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Article

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Article

An Analysis of the Effects of Traditional Exports on Peru's Economic Growth: A Case Study of an Emerging Economy

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Abstract

Economically, all countries seek sustained growth driven by domestic demand, investment, and exports; however, COVID-19 revealed the vulnerability of interconnected economic systems and a sharp contraction in global trade. The objective of this research is to analyze through an econometric model the effect of traditional exports on Peru's economic growth during the 2012–2023 period. The study employed a quantitative approach with a non-experimental, longitudinal design, using quarterly data from the Central Reserve Bank of Peru and the National Bureau of Statistics of China, which were transformed into natural logarithms. Unit root tests, the ordinary least squares (OLS) method and a two-stage least squares (2SLS) model were applied to correct for endogeneity. The results show that mining accounts for 81.7% of total traditional exports from Peru. The model indicated that a 1% increase in traditional exports leads to a 0.29% increase in GDP, confirming a positive impact. However, the high dependence of the mining sector exposes the economy to external risks. Therefore, a productive diversification strategy, alongside the modernization of the mining sector, is recommended to strengthen Peru's economic resilience in the face of global crises and external fluctuations.

Keywords: traditional exports; economic growth; Peru; time series analysis; OLS; MC2E



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1. Introduction

Foreign trade, together with domestic demand, public spending, and private investment, is one of the pillars of economic growth, and is seen as a driver for the development of a country; the exchange of products promotes trade relations, covers market needs, expands sectors for the division of labor and production (Silveira-Pérez et al., 2022). China is one of the most dynamic exporting countries globally, exerting significant influence on other economies through international trade (Yu et al., 2014; Laguna Inocente et al., 2020). However, its remarkable economic growth has been largely driven by an extractive economy. Such success is attributed to a progressive transition toward more inclusive economic institutions (Acemoglu & Robinson, 2016).

In recent years, the world has faced several economic crises, most notably the one triggered by the COVID-19 pandemic (Cancelo & Vázquez-Rozas, 2020; Susskind & Vines, 2020; Akbulaev et al., 2020). It directly affected international trade, a fundamental component of global value chains, disrupting supply chains and economic flows worldwide (Tudorache & Nicolescu, 2023). In addition, governmental measures were taken in response and these actions had severe impacts on the world's major economies, with considerable

disruption to productive activities and accompanied by border closures (Seyfi et al., 2020; Hale et al., 2021; Rengifo et al., 2022).

During the first six months of 2020, world trade experienced a decrease of approximately 13% as a result of factory closures in several regions, including China, Europe and the United States (Espitia et al., 2022). Due to the lockdowns that forced people to stay at home, factory staff were reduced, leading to a drop in production. Consequently, there was a global drop in exports, which negatively affected international trade (Hayakawa & Mukunoki, 2021).

It also led to a severe contraction of the global economy that year, due to isolation measures aimed at slowing the spread of the virus. As a result of this event, unemployment rose considerably, but as lockdowns were lifted, there was a steady decline until it was close to pre-pandemic levels (BCRP, 2021; Mayuri-Ramos et al., 2023b). An increase in foreign sales may indicate rising demand for a country's goods, which implies growth in real output and employment (Andraz & Rodrigues, 2010; Feenstra et al., 2019). As small- and medium-sized enterprises (SMEs) play a key role in the export supply chain, if they face financing problems and declining revenues in times of crisis, their ability to export is compromised, which in turn impacts the country's economy (Salazar-Rebaza et al., 2022; Chikwira & Iqbal Jahed, 2024).

Economic actors benefit equally in a globalized world, but the pandemic revealed dependence among foreign markets and demonstrated a vulnerability in highly interconnected economic systems (Hansen et al., 2023). The multiple ramifications of the emerging exchange crises, such as health and direct economic crises that resulted from the pandemic, had catastrophic effects on Latin American countries, whose economies are dependent on the production of raw materials (Franz, 2021). The Peruvian territory is characterized by its extraordinary diversity of natural heritages (Li, 2020); however, it also has a high vulnerability to climate change (Cardoza Sernaqué et al., 2022). Events such as El Fenómeno del Niño Costero during the austral summer of 2016–2017 caused intense rainfall, flooding, and landslides, negatively affecting the country's economic activities (Rodríguez-Morata et al., 2019; Alatrística-Salas et al., 2021; Yglesias-González et al., 2023). In this context, corporate social responsibility (CSR) plays a crucial role, not only in promoting ethical and social governance within organizations, but also in ensuring the sustainable management of natural resources (Mayuri-Ramos et al., 2023a; Usuriaga-Medrano et al., 2023). Within a sustainable development framework, resources should be utilized responsibly and efficiently, adhering to environmental policies, to promote sustainable economic growth that benefits both present and future generations (Macheka, 2021).

Trade plays an important role in the advancement of a country, providing development and innovation, and increasing exports increases the Gross Domestic Product (GDP) (Dvouletý, 2019; Alca Cruz et al., 2021). Since the 1990s, Peruvian exports have been a key driver of the country's economic growth. Through open trade policies, Peru has managed to integrate into the international market, actively practicing in the World Trade Organization (WTO) and signing free trade agreements that have strengthened its global competitiveness (Organización Mundial del Comercio, 2019; Yllescas-Rodríguez et al., 2021). In turn, this favorable projection was stimulated by the signing of free trade agreements since 2000, which has allowed Peru to develop in foreign markets, mainly in exports in the agricultural and mining sectors (Rossini et al., 2018).

