag specifications, confirming that favorable external price conditions constitute a stable and genuine determinant of long-run growth performance across the European panel, independent of the specific dynamic structure chosen. The study recommended the economies should make a diversification in the export structure to reduce sensitivity to global price fluctuations and enhance the resilience of European economies in the face of external shocks, and promoting trade openness while maintaining exchange rate stability to ensure international competitiveness of exports and imports**.**

Keyword: Terms of trade, economic growth, ARDL, trade openness, capital formation

DOI: 10.69938/Keas.2603033

1. Introduction

International trade plays a crucial role in promoting economic growth by directly linking it to increases in export revenues and productivity. Additionally, foreign trade utilizes unemployed resources effectively. To optimize resource use, boost productivity, and secure a larger share of global trade, countries should improve their terms of trade. Terms of trade serve as a vital indicator of competitiveness and economic well-being. In the context of globalization, European countries experience constant fluctuations in export and import prices, which directly impact their national income and growth rates. Numerous studies seek to assess the overall effects of these fluctuations on the economy and identify the most effective policy measures. This paper aims to address the question: Do improvements in terms of trade promote sustainable economic growth in these countries?

1.1. Importance of research

Terms of trade consider a drive of economic growth, and this impact is generated within many channels, which include productivity of the economy, human capital, and other factors related to the ability to export more than import, and the influence of terms of trade is revealed obviously when analyzed on a level bigger than one economy to understand how it affects economic growth specifically, beside that foreign trade is a major activity that most economies depend on it for ensuring the enough amount of currency for what the needs of goods or services to import, and therefore the terms of trade make a corner stone. Countries depend on terms of trade to achieve many goals, most of them related with economic development and acquisition of global markets, beside to obtain foreign currencies

1.2. Research problem

Economic growth depends on a wide array of macroeconomic determinants, making the selection of the most effective growth-enhancing strategy a persistent challenge for policymakers. Despite the theoretical importance of the terms of trade as a driver of real income and long-run productive capacity, their empirical relationship with GDP per capita growth remains insufficiently examined within the European context. This gap is further compounded by the limited panel econometric evidence that jointly addresses the long-run and short-run growth effects of external price conditions alongside complementary determinants such as trade openness, capital formation, inflation, and human capital investment. The heterogeneity of European economies, spanning both advanced and transitional members, adds a further layer of complexity that standard single-country analyses are ill-equipped to address. Therefore, the research aims to find the impact of trade on economic growth.

1.3. Research objective

This study aims to investigate empirically long-run and short-run determinants of GDP per capita growth across data from a panel of six European economies (Austria, Czechia, France, Germany, Italy, and Poland) over the period 2000–2023. Specifically, the research looks for identifying and quantifying the growth effects of the terms of trade, trade openness, gross fixed capital formation, inflation, real effective exchange rate, and tertiary enrollment using an econometric model. Based on these empirical findings, the research seeks to derive concrete and evidence-based policy recommendations that support sustained and inclusive economic growth across the European panel.

1.4. Research Hypothesis

The research assumes that terms of trade play an important and positive direct role in influencing the per capita economic growth of European economies for the period 2000-2023, besides other macroeconomic factors (inflation, trade openness, human capital, and gross fixed capital formation).

1.5. Research limitations

The research examines the relationship between the per capita economic growth of European economies and terms of trade for six European economies (Austria, Czechia, France, Germany, Italy, and Poland) over the period 2000–2023. For these economies, the terms of trade are especially important for the following reasons:

- Their incorporation into the single market of Europe
- Their significant reliance on international trade
- The variety of their economic and production frameworks over the period 2000–2023.

1.6. Research Methodology

The paper is structured as follows: First Section view the concept of the terms of trade and how they're related to economic growth, and Section 2 provides an overview of the theoretical and empirical literature on the relationship between terms of trade and growth. In section 3, the study uses the ARDL panel model to analyze terms of trade as regressor variables on economic growth. Section 4 briefly presents data issues and the results.

1.7. Literature review

1. **Mendoza (1995):** This paper examines how ToT shocks drive macroeconomic fluctuations, including growth, in small open economies. Using RBC models and empirical analysis, it finds that adverse ToT shocks significantly reduce output and consumption, acting similarly to negative productivity shocks. TOT disturbances explain a substantial portion of business cycle variance, highlighting their role in hindering growth during deteriorations, especially in developing countries (Mendoza, The terms of trade, the real exchange rate, and economic fluctuations, 1995).
2. **Jawaid and Raza, 2013: This** empirical study shows a positive relationship between improvement of terms of trade and levels of economic growth over an income effect channel. The study uses an ARDL bound testing approach on data of India from 1980 to 2010 and finds a significant positive long-run relationship between terms of trade and economic growth, and the study confirms the bidirectional causality suggesting favorable traders significantly Dr. output expansion theory. The study suggests the beneficial terms of a trade are better for the economic growth of India, and the policymaker of India would adopt A-frame growth-enhancing country-wise as well as commodity-wise trade policies (Jawaid & Raza, 2013).
3. **Shahzad and others (2023)** targeted the study target to inspect the impact of tariffs on trade, labor force, and capital on United States economic growth by using ARDL for a time series of data from 1980 to 2022 to find log and short-run variable associations. The study revealed that the economic growth of the United States was negatively and significantly affected by terms of trade, although they couldn't look at growth, capital, and labor force favorable long- and short-run relationships, and the study suggests that policymakers and governments ease trade between countries to achieve the highest economic growth (Shahzad, He, & Muhammad, 2023).
4. **Jawaid, Waheed, and Siddiqui** (2020) study investigate the effects of the growth of trade on economic growth, with a focus on bilateral terms of trade and main commodity groups' terms of trade. The city uses the normal time series data from 1974 to 2017 and all-time series data and dynamic ordinary least square and fully modified ordinary least square. Besides two sensitivity analyses for 17 countries with seven commodity groups, it finds that there is a positive long-run relationship between overall terms of trade and economic growth, and there is a difference in this relationship between the positive significant effect for the major countries and the negative effect on economic growth for others, and there are a few countries with a significant effect on economic growth (Jawaid, Waheed, & Siddiqui, 2020).
5. **Alimi and Aflouk**, **2017,** The study explores the relationship between terms of the trade shops and macroeconomic volatility for a panel of 58 developing countries from 1980 to 2015, using a panel smooth transition regression model. It comes to find that the terms of trade shocks have a statistically significant and positive impact on the vitality of our policy growth, although the impact is not the same on all countries, and the terms of a trade vitality affect macroeconomic fluctuations differently depending on whether the country is a net export of the commodity fuel or manufactured goods (Alimi & Aflouk, 2017).
6. **Wong 2010**, the study discussed the impact of terms of trade and drift-off trade volatility on economic growth in Japan and Korea using data series. The study shows that real GDP per capita and terms of trade are jointly determined, and the increase in terms of trade volatility needs to decrease in real GDP per capita. Although there is a difference between Japan and Korea in the importance of contribution to real GDP per capita, the study shows that favorable and less volatile terms of trade are important for economic growth (Wong, 2010).
7. **Jebran, et al. 2018:** This study investigates the effect of terms of trade (TOT) on the economic growth of China over the period 1980–2013. By using the ARDL model for examining the short-run and long-run associations, the model reveals that TOT significantly and adversely affects

economic growth in the short run as well as in the long run. The results also imply positive short-run and long-run effects of labor and capital on the economic growth of China. The results show unidirectional causality from TOT to the labor force. The variance decomposition results show that most of the innovation in economic growth is explained by its own innovation, while other variables have very small contributions to its innovations. The notable findings of the study suggest that TOT deterioration is relatively important for enhancing the economic growth of China (Jebran & al, 2018).