Peru's economic progress and the attraction of more investment are largely due to mining, which accounts for 61.6% of the country's exports, and copper is one of the most popular minerals in the international market (Organización Mundial del Comercio, 2019). In this scenario, it is the world's second largest producer of red metal and ranks third in copper reserves (Li, 2020; Bamber & Fernandez-Stark, 2021; Coayla et al., 2024). If

the country faced a shortage of this mineral, tax revenues would decline significantly, reducing its contribution to GDP. Evidence suggests that copper exports play a revealing and significant role in economic growth, figures indicate that in the period 1995–2018, for every 1% increase in the rate of copper shipments, holding all other factors constant, GDP increased by about 3.56% (Cadenas Polando & Loayza Melgar, 2019).

Since 2012, exports have shown continuous growth with an average annual rate of 3.3%; precisely, in 2022, copper stood out with the highest volume exported, with an annual increase of 6.8%. On the side of traditional exports, agricultural products stood out with an increase of 10.9% (BCRP, 2023a). Likewise, in 2023, traditional exports reached USD 48.600 billion, an increase of 1.8% compared to 2022. This positive effect was mainly driven by the expansion of international shipments of goods from the mining sector, which grew by 11.6%. In contrast, non-traditional exports totaled USD 18.424 billion, representing a 1.1% increase compared to the previous year (BCRP, 2024a). However, this performance has also been influenced by fluctuations in the real exchange rate, which plays a key role in export competitiveness (Blecker, 2023).

Several theoretical frameworks support the link between traditional exports and economic growth. These suggest that exports reflect international demand for goods produced in a country, and the quantity demanded is subject to changes in value and income; if the number of indigenous products decreases, international demand tends to increase. The reason for this is that, when the real exchange rate appreciates, fewer units of foreign currency are needed to purchase domestic goods, in other words, a foreign individual needs to sacrifice fewer goods from his own country to purchase domestic goods (De Gregorio, 2007).

However, traditionally exported goods primarily consist of mining, agricultural, hydrocarbon, and fishmeal products, as established by Supreme Decree 076-92 EF. Products that are not on that list are considered non-traditional exports and tend to have higher value added and are grouped into categories such as agricultural, textile, fishing, wood, chemical, non-metallic mining, mechanical metal, and jewelry, etc. (BCRP, 2024b).

Increasing a nation's foreign sales volume requires evaluating several factors, particularly its comparative advantage (Alvarado Mora et al., 2020), for which the country must encourage investment in sectors where it has a comparative advantage, enhance domestic manufacturing capacity and promote more robust economic growth. Likewise, increased exports facilitate the inflow of foreign exchange, which in turn makes it possible to expand imports of services and capital goods, which are essential to boost productivity and promote economic growth (Kalaitzi & Chamberlain, 2020).

The theory of comparative advantage, originally proposed by Smith and later elaborated by Ricardo, suggests that a nation should specialize in producing and distributing goods and services in which it has higher comparative efficiency, i.e., that which it can manufacture with a lower economic sacrifice compared to other goods and services (Ezeani, 2018). On the other hand, it should import goods and services where it has a higher economic sacrifice in its domestic production (Sujová et al., 2021). Economic models of commodity exports analyze how economies achieve economic growth thanks to the income generated by exports, but also face serious challenges due to price volatility (Nikonenko et al., 2020).

International trade allows each region to concentrate on the manufacture of products that have a relative advantage, while facilitating the transfer of resources between nations, thus boosting economic growth (Belloumi & Alshehry, 2020). It has been argued that trade plays an essential role in the capital accumulation of countries. Moreover, it encourages specialization in production, resulting in an efficient allocation of resources. Neoclassical growth theories, particularly led by Solow, stress the importance of trade flows, both in

and out of goods, as an essential component in long-term economic progress (Albiman & Suleiman, 2016).

Economic growth refers to the numerical increase or expansion of the income from the value of final goods and services produced in an economic system, whether at the local, state or global level, during a specific period, generally one year, this growth is evaluated by the GDP growth rate (Márquez Ortiz et al., 2020). Moreover, it not only calculates the value of goods and services but is also an economic indicator that calculates the volume of production and describes the performance of the economy in terms of stabilization (Ressin, 2024). GDP is a critical metric for assessing the economic performance of a country or region (Sujová et al., 2021; Shams et al., 2024).

According to Adam Smith (1776), economic growth focuses on the importance of the division of labor, specialization and trade as fundamental drivers of economic growth. He also argues that the division of labor allows workers to specialize in specific tasks, which leads to greater efficiency and productivity in the production of goods and provision of services; this increase drives economic growth in total production and income (Schumacher, 2012). In endogenous growth theory, Romer (1986) emphasizes innovation as a driver of growth, while Lucas (1988) highlights the role of human capital. Aghion and Howitt (1992) extended this theory as their model of creative destruction where investment in R&D drives technological progress, which in turn increases economic growth (Maris & Holmes, 2023).

Exports constitute a fundamental source of growth for developing economies; however, these economies may be adversely affected by declines in international trade activity (Alvarado Mora et al., 2020). Nations with greater integration into international trade are generally expected to experience more favorable economic outcomes, particularly developing countries that benefit from commercial relations with more advanced economies (Angulo Bustinza & Zeballos Ponce, 2023).

This implies several risks and challenges, such as dependence on external markets, price volatility, competitiveness, and sustainability. For a long time, Latin America has played a fundamental role in the global market as a supplier of primary resources, which has led to a strong dependence on the extraction and export of natural resources. In addition, the region has relied on the import of capital goods as part of its economic strategy (Uribe-Sierra et al., 2023).

Several prior studies have addressed these variables. For instance, Usman (2023) confirms the relevance of exports to China's economic growth and highlights the influence of money on production. In addition, it is found that domestic credit from the banking industry drives world trade, but changes in imports can lead to currency fluctuations. These findings may be useful for policy makers in identifying growth trends in the Chinese economy. They also performed the Granger causality test, CUSUM and CUSUM squared, indicating stability in their models.

Madaleno et al. (2023) in their research focused on South Asian countries, show a beneficial connection between import diversification, natural resources and sustainable economic growth. Advanced estimators were employed and the long-run association between various economic variables was confirmed. Import diversification is found to be vital for productivity and economic growth, while effective control of corruption and transparent government administration are crucial for strengthening economic growth. Governments are encouraged to diversify imports to promote economic growth and industrialization.

Barbhuiya (2023) finds that outbound trade positively influences economic expansion in India. Using an econometric model and the Augmented Dickey–Fuller test, the author confirms the stationarity of the differenced variables and analyzes the relationship through regression analysis, resulting in the original series being non-stationary, but by taking the

first difference they become stationary and without the risk of having spurious results and performing their relationship with a regression analysis.

Bazán Navarro and Álvarez-Quiroz (2022) in their Granger causality analysis, which is used to see how endogenous and exogenous variables are related, revealed that foreign investments boosted growth in Peru during the period 1970–2020. Furthermore, exports exhibit a feedback relationship with GDP, which in the long run results in a positive impact—higher exports are associated with increased GDP, although the short-run effect is not statistically significant. In their study, Huacani-Sucasaca and Mamani Morales (2023) examine the dependence between traditional and non-traditional exports and Peru's trade balance, using a linear regression model and the CUSUM test. They concluded that both exports have a positive effect on the trade balance, and it is necessary to encourage both traditional and non-traditional exports to contribute to the country's economic growth.

Wu et al. (2021) used the instrumental variables method and showed that the increase in the proportion of older adults in developing economies has a significant and negative impact on the improvement of their exports. This adverse effect is mainly due to the decrease in innovation and human capital. However, this negative impact is not observed in developed countries and is decreasing in developing countries in recent years, possibly due to less developed institutions and slower adoption of automation. In addition, it was found that aging countries tend to export less, but higher quality products.

Hatab et al. (2019), based on a survey and the application of ordered probit statistical models, examined how small- and medium-sized agri-food firms in Egypt adapt to European Union (EU) food quality and safety standards to export. They concluded that certification is essential for accessing these markets, and that previous export experience reduces the likelihood of facing rejection. In addition, companies tend to seek fewer demanding markets as standards increase in their usual markets. However, the impact of skilled personnel on export performance could not be clearly determined.

Kalaitzi and Cleeve (2018) focused on the relationship between primary exports, manufacturing exports and economic growth in the United Arab Emirates (UAE). The analysis conducted, which includes unit root tests, Johansen cointegration, Granger causality and modified Wald test, determined that a 1% increase in primary exports drags to a 0.319% growth in real GDP, revealed that manufacturing has a more significant contribution to long-run economic growth than primary exports. In addition, they found evidence of a bidirectional relationship between manufacturing exports and short-term economic growth.

Bahar et al. (2018) found that export expansion is related to competitiveness in similar sectors, as measured by patents and customer relationships. Countries that excel in certain sectors tend to increase their exports in related areas, underscoring the importance of adopting technology. Inter-sector linkages facilitate knowledge transfer, being more influential in developing countries for customer linkages and in developed countries for supplier linkages. These findings inform development policy, showing that, in developing countries, new export sectors tend to emerge upstream of existing industries and highlight the importance of addressing market failures.

Similarly, Toledo (2017) analyzed the hypothesis that foreign sales impulse economic expansion in 17 countries, using the Granger test (causality), estimating a PVAR, OLS model. With an econometric publication finds a feedback dependence between real GDP, also finds a fragile uni-directional relationship of high-tech exports to real GDP and suggests that this type of exports can have a positive effect on economic increase.

Ramanayake and Lee (2015) examined the determinants of economic growth in developing nations, focusing on international integration variables. They find that export growth and export specialization are the most robust factors, while international exchange liberalization and foreign capital inflows are not as robust. He warns that simply opening

up the economy does not guarantee economic growth, stressing the importance of integration leading to increased exports, which requires local capabilities and innovative efforts. This finding is in line with experiences of economic success in Asia, such as Korea, Taiwan, and China.

Diaz Tay and Torres Saavedra (2016) examined the influence of conventional products sold abroad on the expansion of the Peruvian economy during the period 1990–2015 through an econometric model with the exogenous and endogenous variables using statistical methods demonstrated the presence of both an immediate and long-lasting operational link and that the elasticity is 0.07% where that the variation of 1% in conventional products the GDP varies 0.07%.

Caglayan and Demir (2019) analyzed the impact of the real exchange rate (RER) on exports, considering the sophistication and direction of trade in a North–South framework, in their study of 172 countries over the period 1962–2012, they found that both the composition and direction of trade influence the response of exports to changes in the RER. Specifically, the effects of the PER are significant for total exports and for three types of manufactures, those of low and medium skill, as well as resource intensive.

Cacciuttolo and Atencio (2022) examined the evolution of the governance of copper mining sites in Chile between 1905 and 2022, highlighting how the resilience of the mining sector has been strengthened in the face of socio-environmental and seismic challenges. They identify advances in technologies such as thickened tailings and circular economy, which have reduced risks of failures and environmental impacts, ensuring the stability of the sector in the face of external pressures. These strategies reflect the importance of sustainable adaptations to maintain the viability of mining.

Sarin et al. (2020) reviewed 88 studies on the relationship between export diversification and economic growth, finding solid evidence of its positive impact, while export instability showed mixed effects. The authors identify a lack of studies on this topic in emerging economies, especially those identified by UNCTAD and the IMF, and suggest future research to address these gaps.