The empirical evidence on the relationship between terms of trade (ToT) and economic growth reveals mixed findings. Conformation from many studies for a significant positive long-run relationship, however improvements in terms of trade stimulate economic growth through income effect channels, as evidenced in India and across multi-country panels. Although studies on China and the United States report a significant negative effect of TOT on economic growth in both the short and long run. Moreover, the reduction in GDP per capita and the increase in macroeconomic fluctuations were due to the extreme volatility of terms of trade. Generally, the size and direction of the terms of trade vary across countries and commodity groups, and this variety largely depends on country-specific structural characteristics.

2. Theoretical aspect: terms of trade and economic growth

2.1. The concept of terms of trade

Terms of trade serve as a benchmark for all global trade activities, while anything exceeding it signifies economic expansion. Numerous approaches exist for effectively relying on these strategies through policies determining what should be exported and imported, thereby enhancing the economic terms of trade. Studying the role of terms of trade on economic growth related to the economic theories and countries' experiments on how to make use of terms of trade. The terms of trade (TOT) play a crucial and pivotal role in shaping the trajectories of economic growth, as they serve as a key channel for the transfer of wealth, the distribution of national income, and the determination of the competitiveness of countries (Shahzad & Miao, 2025, p. 2).

The terms of trade are not a new concept, but much research has been studying their effect on multiple dimensions, and the basic concept of it depends on exports and imports; it is a crucial measurement, more specifically. The terms of trade refer to a ratio in which an economy exchanges goods and services with another economy. (Kehoe & Ruhl, 2008, p. 1)

Another definition of "terms of trade" is about price; it means the ratio of export prices to import prices of a country, and that is recommended to be used for the purchasing power of exports of a country in terms of its imports. Terms of trade reflect relative demand and will be considered in later chapters. However, the terms of trade are important for the distribution of the gains between the two countries. (Dennis & Alfred, 2014, p. 32)

2.2. factors affecting the terms of trade

There are many factors affecting the terms of trade and the exports and imports: (Salvatore, 2019, p. 80)

1- Reciprocal demand:

The elasticity of reciprocal demand for another country's product has a great effect on the terms of trade, and in this context, it tends to be favorable when a country's demand for exports is more elastic compared to its demand for imports and unfavorable if demand for imports is relatively more elastic than its demand for exports (Dennis & Alfred, 2014, p. 34)

2- Change in factor endowment: the change in factor endowment may increase or decrease the exports.

3- Change in technology: the effects of technology on the structure of production in the economy. The direction depends on where productivity improves and what a country exports. In standard trade theory, improvements in a country's technology can change export competitiveness and relative prices, which then shifts the terms of trade (Lee & Wu, 2023), Countries with lower manufacturing costs have higher GDP but supply a smaller number of goods at a lower international price — a ToT deterioration — while countries with lower entry and differentiation costs also have higher GDP but supply a larger array of goods at improved terms of trade (Corsetti, Martin, & Pesenti, 2005, p. 3)
4- Nature of the supply of exports: the terms of trade will be favorable if the elasticity of exports is greater than that of imports, and vice versa.
5- Nature of commodity: This refers to a situation where a country exclusively produces primary products for export while importing manufactured goods. In such cases, the terms of trade are likely to be unfavorable due to the low elasticity of demand for primary goods.
6- Size of Population: An overpopulated country will have a pressing demand for goods and relatively larger imports. Hence, the terms of trade will tend to be adverse. In the case of an underpopulated or optimally populated country, the terms of trade are likely to be favorable.
7- Changes in Tastes: Changes in tastes among the people of a country also influence its terms of trade with another country. If the tastes of the individuals in a country go in favor of foreign goods (imports), then its terms of trade will be unfavorable. When tastes shift in favor of domestic commodities, the terms of trade are likely to be favorable.
8- Economic Growth: Economic growth is another factor that affects the terms of trade. As a result of economic growth, a country's national product or income rises. This affects both the demand and supply conditions of the country. This again influences the terms of trade of the country.
9- Tariff: An imposition of import duty or tariff improves the terms of trade of the tariff-imposing country. Again, if a country erects a tariff wall and follows a restricted trade policy, it can improve its terms of trade by restricting its imports (Krugman, Maurice, & Marc J, 2012, p. 671).
10- Devaluation: Devaluation means the reduction in the foreign value of home currency or the increase in the value of foreign currency in terms of domestic currency. Devaluation raises the domestic price of imports and reduces the foreign price of exports of the devalued country. The effects of devaluation on the terms of trade have been much debated among economists. According to Prof. Machlup, devaluation is supposed to improve the balance of trade. If the foreign demand for exports and home demand for imports are highly elastic, and the supplies of both home exports and imports are highly inelastic to price movements, devaluation leads to an improvement in the commodity terms of trade. (Jhingan, 2009, p. 149)

11. Size of Country

If a country is large economically, it will have less favorable terms of trade than a small country. This is because a small country can reap the advantage of the economies of scale of the big country in international trade. Globalization has reduced the prices of

manufactured goods. Industrialized countries' advantage over developing countries is becoming less significant.

Heckscher-Ohlin models, absolute advantage, and comparative advantage define how nations trade today. Actually, these traditional theories claim global agreements reflect deep cost differences between partners. Such frameworks provide the necessary logic for every beneficial strategy. That is how things are. Nations track these trends for their lasting financial stability. Thus, the terms of trade form the basis for mutually beneficial trade

A country's resources shift from wasteful to profitable sectors because of an increase in trade, resulting in an increase in global yield that could be shared by trading nations. A country's resources shift from wasteful to profitable sectors because of an increase in trade, resulting in an increase in global yield that could be shared by trading nations. Therefore, each of these hypotheses holds that the terms of trade lead to production specialization, which in turn increases resource productivity as resources are utilized in a productive industry. It is also the fundamental principle of economics that resources should be used efficiently, and in an open economy, the terms of trade could be a driving force for such efficiency improvement. Variations in trade arrangements and economic improvement within a cohort of 94 nations allows for a thorough examination of such theories (Jawaid & Waheed, 2011, p. 5).