Based on the above, this research posed the following general problem: What is the effect of traditional exports on Peru's economic growth during the period 2012–2023? Accordingly, the general objective is to analyze the impact of traditional exports on Peru's economic growth during the period 2012–2023 by applying an econometric approach. The specific objectives are as follows: (i) to evaluate the elasticity of traditional exports with respect to Peru's GDP, and (ii) to determine whether there is a cointegration relationship between these variables during the 2012–2023 period 2012–2023. The general hypothesis proposes that traditional exports exert a positive and statistically significant effect on Peru's economic growth during the 2012–2023 period. Likewise, the specific hypotheses are stated as follows: the elasticity of traditional exports with respect to Peru's GDP is positive and statistically significant during 2012–2023 and external factors such as the Terms of Trade (ToT), China's GDP, and the exchange rate have a significant impact on traditional exports, influencing their relationship with economic growth during the period 2012–2023.

This study provides a quantitative assessment of the influence of traditional exports on Peru's economic development, using statistical data analysis and econometric modeling to estimate elasticity and cointegration relationships between key variables during the study period. Likewise, it allows contributing to academic knowledge and informed decision making for future research on the influence of exports on the economy, in addition to favoring public policies and the design of strategies aimed at promoting economic growth and economic openness.

2. Methodology

This study adopts a quantitative approach based on the analysis of numerical data. It follows a non-experimental design, as the variables are examined in their natural context without manipulation. A longitudinal perspective is used, analyzing quarterly reports from the period 2012 to 2023. Likewise, the study adopts a descriptive-correlational scope, analyzing the relationship and specification between the variables under investigation (Hernández Sampieri et al., 2018).

The study population comprises available time series information on GDP (in millions of constant 2007 soles), traditional exports (FOB values in millions of USD), copper prices and the multilateral real exchange rate (MIRR) provided by the Central Reserve Bank of Peru (BCRP) on its web page, an institution that has the legal mandate to report periodically on the national economy and finances. On the other hand, China's GDP information was obtained from the National Bureau of Statistics of China (NBS, 2024), China being Peru's main trading partner. The sample is made up of quarterly periods from 2012 to 2023, obtaining a total of 48 data for the econometric analysis. This period was selected as it encompasses key economic events that influenced traditional exports and economic growth in Peru.

Documentary analysis was used to collect and process the data. The information was organized in a time series and structured in tables using Microsoft Excel to facilitate interpretation. Subsequently, the econometric analysis was conducted using EViews 10 software, and the Augmented Dickey–Fuller (ADF) unit root test was applied to evaluate the stationarity of the variables, confirming that Peru's GDP is stationary in levels ($I(0)$), while traditional exports, the Terms of Trade (ToT), China's GDP and the multilateral real exchange rate have a unit root ($I(1)$), so they were transformed to first differences. Next, an Ordinary Least Squares (OLS) regression was estimated to examine the relationship between GDP and traditional exports, White's test was applied to detect the presence of heteroscedasticity in the model, Model corrected with HAC (Newey–West), and, subsequently, an autoregressive AR(1) model was estimated to correct the positive autocorrelation, evidenced by the low value of the Durbin–Watson (DW) statistic. Next, the Bai–Perron test was applied to identify structural breaks, detecting significant changes in the periods 2016Q4–2017Q4 and 2020Q3, which motivated the inclusion of a dummy variable (DUMMY_COVID) defined for the second quarter of 2020 (2020Q2) to capture the initial impact of the pandemic.

To correct for endogeneity problems, the Two-Stage Least Squares (MC2E) method was used, complemented with the CUSUM test to evaluate the stability of the model. In the first stage, traditional exports were modeled as a function of the Terms of Trade (ToT), China's GDP, the Multilateral Real Exchange Rate (TCR_MULT) and the DUMMY_COVID. In the second stage, the impact of adjusted traditional exports and (DUMMY_COVID) on Peru's GDP was evaluated. This approach allowed a robust estimation of the elasticity of traditional exports on economic growth, as well as a comprehensive analysis of the influence of external factors and structural shocks on the Peruvian economy.

3. Results

The effect of Traditional Exports on Peru's Economic Growth 2012–2023 was analyzed through an econometric approach.

Table 1 shows that during the period 2012 to 2023, total traditional exports reached USD 421,334 million. Of this figure, mining products dominated significantly, representing 81.7%, equivalent to an impressive USD 344,311 million. Petroleum and natural gas products contributed 10.7% of total exports, with a value of USD 44,882 million. On the other hand, fishery products accounted for 5.1% of traditional exports, totaling USD

21,535 million. Agricultural products accounted for only 2.5% of the total, reaching USD 10,606 million. It is worth mentioning that one of the sectors with the highest exports during the periods analyzed was mining, in contrast to agricultural products, which had a more modest participation in the international market.

Table 1. Exports of traditional products 2012–2023 (FOB values in million USD).

Traditional Products	USD	%
Agricultural	10,606	2.5
Fisheries	21,535	5.1
Mining	344,311	81.7
Oil and natural gas	44,882	10.7
Total	421,334	100.0

Note: USD = amount, % = percentage. Source: Data obtained from the BCRP (2023b, 2014). Own Elaboration.

Table 2 shows the real percentage variations in GDP by productive sectors in Peru. A general growth is observed in 2012, led by Construction with 15.8%, but on the other hand, fishing recorded a sharp drop of −32.2% as a result of the decrease in the volume of catches of marine species for direct consumption. In the course of 2020, as a result of the global spread of the virus, all sectors recorded sharp declines such as −12.5% in manufacturing, −13.3% in construction and −16.0% in trade, due to isolation and border closures. However, in 2021 a recovery is already evident, with 34.9% in construction, 18.6% in manufacturing, 17.8% in commerce and mining and hydrocarbons growing by 8.1%. After facing the health crisis in 2020, the Peruvian economy managed to recover, although with some ups and downs in 2023 in key sectors.

Table 2. GDP by productive sectors (real percentage variations).

Years	Agricultural	Fishing	Mining and Hydrocarbons	Manufacturing	Electricity and Water	Construction	Commerce	Other Services
2012	5.9	−32.2	2.8	1.5	5.8	15.8	7.2	7.3
2013	1.60	24.0	4.9	5.0	5.5	8.9	5.9	6.1
2014	1.57	−27.9	−0.9	−3.6	4.9	2.2	4.4	5.9
2015	3.47	15.9	9.5	−1.5	5.9	−5.9	3.9	5.0
2016	2.70	−10.1	16.3	−1.4	7.3	−3.2	1.8	4.2
2017	2.95	4.7	3.4	−0.2	1.1	2.2	1.0	3.3
2018	7.69	47.7	−1.5	5.9	4.4	5.3	2.6	4.5
2019	3.54	−17.2	0.0	−1.7	3.9	1.4	3.0	4.2
2020	1.03	4.2	−13.4	−12.5	−6.1	−13.3	−16.0	−9.6
2021	4.64	9.9	8.1	18.6	8.5	34.9	17.8	10.0
2022	4.53	−11.4	0.5	1.0	3.9	3.1	3.3	3.2
2023	−2.91	−19.7	8.2	−6.8	3.7	−7.9	2.4	0.1

Source: Data obtained from BCRP (2023b, 2014).

Econometric Analysis

The Sequential data compiled by the BCRP was used for the analysis, where GDP (millions of soles constant 2007) and exports of traditional products—FOB values (millions of USD), with quarterly frequency and the observation period from 2012 to 2023.

To carry out the analysis, the two data series have been transformed using natural logarithms, in order to ensure the accuracy of the results, since the quarterly database is in different currencies, which prevents correct measurement. This technique provides several advantages, including the reduction in the volatility inherent in the series, especially those associated with heteroscedasticity, which facilitates a more accurate interpretation of the results.

Figure 1 shows an upward trend in GDP with fluctuations, while traditional exports remain relatively stable, with a non-regular drop during the pandemic (2020), suggesting a temporary impact on both variables. This initial observation prompted a more detailed analysis of the relationships between them.

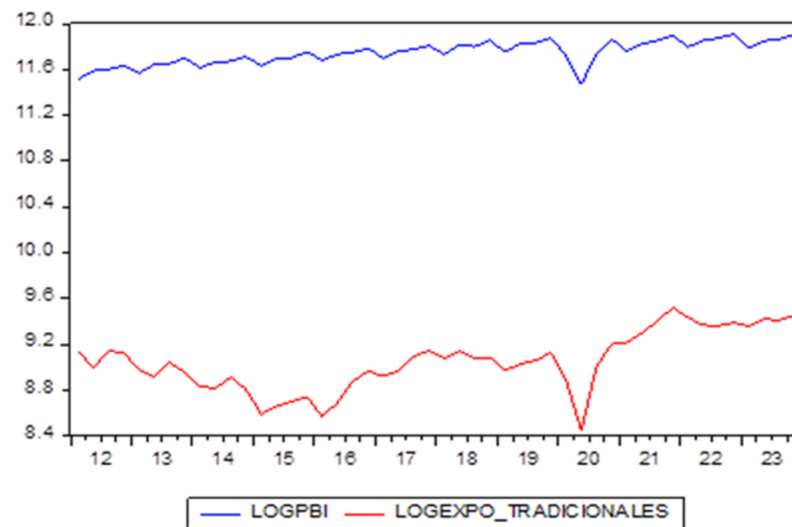


Figure 1. Logarithms of GDP and Traditional exports series. Source: Data obtained from BCRP; Results obtained in Eviews 10 software.

In the initial econometric model, the dependent variable is the logarithm of GDP (logPBI_Peru) and the independent variable is the logarithm of traditional exports (log-expo_Trad), according to equation:

$$\text{LogPBI_Peru}_t = B_0 + B_1 \times \text{Logexpo_Trad}_t + u_t, \quad (1)$$

where B_0 is the intercept, B_1 reflects the elasticity of traditional exports on GDP (a 1% increase in exports impacts a $B_1\%$ change in GDP), and u_t represents the error term that captures factors not explicitly included. Initially, the Ordinary Least Squares (OLS) method was used to explore this relationship. To evaluate the properties of these variables, Augmented Dickey–Fuller (ADF) stationarity tests were performed.

Table 3 shows the Augmented Dickey–Fuller (ADF) unit root test, where it is observed that only Peru’s GDP (logPBI_Peru) is stationary in levels, while traditional exports (log-expo_trad) present a unit root and is non-stationary (I(1)). This indicates that they should be differentiated to avoid spurious regressions and subsequently analyzed in OLS.

Table 3. Dickey–Fuller test for GDP and traditional exports.

Variable	ADF Statistic	5% Critical Value	p-Value	Conclusion
LOGPBI_PERU	−5.582555	−3.508508	0.0002	Stationary (I(0))
LOGEXPO_TRAD	−2.900865	−3.508508	0.1715	Non-stationary (I(1))

Source: Quarterly data obtained from BCRP (2024c, 2024d) and results processed in Eviews 10 soft-ware.

Table 4 presents the relationship between Peru’s GDP and traditional exports based on log-differenced data. It is observed that the constant (C) is 11.75119, while the coefficient of dLogexpo_trad is positive and significant ($p = 0.0027$), suggesting that a growth in traditional exports is associated with an increase in GDP. However, the R-squared value of 0.183 indicates that the model explains only 18.3% of the variability in GDP, and the Durbin–Watson statistic (0.51) suggests the possible presence of autocorrelation in the

residuals, which limits the validity of the results. Next, a White test will be performed to detect heteroscedasticity.