Although Ricardo did not examine the precise determination of terms of trade, he illustrated what happens after trade between two countries: the relative price will be going to rise for each tradable product, and he mentions "the equilibrium terms of trade," which means the balanced trade (exports = imports in total value) for each country, and this concept depends on gains for each country, and the equilibrium of it depends on comparative strength on one side and the elasticity of demand on the other for each country for other production. (Dennis & Alfred, 2014, p. 34)

2.3. analyzing the relationship between the rate of trade and economic growth

As a result, sources say they consider the Prebisch-Singer hypothesis to be an important theory that can help understand how trade rate is related to economic growth, especially in developing countries (Popa, 2025, p. 15). This hypothesis is centered on the idea that the rates of trade of countries that depend on the export of commodities tend to deteriorate in the long term compared to those of countries that export manufactured goods. The Theoretical foundations focus on the following:

1. The theoretical essence of the Prebisch-Singer hypothesis

The hypothesis is based on the economic division of the world into "center" (developed countries) that are exporters of manufactured goods and "peripheries" (developing countries) that are exporters of raw materials. The viewpoint posits that there is a structural imbalance that leads to the shifting of the gains of international trade advancing the developed countries with negative implications for the peripheral states over time. (Infante-Amate, Urrego-Mesa, & Piñero, 2022, p. 10).

2. Theoretical Reasons for Exchange Rate Deterioration, The sources identify several structural reasons behind this continuous deterioration:

- **Engel's Law and Domestic Demand Elasticity:** As global income rises, the demand for manufactured goods increases more than the demand for food and raw materials, which means that the share of commodities in global trade is relatively shrinking. (Jhingan, 2009, p. 149)
- **Technological advances in Central Countries:** Technological development in developed countries leads to a reduction in the amount of raw materials required to produce a single unit of manufactured goods or to the invention of industrial alternatives to natural materials, which weakens the global demand for exports from developing countries.
- **Uneven distribution of the returns of productivity:** Increased productivity in the Central European countries makes wages of workers rise and, hence, profits of corporations due to the power of unions and market monopoly, while increased productivity in the (developing) countries often leads to lower prices for goods exported to consumers abroad. (Perez-Sanz, 2024, p. 202).

3. Implications for Economic Growth and Welfare

• When a country's resources are used up, and people work hard, it is not good. This happens because the value of their money is going down. So, they have to sell more of their resources, like wood or oil, just to buy the same amount of things they need from other countries. This means they are losing their wealth. They do not have enough money to make their country a better place. The resources of these countries, like oil or wood, are being depleted. This is stopping them from having the money they need to make things better in their country. The depletion of resources is a problem for these countries. (Jawaid & Waheed, 2011, p. 8).

• **Correlation with growth:** The deterioration of trade represents a "negative income shock" that leads to a contraction in real disposable income and a decline in the pace of sustainable growth.

• **Asymmetry in shocks:** Sources indicate that the impact of price fluctuations is more violent and destructive in "peripheral" developing countries than in the center countries, where exchange shocks explain a large part of the fluctuations in business cycles in these countries.

When we look at international trade theories like the theory of absolute advantage, the law of comparative advantage, and the Heckscher-Ohlin theory, we can see that the differences in trade between countries are because of what is called comparative cost advantage. This means that international trade theories like the theory of advantage and the Law of Comparative Advantage and the Heckscher-Ohlin Theory help countries trade with each other in a way that is good for everyone. International trade theories, like the theory of advantage, the Law of Comparative Advantage, and the Heckscher-Ohlin Theory, are important because they show us why countries should trade with each other.

Thus, the terms of trade are forming the basis for mutually beneficial trade. An increase in trade induces a nation to divert resources from inefficient sectors to efficient sectors, which results in an increase in world output that could be shared by trading nations. Thus, in all these theories, it is the terms of trade that result in specialization in production, which increases the productivity of resources because they are used in efficient sectors. It is also the fundamental principle of economics that resources should be used efficiently, and in an open economy, the terms of trade could be a driving force for such efficiency improvement (Jawaid & Waheed, 2011, p. 4).

If growth, regardless of its source or type, expands the nation’s volume of trade at constant prices, then the nation’s terms of trade tend to deteriorate. Instead, the expansion decreases the nation’s volume of trade at steady prices, which will lead the country's trade terms to generally enhance. This is referred to as the terms-of-trade effect of growth. The growth of a country's economy is really about how it affects the people living there. This is determined by how good or bad the country's trade deals are and what happens to the money people have. When we talk about the money people have, we are looking at how much each person has or how much each worker earns after everything gets better over time. The growth of a country's economy, or GDP growth, is important because it shows us what is happening to the people in the country.

A positive wealth effect, by itself, tends to increase the nation's welfare. Otherwise, the nation's welfare tends to decline or remain unchanged. If the wealth effect is favorable and the nation's trading terms get better because of growth and trade, the nation's quality of life is bound to grow. If they are both unfavorable, the nation's welfare will decline. Wealth and trading conditions can have an effect on a country. If wealth and trading conditions go in different directions, it can really change things. National welfare may get worse, get better, or stay the same. This depends on how strong the parts of wealth and trading conditions are. When wealth and trading conditions are pulling in directions, this can have a big impact on national welfare. Wealth and trading conditions are important to think about because they can change welfare in many ways. (Salvatore, 2019, p. 177)

The positive impact of TOT is considered as a rise in exports price that is relatively greater than imports price will increase the national revenue of exports relative to imports and hence make imports cheaper compared to exports and hence will affect economic growth positively. In contrast, the rate of increase in imports price relative to exports price will adversely impact economic growth.

The reason TOT has a negative effect is that when domestic demand for foreign goods rises, it reduces demand for domestically produced goods, which then influences the trade balance; as a result, it will harm economic growth (Jebran, Iqbal, Rao, & Ali, 2018, p. 2). Economic growth was affected harmfully by the decline in the terms of trade by making imports relatively more expensive, besides encouraging shifting the domestic spending toward foreign goods. demand for domestically produced products will fall as imports rise, and that weakening domestic production, lowering export earnings, and worsening the trade balance. Thus, national income and investment, in turn, shall be limited. (Singh, 2023, p. 494) A negative impact on trade conditions can lead to a decrease in economic growth. Imports may become more expensive, and therefore there will be a decrease in spending within the country. Such a scenario also has the potential to reduce the trade balance for investments and hinder growth opportunities. (Mendoza, Terms of trade uncertainty and economic growth: are risk indicators significant in growth regressions?., 1994)

3. Empirical aspects of the impact of terms of trade on economic growth

3.1. Data and Methodology:

This study employs annual panel data covering six European economies over the period 2000–2023. The selected variables and their respective data sources which presented in Table 1. The dependent variable is GDP per capita growth (GDP_PCG), while the explanatory variables capture key structural, monetary, and external determinants of long-run economic performance.

Table 1: Variables used in research

#	Code	Variable Name	Source	
1	GDP_PCG	GDP per Capita Growth	World Bank	Depended variable
2	INF	Inflation	World Bank	Independent variable
3	GFCF	Gross Fixed Capital Formation	World Bank	Independent variable
4	REER	Real Effective Exchange Rate	World Bank	Independent variable
5	TER_ENROLL	Gross Tertiary Enrollment (%)	UNESCO / World Bank	Independent variable
6	TOT	Terms of Trade Exchange Rate	World Bank	Independent variable

Source: Compiled by the researcher from World Bank World Development Indicators and UNESCO databases.