Table 4. OLS regression.

Variable	Coefficient	Standard Error	t Statistic	Probability
C	11.75119	0.013395	877.2810	0.0000
dLogexpo_trad	0.293857	0.092422	3.179500	0.0027

Source: Results processed in Eviews 10 software. Note: R^2 0.183, Durbin–Watson 0.510126.

Table 5 indicates that there is evidence of heteroscedasticity in the model, as the p -values are less than 0.05.

Table 5. White’s test for Heteroskedasticity.

Test	Statistic	p -Value	Conclusion
White F-statistic	5.150	0.010	Heteroscedasticity present ($p < 0.05$)
Obs $\times R^2$	8.915	0.012	Heteroscedasticity present ($p < 0.05$)

Source: Results processed in Eviews 10 software.

Table 6 presents the results of the model corrected by the HAC (Newey–West) estimator, which adjusts the standard errors to correct the heteroscedasticity problem previously detected by the White test. It is observed that the coefficient of traditional exports remains positive and statistically significant, while the standard errors have been adjusted to ensure more robust inferences.

Table 6. Model corrected with HAC (Newey–West).

Variable	Coefficient	Standard Error	t Statistic	Probability
C	11.75119	0.022333	526.1848	0.0000
dLogexpo_trad	0.293857	0.067402	4.359768	0.0001

Source: Results processed in Eviews 10 software. Note: R^2 0.183, Durbin–Watson 0.510126.

Table 7 presents the estimation of the model with autoregressive correction AR(1), carried out with the objective of correcting the positive autocorrelation identified in the residuals of the OLS model presented (Durbin–Watson = 0.51). The AR(1) coefficient was statistically significant, and the new Durbin–Watson statistic (2.18) confirms that the autocorrelation problem was corrected. This improves the statistical validity of the model and the robustness of the inferences. Next, the Bai–Perron test was carried out to identify structural breaks in the traditional export series.

Table 7. Model AR (1) for Autocorrelation Correction.

Variable	Coefficient	Standard Error	t Statistic	Probability
C	11.75283	0.03957	297.0166	0.0000
dLogexpo_trad	0.259036	0.05520	4.6946	0.0000
AR(1)	0.75834	0.11334	6.69074	0.0000

Source: Results processed in Eviews 10 software. Note: R^2 0.6262, Durbin–Watson: 2.181357.

Tables 8 and 9 show the results of the Bai–Perron test, where two significant structural breaks in the relationship between GDP and traditional exports were identified. The first break, occurring between 2016Q4 and 2017Q4, presented an F-statistic of 19.60, exceeding

the critical value of 11.47, which confirmed a structural change in that period. The second break, corresponding to 2020Q3, registered an F-statistic of 17.43, higher than the critical value of 12.95, suggesting that the pandemic significantly altered the relationship between both variables. However, the possible third break was not significant, since the F statistic of 5.30 was lower than the critical value of 14.03. Since the initial OLS model could be affected by endogeneity problems between traditional exports and GDP, we proceeded to estimate a Two-Stage Least Squares Model (MC2E) to correct this limitation. In the first stage, Terms of Trade (ToT), China's GDP and the multilateral real exchange rate were included as control variables, with quarterly frequency in the years studied and transformed to logarithms. To evaluate the properties of these control variables, Augmented Dickey–Fuller (ADF) stationarity tests were performed.

Table 8. Multiple Breakage Tests (traditional exports).

Break Test	F-Statistic	Critical Value	Significant
0 vs. 1	19.60399	11.47	Yes
1 vs. 2	17.43440	12.95	Yes
2 vs. 3	5.300934	14.03	No

Source: Results processed in Eviews 10 software.

Table 9. Significant Breakup Dates.

Breakage Number	Sequential Date	Date of Distribution	Significant
1	2016Q4	2017Q4	Yes
2	2020Q3	2020Q3	Yes

Source: Results processed in Eviews 10 software.

Table 10 shows the Augmented Dickey–Fuller (ADF) unit root test, which shows that the variables have a unit root (I(1)). This suggests they should be different to avoid spurious regression results. In addition, the Bai–Perron test identified a significant structural break in 2020Q3 (detailed in Tables 8 and 9), related to the COVID-19 pandemic, which led to incorporate DUMMY_COVID in the model to capture its effects on the dynamics of traditional exports. The first MC2E equation is specified as:

$$\text{dlogexpo_trad}_t = B_0 + B_1 \times \text{dlog_tot}_t + B_2 \times \text{dlogpbi_china}_t + B_3 \times \text{dlogtcr_mult}_t + B_4 \times \text{dummy_covid}_t + u_t. \quad (2)$$

Table 10. Dickey–Fuller test for control variables.

Variable	ADF Statistic	5% Critical Value	p-Value	Conclusion
LOGTCR_MULT	−2.829463	−3.51074	0.1946	Non-stationary (I(1))
LOGPBI_CHINA	−2.170798	−3.51809	0.4931	Non-stationary (I(1))
LOG_ToT	−2.571404	−3.510740	0.2946	Non-stationary (I(1))

Source: Data obtained from BCRP (2025a, 2025b) and NBS (2024), processed in Eviews 10 software. Own elaboration.

This approach allows us to correct for endogeneity and analyze how fluctuations in the Terms of Trade, China's GDP growth, the multi-lateral real exchange rate and the impact of COVID-19 influenced Peru's traditional exports.

Table 11 shows the results of the first stage MC2E regression indicate that the terms of trade, China's GDP and the multilateral real exchange rate have a positive and statistically significant impact on Peru's traditional exports. In particular, a 1% increase in China's GDP generates a 0.62% increase in traditional exports, while a 1% increase in the terms of trade translates into a 1.72% growth. Likewise, the multi-lateral real exchange rate presents a coefficient of 0.98, suggesting that a depreciation of the sol against the currencies of

trading partners boost export growth. On the other hand, the DUMMY_COVID variable (corresponding to the second quarter of 2020) showed a coefficient of -0.5375 , statistically significant at 1%, indicating a considerable negative effect of the onset of the pan-demic on traditional exports. The model presents a R^2 of 0.653, which implies that it explains approximately 65.3% of the variability of traditional exports, and a Durbin–Watson statistic of 1.97, suggesting that there are no serious autocorrelation problems in the residuals.

Table 11. Results of the first Stage MC2E (Traditional Exports).

	Coefficient	Std. Error	t-Statistic	Prob.
DLOG_TOT	1.721067	0.426916	4.031392	0.0002
DLOGPBI_CHINA	0.622390	0.115738	5.377590	0.0000
DLOGTCR_MULT	0.985068	0.581532	1.693919	0.0977
DUMMY_COVID	-0.537542	0.095398	-5.634734	0.0000

Source: Results processed in Eviews 10 software. Note: $R^2 = 0.653412$; DW = 1.976390.

Figure 2 shows the CUSUM test applied to the model where the cumulative sum of recursive residuals (solid blue line) is compared with 95% critical bands (dashed red lines). The stability of the parameters is confirmed when the CUSUM sequence remains within the bounded corridor. In our case, this result validates the absence of significant structural breaks during the study period, reinforcing the reliability of the instrumental estimates.

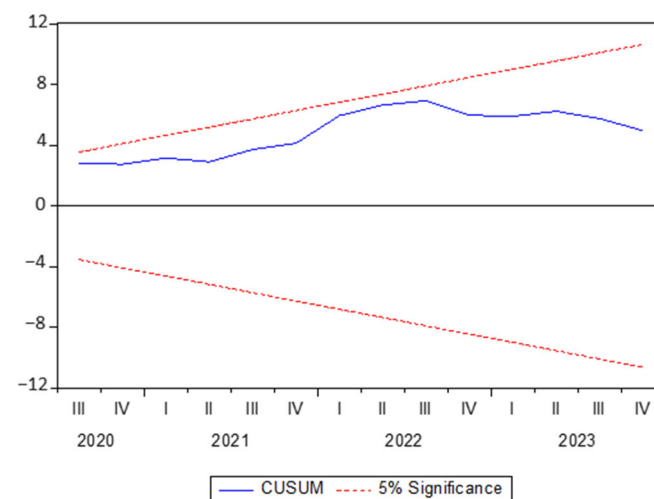


Figure 2. CUSUM stability test applied to the MC2E model (first stage). Results obtained in Eviews 10 software.

The results in Table 10 allowed us to generate the adjusted traditional exports, which were used in the second stage of the Two-Stage Least Squares (LS2E) model to analyze their impact on Peru's GDP using the following equation:

$$\log pbi_Peru_t = B_0 + B_1 \times dlogexpo_trad_ajustado_t + B_3 \times dummy_covid_t + u_t. \quad (3)$$

This equation allowed for an analysis of whether the growth in traditional exports—adjusted for potential endogeneity—had a significant impact on the country's economic activity, also considering the possible disruptive effect of the pandemic.

Table 12 shows that adjusted traditional exports have a positive and statistically significant impact on Peru's GDP. Specifically, a 1% increase in traditional exports, corrected for potential endogeneity, generates a 0.29% increase in GDP ($p < 0.05$). On the other hand, the effect of the pandemic, captured by the DUMMY_COVID variable corresponding to the

second quarter of 2020, presents a negative coefficient (-0.1546), but it is not statistically significant at conventional levels. This suggests that the impact of the pandemic was more evident in the external sector than in the aggregate output of the economy.

Table 12. Results of the second Stage MC2E (Peru's GDP).

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOGEXPO_TRAD_ADJUSTED	0.290047	0.133647	2.170244	0.0354
DUMMY_COVID	-0.154640	0.108387	-1.426733	0.1607

Source: Results processed in Eviews 10 software.

Figure 3, CUSUM test applied to the model, shows that the blue line exceeds the critical limits at 5%, suggesting instability in the coefficients as of 2021. This behavior could reflect structural changes derived from the post-COVID economic recovery. It is suggested as a future line of research to run additional models that include more controls or lags.

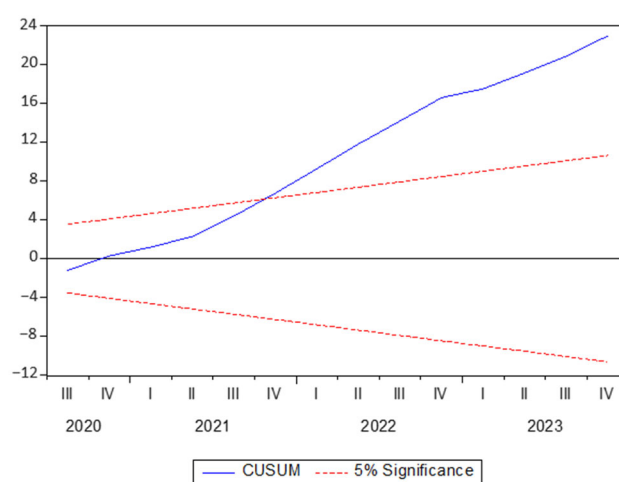


Figure 3. CUSUM stability test applied to the MC2E model (second stage). Results obtained with Eviews 10 software.