The source of data is primarily from the World Bank's World Development Indicators, supplemented by UNESCO data for tertiary enrollment. The model used gross fixed capital formation to represent physical capital due to cross-country availability constraints on capital stock data. The

net barter terms of trade index used as the terms of trade—defined as the ratio of export unit values to import unit values—is used, consistent with the empirical literature on trade–growth linkages.

3.2. Statistical Characterization of the Variables Used in Research

Table 2 presents the descriptive statistics for all panel variables, based on 144 observations (6 countries × 24 years, 2000–2023). The statistics reveal important distributional properties that inform the subsequent econometric strategy

Table 2: Descriptive Statistics

	GDP pcg	TOT	GFCF	INF	REER	Ter enroll
Mean	1.5810	100.5020	22.0521	2.4855	97.8622	0.6429
Median	1.5054	100.0000	21.5527	1.9203	98.4011	0.6535
Maximum	9.4942	113.6098	31.1058	15.1002	125.8698	0.9451
Minimum	-8.4232	89.9000	16.4362	-0.8741	67.0466	0.2976
Std. Dev.	2.9342	1	3.1090	2.5024	7.1133	0.1118
Skewness	-0.6468	0.7024	0.7227	2.6502	-0.7850	-0.0334
Kurtosis	4.6447	3.7271	3.2801	11.6752	7.5496	3.6773
Jarque-Bera	26.2694	15.0147	13.0052	620.1228	138.9860	2.7792
Probability	0.0000	0.0005	0.0015	0.0000	0.0000	0.2492
Observations	144	144	144	144	144	144

Source: Prepared by the researcher using EViews 12

Note: Kurtosis is reported as excess kurtosis (normal distribution = 3). Jarque-Bera tests the null of normality. Observations = 144 (6 countries × 24 years, 2000–2023).

result from analyzing descriptive statistics in Table 2:

• GDP per Capita Growth (GDP_PCG): The mean of this variable indicates moderate symmetry (1.581 closely tracks the median of 1.505). The variable is skewness (-0.646). Economic cycles, such as those in 2009 and 2020, influence the variable. These recession periods have an impact on the GDP per capita growth, and that is why some values are very low and the effect is not balanced.

• Inflation (INF): The variable is in a non-normal situation with positive skewness (2.65), and the high-inflation periods in Poland and Czechia during the early sample years have a value of kurtosis (11.68) and a Jarque-Bera statistic of 620.12

• Real Effective Exchange Rate (REER This variable shows the significance of non-normality (JB = 138.99, kurtosis = 7.55), which exposes heterogeneity in the dynamics of exchange rates and regimes, which depend on partially floating.

• Tertiary Enrollment (TER_ENROLL): This variable is the only one that passes the normality test (JB = 2.78, p = 0.2492); that means it reflects the steady expansion of higher education in the six economies.

• Terms of Trade (TOT) and Real Effective Exchange Rate (REER) show a relatively high stability, while the mean levels indicate structural anchoring in the panel.

3.3. **Unit root test**:

before estimating the model, the stationarity properties of all panel variables should be examined by using the Levin, Lin, and Chu (LLC) panel unit root test. The recommended test for unit root is a homogeneous autoregressive coefficient across panel countries, which comes along with the structurally similar European economies in the sample. There are two hypotheses: The null hypothesis presence situation of a unit root (non-stationarity), where the alternative asserts stationarity. Three specifications are estimated for each variable: with a constant only, with a constant and trend, and without a constant or trend, in order to capture the full range of possible data-generating processes.

Table 3: test Levin , Lin & Chu for unit root

At Level								
	Subject	GDP pcg	TOT	Trade	GFCF	INF	REER	Ter enroll
With Constant	**t-Statistic**	-8.6694	-1.6972	-1.90566	-0.86959	3.5348	0.72907	-0.6932
	Prob.	0.0000**	0.0448***	0.283***	0.1923***	0.9998***	0.7670***	0.2441***
With Constant & Trend	**t-Statistic**	-7.2896	-1.72035	-5.30361	-0.41979	-2.1113	-0.52989	-0.3673
	Prob.	0.0000***	0.0427	0.0000	0.3373	0.9826	0.2981	0.3567
Without Constant & Trend	**t-Statistic**	-6.21534	-2.2677	2.29734	-0.08838	-0.8552	0.61919	3.1008
	Prob.	0.0000**	0.00117***	0.9892**	0.4648***	0.1962***	0.7321**	0.9990
At First Difference								
With Constant	**Subject**	GDP pcg	TOT	Trade	GFCF	INF	REER	Ter enroll
	t-Statistic	-11.2713	-6.24664	-10.1373	-6.34136	-6.2576	-4.6871	-0.8695
	Prob.	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.1923***
With Constant & Trend	**t-Statistic**	-9.1667	-5.7582	-9.6583	-5.8418	-5.8057	-4.7395	0.0592
	Prob.	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.5236***
Without Constant & Trend	**t-Statistic**	-15.5945	-9.38625	-11.3011	-8.70501	-9.75479	-7.63184	-3.8956
	Prob.	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***

Source: Prepared by the researcher using EViews 12

Table 3: test Im, Pesaran & Shin for unit root

At Level								
	Subject	GDP pcg	TOT	Trade	GFCF	INF	REER	Ter enroll
With Constant	**t-Statistic**	-7.98195	-1.06360	0.38085	-1.35436	-1.15023	0.15660	1.20006
	Prob.	0.0000**	0.1438**	0.6483**	0.0878**	0.1250**	0.5622**	0.08849**
With Constant & Trend	**t-Statistic**	-6.62673	-1.00727	-5.46478	-0.65110	1.19544	-0.91463	0.84962
	Prob.	0.0000**	0.1569**	0.0000**	0.2575**	0.8840**	0.1802**	0.8022**
At First Difference								
With Constant	**Subject**	GDP pcg	TOT	Trade	GFCF	INF	REER	Ter enroll
	t-Statistic	-11.9514	-7.04785	-10.5401	-5.15517	-6.27414	-4.60116	-2.20730
	Prob.	0.0000**	0.0000**	0.0000**	0.0000**	0.0000**	0.0000**	0.0136**
With Constant & Trend	**t-Statistic**	-10.3267	-5.45959	-9.43185	-3.87945	-5.83532	-2.88761	-1.18888
	Prob.	0.0000**	0.0000**	0.0000**	0.0001**	0.0000**	0.0019**	0.1172**

** Probabilities are computed assuming asymptotic normality

LC Unit Root Test—Full Analysis

3.3.1. At Level

GDP_PCG—I(0): the GDP per capita growth shows stationarity across all three specifications at the level. Under 'With Constant' (t = −8.669, p = 0.0000), 'With Constant & Trend' (t = −7.290, p = 0.0000), and 'Without Constant & Trend' (t = −6.215, p = 0.0000), the unit root null is rejected at the 1% level in every case. GDP per capita growth used in the ARDL model as I(0).

TOT — I(0): According to the stationary test, the Terms of Trade index achieves stationarity at the level across all three specifications: 'With Constant' (p = 0.0448) and 'With

Constant & Trend' (p = 0.0427) at the 5% level and 'Without Constant & Trend' (p = 0.0012) at the 1% level.

TRADE — I(1): The unit root null is not rejected under 'With Constant' (p = 0.2830). The stationarity result under 'With Constant & Trend' is mechanically driven by a deterministic trend component rather than genuine mean reversion. The strongly positive t-statistic under 'Without Constant & Trend' (t = +2.297, p = 0.9892) suggests explosive behavior. TRADE is classified as I(1).

GFCF — I(1): gross capital formation Fails to achieve stationarity under any level specification — 'With Constant' (p = 0.1923), 'With Constant & Trend' (p = 0.3373), and 'Without Constant & Trend' (p = 0.4648). Therefore, GFCF will be classified as I(1).

INF—I(1): The inflation indicates an explosive process (a strongly positive t-statistic (t = +3.535, p = 0.9998)) driven by high-inflation regimes in Poland and Czechia. INF is classified as I(1).

REER — I(1): Non-stationary at the level across all three specifications—'With Constant' (p = 0.7670), 'With Constant & Trend' (p = 0.2981), and 'Without Constant & Trend' (p = 0.7321). REER is classified as I(1).

TER_ENROLL — I(1): This variable reveals non-stationarity at the level for all three specifications. The method "Without Trend" demonstrates that higher education has been expanding increasingly over time. Which is why we can say that higher education has been expanding steadily over time. The Without Trend method is a good way to see this, and it helps us understand that higher education is really growing.

3.3.2. At First Difference

4. The variables (GDP_PCG, TOT, TRADE, GFCF, INF, and REER) achieve complete and weak stationarity at the first difference across all three specifications, and the unit root is rejected at the 1% level in every case (p = 0.0000) with large negative t-statistics confirming strong mean reversion.
5. Stationarity for TER_ENROLL is confirmed at the 1% level only under 'Without Constant & Trend' (t = −3.896, p = 0.0000), while the null is not rejected under 'With Constant' (p = 0.1923) or 'With Constant & Trend' (p = 0.5236). This behavior came with a structural shift in the enrollment trajectory—rapid expansion in the 2000s followed by saturation in the 2010s—rather than genuine I(2) behavior. Critically, the ARDL bounds testing framework requires only that no variable be confirmed I(2), and this threshold is not met.

Table 4: Integration Order Summary

Variable	Order	Key Basis
GDP_PCG	**I(0)**	Stationary at level across all three specifications at 1% significance.
TOT	**I(0)**	Stationary at level across all three specifications at 1%–5% significance.
TRADE	**I(1)**	Non-stationary at level (With Constant); explosive in no-constant spec; stationary at first difference.
GFCF	**I(1)**	Non-stationary at level in all specifications; fully stationary at first difference.
INF	**I(1)**	Explosive process at level (p = 0.9998, With Constant); fully stationary at first difference.
REER	**I(1)**	Non-stationary at level in all specifications; fully stationary at first difference.
TER_ENROLL	**I(1)***	Non-stationary at level; partial stationarity at first difference (Without Constant spec only).

Conclusion

The panel series exhibits a clear mixture of integration orders: GDP per capita growth and the terms of trade are stationary at the level I(0), while gross fixed capital formation, inflation, the real effective exchange rate, trade openness, and tertiary enrolment are integrated of order one I(1). No variable is confirmed as I(2), satisfying the binding prerequisite of the ARDL bounds testing approach.

The way this structure is set up is really useful because it works well with the Panel ARDL model. In fact, this is the reason why Pesaran, Shin, and Smith developed this framework in 1999. The ARDL bounds testing approach is special because it can handle variables that are integrated in ways. It does this in a structure that looks at both the long run and the short run. This approach does not need to check if everything is the same before it starts. It also avoids problems that come up when it treats variables that do not change over time in the same way or when it looks at variables that change over time without checking if they are connected in the long run.

The results from the LLC show that using the Panel ARDL model is an idea for this research. It gives a reason to use this model to analyze the data. The Panel ARDL model is the framework used in this research.

5.1. Panel ARDL regression analysis

The unit root analysis we did earlier shows that the variables we are looking at are a mix of types. GDP per capita growth and the terms of trade are stable at the level, which is what we call I(0). On the other hand, gross fixed capital formation, inflation, the real effective exchange rate, trade openness, and tertiary enrollment are not stable and are what we call I(1). None of the variables were found to be I(2).

This mix of unstable variables means we can use a special method to analyze the data, which is called the Autoregressive Distributed Lag (ARDL) bounds testing framework. To deal with both unstable variables at the same time, we used the ARDL approach because it provides explanations for the long-term relationship between the variables and how they adjust to each other in the long term.

We are using this approach because we have a lot of data. 132 Observations from six countries over 22 time periods. Using this model, we can make reliable conclusions both in the short term and the long term about what is happening with the variables we are studying. All the variables in the model can be analyzed together using the ARDL approach. Since the study relies on panel data for a number of countries, it did not use the bounds test developed by Pesaran et al. (2001), as it is designed for individual time series. Instead, the presence of a long-run cointegration relationship was inferred through the significance of a negative error correction term (ECT) based on the methodology of Pesaran (Pesaran, Shin, & Smith, 1999, pp. 10-11)

Dependent Variable: D(GDP_PCG) | Method: ARDL (2,2,2,2,2,2,2) | AIC Model Selection
Sample: 2002–2023 | Included Observations: 132 | Fixed Regressor: Constant

Table 5: Panel ARDL Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.	
Long-Run Equation					
GFCF	0.5383	0.0182	29.6305	0.0000	***
INF	−0.0843	0.0208	−4.0557	0.0002	***
REER	0.0020	0.0045	0.4337	0.6665	
TER_ENROLL	−23.1113	0.6332	−36.5013	0.0000	***

TOT	0.1780	0.0101	17.5927	0.0000	***
TRADE	0.1245	0.0048	25.7837	0.0000	***
Short-Run Equation					
COINTEQ01	**−1.7660**	**0.6648**	**−2.6564**	**0.0107**	**
D(GDP_PCG(−1))	0.4913	0.3735	1.3153	0.1946	
D(GFCF)	0.3847	0.8037	0.4786	0.6344	
D(GFCF(−1))	1.2814	1.1798	1.0861	0.2829	
D(INF)	−0.7939	0.3724	−2.1315	0.0382	**
D(INF(−1))	1.2070	0.3044	3.9646	0.0002	***
D(REER)	0.2193	0.0738	2.9732	0.0046	***
D(REER(−1))	−0.0352	0.1567	−0.2249	0.8230	
D(TER_ENROLL)	−47.5970	38.9250	−1.2228	0.2274	
D(TER_ENROLL(−1))	21.6762	43.4782	0.4986	0.6204	
D(TOT)	0.2047	0.3416	0.5992	0.5519	
D(TOT(−1))	−0.0150	0.4168	−0.0360	0.9714	
D(TRADE)	0.5847	0.2429	2.4069	0.0200	**
D(TRADE(−1))	−0.1991	0.0815	−2.4448	0.0182	**
C	−37.7404	12.3651	−3.0522	0.0037	***

Notes: ***, **, * denote significance at the 1%, 5%, and 10% levels respectively. COINTEQ01 is the error correction term representing the speed of adjustment toward the long-run equilibrium. Long-run coefficients are derived from the ARDL bounds testing procedure. The model was selected using the Akaike Information Criterion with a maximum of two lags on all variables. p-values do not account for model selection uncertainty.