Table 13 presents the Hansen overidentification test to validate the exogeneity of the instruments used in the estimation. The value of $J = 2.326$ with a p -value of 0.313 indicates that the null hypothesis of instrument validity is not rejected, confirming that the instruments are not correlated with the error term. Therefore, it is considered that the instruments used in the MC2E model are valid.

Table 13. Validation of Instruments (Hansen's Test).

Test	Statistic (J)	p -Value	Conclusion
Hansen J-test (Overidentification)	2.326	0.313	Valid instruments

Source: Results processed in Eviews 10 software.

4. Discussion

The general objective of this research was to analyze the impact of traditional exports on Peru's economic growth over the 2012–2023 period, using an econometric model. The econometric results confirm that traditional exports have a significant influence on GDP, with an estimated elasticity of 0.29%, indicating that a 1% increase in traditional exports leads to an approximate 0.29% increase in GDP. This finding is consistent with [Diaz Tay and Torres Saavedra \(2016\)](#), who found that GDP variation in Peru responds positively

to changes in traditional exports, albeit with a lower elasticity (0.07%). Likewise, [Bazán Navarro and Álvarez-Quiroz \(2022\)](#) showed that Peruvian exports have a feedback relationship with GDP in the long run, reinforcing the idea that foreign trade is a key factor in the country's economic growth.

The results of the Bai–Perron test identified two significant structural breaks in the relationship between GDP and traditional exports: 2016Q4–2017Q4 ($F = 19.60$) and 2020Q3 ($F = 17.43$), associated with the El Niño Costero phenomenon and the COVID-19 pandemic, respectively, which evidences the sensitivity of traditional exports to internal and external shocks. In the first stage of the MC2E model, the results show that the Terms of Trade (1.72%, $p = 0.0002$), China's GDP (0.62%, $p = 0.0000$), and the multilateral real exchange rate (0.98%, $p = 0.0977$) have a positive impact on Peru's traditional exports. Likewise, the variable DUMMY_COVID (2020Q2) presented a negative and statistically significant coefficient (-0.5375 ; $p < 0.01$), indicating that the pandemic had a considerable and negative effect on traditional exports, particularly during its onset.

However, in the second stage of the MC2E model, where the impact of adjusted traditional exports on GDP is assessed, the variable DUMMY_COVID was not significant ($p = 0.1607$). This suggests that, within the framework of the estimated model, the direct effect of the pandemic on GDP was not statistically proven, although its impact was relevant to explain the contraction of traditional exports, which confirms the exposure to international volatility. These findings are consistent with [Caglayan and Demir \(2019\)](#), who emphasize that the responsiveness of exports to real exchange rate fluctuations depends on both trade composition and direction. In addition, [Usman \(2023\)](#) found that, in China, domestic credit and monetary stability influence production and international trade.

Regarding the Peruvian economy's dependence on the mining sector, the results show that 81.7% of traditional exports come from this sector, underscoring the country's vulnerability to external shocks such as variations in the terms of trade or Chinese demand. In fact, the results of the first stage of MC2E indicate that China's terms of trade and GDP have a positive and significant impact on Peru's traditional exports, highlighting the country's dependence on these external factors. These findings are consistent with previous studies such as those of [Cacciuttolo and Atencio \(2022\)](#), who highlight the importance of strengthening mining governance through sustainability strategies, such as the circular economy and thickened tailings, to ensure the stability of the sector in the face of socio-environmental and economic challenges.

The results show that, although traditional exports have been an engine of economic growth in Peru, their high concentration in the mining sector makes them vulnerable to changes in global demand and external shocks. As suggested by other studies such as those of [Sarin et al. \(2020\)](#) and [Madaleno et al. \(2023\)](#), a productive diversification strategy, combined with sustainable approaches in the mining sector, is advisable to strengthen economic stability in the long term. Also relevant in this regard are the findings of [Wu et al. \(2021\)](#), who showed that demographic factors, such as population aging, can affect the export capacity of developing countries, which reinforces the need for policies that promote innovation and productive diversification. [Kalaitzi and Cleeve \(2018\)](#) demonstrated the importance of manufacturing exports for long-term sustained economic growth.

5. Conclusions

This study concludes that traditional exports had a positive and statistically significant impact on Peru's economic growth during the 2012–2023 period. The results indicate that a 1% increase in traditional exports translates into a 0.36% increase in GDP.

Mining has been the primary driver of Peruvian foreign trade, accounting for 81.7% of traditional exports. Nevertheless, this high concentration increases the economy's

vulnerability to external shocks, including volatility in commodity prices and shifts in international demand. The Bai–Perron test identified two critical moments in the relationship between exports and economic growth: 2016Q4–2017Q4, possibly linked to climatic events and changes in global demand, and 2020Q3, associated with the COVID-19 pandemic. These findings suggest that while mining has supported growth, excessive dependence on this sector poses a macroeconomic risk. Although this study focused exclusively on traditional exports, previous research has shown that export diversification, particularly in agricultural and industrial products can significantly contribute to sustainable economic growth. Several studies support this view (Alshomaly & Shawaqfeh, 2020; Matezo et al., 2021; Zarach & Parteka, 2023). Furthermore, a comparative analysis between developed and developing countries reveals that, while in some emerging economies the concentration of primary exports can boost short-term growth, export diversification maintains a more stable and positive association with sustainable economic development in the long run (Dergachova et al., 2021).

Therefore, enhancing the country’s economic resilience requires implementing a productive diversification strategy. The expansion of sectors such as agro-industry and manufacturing would reduce Peru’s exposure to the volatility of international markets.

In summary, traditional exports remain a key pillar of Peru’s economic growth. However, a strategy that combines the modernization of the mining sector with export diversification would strengthen the country’s economic resilience in the face of global crises and external fluctuations.

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