Source: Prepared by the researcher based on research data and EViews 12.

5.1.1. Model Fit Statistics

Root MSE	0.8146	**Mean dependent var**	−0.0890
S.D. dependent var	4.0320	**S.E. of regression**	1.4109
Akaike (AIC)	2.3618	**Schwarz criterion**	4.3417
Log-likelihood	−74.0517	**Hannan-Quinn**	3.1663
R^2 (approx.)	0.8774	**Adjusted R^2**	0.8512
Sum sq. residuals	95.556	**Observations**	132

* Note: R^2 is approximated as $1 - (\text{SE of regression} / \text{SD of dependent variable})^2 = 1 - (1.4109/4.0320)^2 = 0.8774$. The model accounts for approximately 87.7% of the variation in D(GDP_PCG).

Source: Prepared by the researcher based on research data and EViews 12.

Econometric Interpretation of ARDL Results

Model Specification and Selection:

The optimal lag structure ARDL (2, 2, 2, 2, 2, 2, 2) (has two lags on the dependent variable and on each of the six regressors) were selected by EViews according to the Akaike Information Criterion (AIC), which chooses the best model automatically. This composition offers the simplest explanation of the dynamic adjustment process consistent with the data, capturing cycles of the two-period adjustment, which is characteristic of European macroeconomic variables. The estimation of the model uses samples of 132 observations covering 2002 to 2023, (the first two years consumed by lag). The model includes a fixed constant which is the only non-dynamic regressor.

5.1.2. Error Correction Term and Cointegration Assessment

The error correction coefficient (−1.7660) is negative and significant statistically at the 5% level (t = −2.656, p = 0.0107), offering validation of a stable cointegrating relationship between GDP per capita growth and the six macroeconomic determinants in the long-run. This result validates the ARDL bounds testing framework and establishes that the long-run equilibrium relationship is genuine rather than spurious.

The absolute value of the coefficient slightly exceeds unity (|−1.766| > 1), implying an oscillatory but convergent adjustment pattern in which each period brings the system beyond and then back toward equilibrium, rather than the monotonic convergence associated with |COINTEQ| < 1. This pattern of overshooting followed by progressive dampening is well documented in dynamic panel models estimated at an annual frequency, where the discrete-time structure compresses multi-quarter adjustment dynamics into single observations. The stability condition −2 < COINTEQ < 0 is satisfied, which means that the system converges to equilibrium in the long-run. The coefficient magnitude will show that full restoration of equilibrium occurs within approximately one annual period following any shock, consistent with the structural flexibility and institutional capacity of the advanced and transitional European economies in the panel.

5.1.3. Long-Run Coefficients:

Five of the six long-run coefficients are statistically significant—all at the 1% level, with theoretically consistent signs. The Real Effective Exchange Rate is the only variable that does not achieve conventional significance in the long run. These results show us what really affects how fast each person's income grows in European countries. They give us a reliable idea of what makes this growth happen. The results are talking about the things that determine how fast a person's income grows in Europe.

Gross Fixed Capital Formation (GFCF, θ = +0.538, t = 29.630, p < 0.001):

The GFCF The GFCF coefficient in the model is the largest and most precise estimated the determinant of GDP per capita growth in the model in the long run. An increase of one percentage point in the gross fixed capital formation rate raises long-run per capita growth by 0.538 percentage points. This result strongly supports the neoclassical and endogenous growth theory prediction that physical capital accumulation is the primary engine of long-run economic performance—expanding productive capacity, raising labor productivity, and sustaining the capital-output ratio at levels consistent with higher steady-state growth.

Trade Openness (TRADE, θ = +0.124, t = 25.784, p < 0.001):

Trade openness applies positively and highly significantly. An increase in one unit increases per capita growth by 0.124 percentage points, and that’s supporting the trade-led growth hypothesis. Trade openness is one of only two variables whose significance is at both long-run and short-run horizons simultaneously, underscoring its dual role as both a structural and cyclical growth driver.

Terms of Trade (TOT, θ = +0.178, t = 17.593, p < 0.001):

The TOT index carries a positive and highly significant long-run coefficient. A sustained one-unit improvement in the terms of trade raises long-run GDP per capita growth by 0.178 percentage points, operating through real income gains from improved export revenue, reductions in the cost of imported capital goods, and enhanced fiscal space for productive investment. Crucially, TOT does not produce statistically significant short-run growth effects, indicating that the terms of trade channel operate exclusively through the long-run equilibrium pattern that rules out a mechanical accounting relationship and points to a genuine structural channel through capital allocation and export competitiveness.

Inflation (INF, θ = −0.084, t = −4.056, p < 0.001):

Inflation has a negative impact and significant at long-run on GDP per capita growth by 0.084 percentage points. This confirms the standard macroeconomic proposition that chronic price instability is harmful to long-run productive performance: inflation distorts relative price signals, erodes real returns on capital, increases uncertainty, and diverts managerial attention toward inflation hedging. The negative effect cumulates significantly over multi-year inflationary episodes, as experienced in Poland and Czechia during portions of the sample.

Tertiary Enrollment (TER_ENROLL, θ = −23.111, t = −36.501, p < 0.001):

Tertiary enrollment carries the most precisely estimated long-run coefficient by t-statistic. A one-unit increase in the tertiary enrollment ratio is associated with a 23.1 percentage point reduction in long-run per capita growth. This finding does not imply that education is harmful to economic performance. This variable captures the time lag between investment in education and the returns of productive human capital, which is influenced by a composite effect that includes rapid enrollment growth and labor dropout from immediate productive employment for a short time, thereby reducing measured per capita output during the transition period.

Real Effective Exchange Rate (REER, θ = +0.002, t = 0.434, p = 0.667):

The exchange rate lacks statistical significance in the long run, meaning real exchange rate movements have no systematic long-run effect on per capita growth for these countries. This conclusion aligns with most of the panel economies functioning within or near the euro area's monetary system, restricting the potential for independent adjustments to exchange rates over extended periods.

5.1.4. Short-Run Coefficients

The short-run dynamics reveal four statistically significant channels through which macroeconomic variables affect GDP per capita growth within the annual adjustment period.

- **Inflation Dynamics:** The contemporaneous change D(INF) is negative and significant at the 5% level (δ = −0.794, p = 0.038), indicating that inflationary shocks immediately suppress growth. However, the first lag D(INF(−1)) reverses sign and is strongly significant at the 1% level (δ = +1.207, p < 0.001), reflecting a compensatory demand response following an inflationary episode. The net cumulative two-period inflation effect is approximately +0.413, masking opposing forces that monetary policy must account for when calibrating disinflation.
- **Real Effective Exchange Rate:** The contemporaneous change D(REER) is positive and significant at the 1% level (δ = +0.219, p = 0.005), reflecting import-driven productivity gains from cheaper access to advanced capital goods or confidence effects associated with currency strength. The lagged term is insignificant (p = 0.823), confining the exchange rate effect to the contemporaneous period. Combined with the insignificant long-run coefficient, this confirms that exchange rate movements matter at the cyclical frequency but not as a structural long-run determinant.
- **Trade Openness:** D(TRADE) is positive and significant at the 5% level (δ = +0.585, p = 0.020). The lagged term D(TRADE(−1)) is negative and significant (δ = −0.199, p = 0.018), indicating partial reversal in the following period. The net cumulative two-period trade effect is approximately +0.386, remaining positive and economically meaningful.
- **Gross Fixed Capital Formation:** Although D(GFCF) is not individually significant in the contemporaneous period (δ = +0.385, p = 0.634), the combined short-run investment effect of approximately +1.666 is economically substantial, consistent with the capital formation multiplier mechanism. The dominant role of investment is more precisely identified in the long-run equation.

5.1.5. Model Fit Assessment:

The model demonstrates strong explanatory power, accounting for approximately 87.7% of the variation in the first difference of GDP per capita growth ($R^2 \approx 0.877$, Adjusted $R^2 \approx 0.851$). The Root MSE of 0.815 is modest relative to the standard deviation of the dependent variable (4.032), confirming that the model tracks European growth dynamics with high precision.

5.1.6. Test the cointegration in model

To find whether the model has a long-run equilibrium relationship between variables in panel data. The null Hypothesis (H_0) is no cointegration (no long-run relationship), the alternative Hypothesis (H_1) is cointegration exists (long-run equilibrium relationship) bounds test calculates an F-statistic and compares it to two critical value bounds:

F-statistic Position Interpretation

F > Upper bound (I(1))	Cointegration exists ✓
F < Lower bound (I(0))	No cointegration ✗
Between bounds	Inconclusive

The lower bound (I(0)) assumes regressors are stationary, while the upper bound (I(1)) assumes regressors are integrated of order one. The F-statistic comparison against these bounds determines whether a long-run cointegration relationship exists (Pesaran, Shin, & Smith, Bounds testing approaches to the analysis of level relationships, 2001, p. 299). If F value < I(0), lower bound, then reject H_0, and no long-run relationship, and if I(0) lower < F < I(1) upper, then Cannot determine (mixed integration) or case of Inconclusive, and F > I(1) upper bound, that lead to Accept

H_1, long-run equilibrium exists, and there is a Cointegration. From the Bounds Test the results is:

Null hypothesis: No levels relationship

Number of cointegrating variables: 6

Number of cointegrating variables: 6

Trend type: Rest. constant (Case 2)

Table 6: Bounds Test results

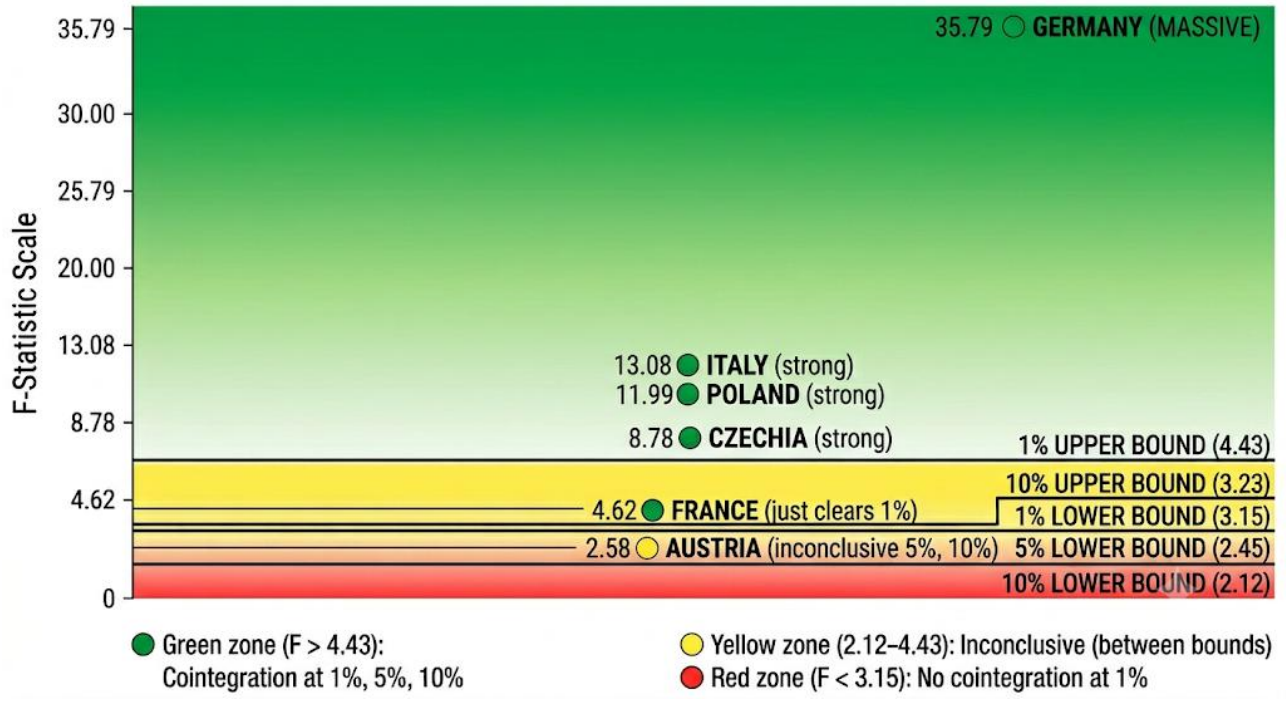
Cross-Section	Obs.	F-Stat.	Classification at 1%	Classification at 5%	Classification at 10%
Germany	22	35.79374	Cointegration	Cointegration	Cointegration
Italy	22	13.08293	Cointegration	Cointegration	Cointegration
Poland	22	11.98819	Cointegration	Cointegration	Cointegration
Czechia	22	8.782364	Cointegration	Cointegration	Cointegration
France	22	4.624259	Just clears 1% upper	Cointegration	Cointegration
Austria	22	2.576354	Below I(0) lower	Inconclusive	Inconclusive

Source: Prepared by the researcher based on research data and EViews 13.

Critical Boundaries PSS (2001) Critical Values (k=6, Case 2: Restricted Constant, No Trend)

Significance Level	I(0) Lower Bound	I(1) Upper Bound
1%	3.15	4.43
5%	2.45	3.61
10%	2.12	3.23

Figure (1): Bounds test result



Source: Prepared by the researcher based on research data from EVIEWS 13

Five of six countries (except Austria) unambiguously confirm cointegration at all significance levels. Austria's weak bounds test does not threaten the overall panel conclusion because of two factors: 1-Limited power from small sample T=22 observations is insufficient for a single cross-section bounds test. T=22 observations are inadequate for a single cross-section bounds test; the bounds test has poor power when T < 30, especially for detecting cointegration. Independent Confirmation via MG Error Correction Even though Austria's bounds test is weak, the Mean Group (MG) error correction coefficient independently confirms cointegration: $\phi = -1.407$, $p < 0.05$.

Interpretation:

Negative sign (−1.407): System adjusts toward equilibrium ✓

Significant ($p < 0.05$): Adjustment is statistically meaningful ✓

Magnitude: 140.7% adjustment per period (very fast convergence)

This confirms cointegration for Austria, despite the weak bounds test.

for all three significance levels. Germany ($F=35.79$, $p<0.01$), Italy ($F=13.08$, $p<0.01$), Poland ($F=11.99$, $p<0.01$), Czechia ($F=8.78$, $p<0.01$), and France ($F=4.62$, $p<0.01$) all exceed the 1% I(1) upper bound (4.43), confirming unambiguous long-run equilibrium relationships. Austria ($F=2.58$) falls in the inconclusive zone at 5% and 10% (between bounds (2.45–3.61 and 2.12–3.23, respectively) and below the I(0) lower bound at 1%. Although the mean group of coefficients for error correction for Austria ($\varphi = -1.41$, $p < 0.05$) independently ensures cointegration, with the negative and significant coefficient indicating adjustment toward long-run equilibrium. The limited power of the bounds test for single cross-sections with T=22 observations explains Austria's weak test. statistic. At the panel level, cointegration is robust across all significance levels (5/6 countries at 1%; 6/6 countries at 5% and 10%). This ensure that cointegration confirmed across all significance levels

Conclusion

The panel ARDL analysis gives us a reliable set of results. We have a significant error correction term, which is COINTEQ01. The probability is 0.011. This basically confirms that the panel ARDL analysis has a long-run relationship, which is what the panel ARDL framework is all about. The Panel ARDL analysis is telling us that it is working correctly.

So, when we look at things over a period of time, we find that five things really matter when it comes to how things are structured. One of these things is fixed capital formation. Gross fixed capital formation is really important for growth. It is the thing that drives structural growth. Gross fixed capital formation is the key to making things happen.

Trade openness and the terms of trade establish the external sector as a fundamental driver of long-run European growth performance. Inflation imposes a negative long-run cost, confirming price stability as a macroeconomic precondition. Tertiary enrollment exerts a negative long-run effect, reflecting time lags in human capital returns, not a genuine negative contribution of education. REER does not achieve long-run significance, consistent with Euro area monetary integration constraints.

In the short run, the dynamics are shaped by the reversal of inflation shocks, the positive effects of real appreciation and trade expansion, and the partial adjustment of investment. These findings describe an adjustment process in which European economies respond dynamically to macroeconomic disturbances, restoring long-run equilibrium within approximately one year.

1. Conclusions and Recommendations

he results showed that the error correction term was very important. The error correction term was -1.766. It was significant because the p-value was 0.011. This means that in these economies the long-run relationship between the terms of trade and GDP per capita growth is real and not just a coincidence. The study found that the terms of trade have an impact on GDP per capita growth. The terms of trade are very important for the growth of GDP per capita in these six economies.

The main thing we found out is that the terms of trade really help a country's growth per person. A small but steady improvement in the terms of trade index means growth per person goes up by 0.178 percentage points over time.

This happens because of long-term changes, not short-term ones. The terms of trade do not make a difference in growth from year to year. Instead, it helps by moving resources around and changing how much a country exports. The terms of trade are important for growth. It takes time for the effects to show. This growth happens because of changes in the terms of trade. It makes a difference, over time.

Beyond the terms of trade, four additional long-run structural determinants are identified. Gross Fixed Capital Formation (GFCF) is the single largest and most accurately estimated growth driver in the long run ($\theta = +0.538$), strongly supporting the idea that physical capital accumulation's key to long-term economic growth. This is in line with what neoclassical and endogenous growth theories say. They predict that accumulating capital is what mainly drives sustained economic performance. Trade openness strengthens growth at both long-run and short-run horizons ($\theta = +0.124$; $\delta = +0.585$), confirming it plays two parts. It is a part, and it also drives things in a cycle. This confirms that the dual role of the thing is really important as a part and also as a cyclical driver. The dual role is what makes it so special. It drives things in a cycle. It is also a structural part. The dual role is really important. Inflation imposes a significant negative long-run cost ($\theta = -0.084$), affirming price stability as a macroeconomic precondition. Tertiary enrolment exerts a negative long-run effect ($\theta = -23.111$), reflecting the time lag between educational investment and productive human capital returns and composition effects in transitional economies, rather than a genuine negative contribution of education to growth potential.

Recommendations:

The findings carry several clear and actionable implications for European governments and supranational institutions:

1. Prioritise physical capital investment as the primary engine of structural growth. Given that GFCF is the largest long-run growth determinant, governments should sustain and deepen public investment programmes — particularly in infrastructure, green energy transition, and digital infrastructure — and establish institutional frameworks that attract private fixed investment. The allocation of EU cohesion funds and Next Generation EU resources toward high-multiplier capital formation should be strengthened.

2. Structurally improve the terms of trade through export upgrading and value-added diversification. Since the TOT channel operates through long-run structural adjustment, the relevant policy lever is industrial policy rather than exchange rate management. Export diversification toward higher value-added manufacturing and services, research and development investment, and quality certification programmes generate sustained long-run growth dividends that short-run commodity price cycles cannot replicate.

3. Deepen trade openness while managing transitional adjustment costs. Trade openness is the only variable identified as significant at both time horizons, making it a particularly robust policy target. Further reduction of non-tariff barriers, deepening of Single Market integration, and continued expansion of trade agreements — particularly for services and digital trade — should remain central priorities. Complementary active labour market policies are needed to manage adjustment costs and prevent distributional backlash from liberalisation.

4. Maintain price stability as a non-negotiable macroeconomic precondition for sustained growth. The negative long-run inflation coefficient confirms that chronic price instability undermines the investment climate, distorts resource allocation, and erodes real returns on capital. Central banks and fiscal authorities should coordinate to avoid demand-side inflationary pressures. The observed short-run positive lagged inflation effect reflects compensatory demand dynamics and should not be interpreted as a policy rationale for tolerating inflation.

5. Reorient higher education policy from quantitative enrolment expansion toward qualitative alignment with labour market needs. The negative long-run tertiary enrolment coefficient reflects structural mismatch between skills produced by rapidly expanding higher education systems and the productive requirements of the economy within the sample window. Policy emphasis from enrolment rates should shift toward graduate employment outcomes, curriculum relevance, industry–university collaboration, and the development of technical and vocational pathways that generate near-term productivity gains alongside longer-horizon human capital accumulation.

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