The Role of Trade Flows in Shaping Macroeconomic Indicators: A Big Data Approach for Albania

Jora BANDA[1]

Iges BANDA[2]

Abstract

Purpose: *This study aims to examine whether trade openness has a measurable influence on economic performance within the context of an emerging economy. Utilizing a Big Data approach, the research highlights the potential of programmatically accessing global datasets for comprehensive country-specific analyses to better understand the complex dynamics between trade and macroeconomic variables.*

Design/methodology/approach: *By employing a quantitative research design, the study investigates the influence of trade flows on key macroeconomic variables such as GDP growth, unemployment, and inflation in Albania from 2000 to 2023. Data retrieved from the World Bank is programmatically arranged, cleaned, and consolidated into a comprehensive dataset by using correlation matrices, scatter plot charts, and OLS regression to ascertain the impact of trade flows on GDP growth.*

Findings: *The findings suggest that during the selected period, trade flows had minimal statistically significant effects on GDP growth, whereas the correlation with*

[1] Department of Informatics and Technology, Faculty of Engineering, Informatics and Architecture, European University of Tirana, Tiranë, Albania, jora.banda@uet.edu.al.
https://orcid.org/0009-0004-8497-2903

[2] Department of Economics and Finance, Faculty of Economics, Technology and Innovation, Western Balkans University, Tiranë, Albania
https://orcid.org/0000-0001-6789-0771

unemployment and inflation was also weak. Time series charts demonstrate certain fluctuations in trade and economic indicators, pointing to the complicated nature of macroeconomic dynamics.

Research limitations/implications: *The study focuses only on Albania; hence, future studies can investigate more countries, or alternative methods could be applied for a deeper understanding.*

Originality/value: *By implementing a Big Data approach to investigate trade-macroeconomic interactions in Albania, this study contributes to the literature, thus providing new insights into emerging economies through the programmatic collection, cleaning, and integration of global datasets for rigorous analysis.*

Keywords: *Trade Flow, Macroeconomic Indicators, Big Data, Emerging Economy, Datasets*

Introduction

Trade flows are widely acknowledged as a main factor affecting economic growth and stability and, as a result, influencing macroeconomic variables such as GDP growth, levels of unemployment, and inflation (Hobbs et al., 2021). These trends can change significantly across different countries, but they are especially critical in small and emerging economies. Hence, the importance of understanding the particularities of the relationship between trade openness and economic performance for the design of economic policy and strategic planning cannot be overemphasized.

For instance, trade openness - defined as the extent to which a country permits free trade without imposing tariffs or quotas - can bring higher competition, global market entry, and the inflow of foreign investments (Nam and Ryu, 2024). These factors can contribute to the development process of the economy. Yet, the results retrieved from trade openness might change based on various elements such as the institutional structure, current economic situations, and the sector focus (Abdi et al., 2024).

Albania has undergone a deep process of integration into the world economy through international trade, a fundamental factor for its economic development after the conversion from a closed economy to a market economy in the 1990s. This transition has turned its economy from an autocrat to a system of openness towards foreign trade and liberalization. Nevertheless, during this process, Albania has faced difficulties such as a chronic trade deficit and the low level of its diversified export base (Cohen, 2016).

The era of Big Data, known for its extensive large-scale data, offers new opportunities for uncovering empirical patterns, causal factors, and important

insights that the traditional econometric techniques might easily overlook (Giannone et al., 2021). According to Wang (2024), the use of very high-dimensional, high-frequency datasets makes it possible to conduct a better in-sample and out-of-sample analysis of complex trade flow and macroeconomic variables' interdependencies in real time, something not feasible with standard econometric techniques (Wang, 2024). In the case of Albania, where data limitations have historically complicated the empirical studies, big data techniques offer a positive path to overcome traditional limitations and produce more robust and relevant findings. This study, to the best of our knowledge, is positioned as a novel contribution to the literature, based on its Big Data approach to examine the connection between trade flows and macroeconomic factors in a developing country, such as Albania.

The remaining parts of this paper are structured as follows: Section 2 includes the literature review; Section 3 provides the methodology, including the detailed analytical framework; Section 4 provides the findings, and Section 5 concludes with a discussion of policy implications and future study directions.

Literature Review

Economic growth is one of the main goals of each country's economy. The term trade flows is defined as the movement of different goods and services among countries, impacting various economic indicators and systems that shape a state's trade dynamics (Ohakwe and Wu, 2025). They give an insight into how countries exchange products and services in markets, both domestically and internationally. Another important measure of the economy is the macroeconomic indicators, such as Gross Domestic Product (GDP), inflation, interest rates, unemployment, and others. Understanding the relationship between trade flows and macroeconomic indicators is key to measuring the performance of the economy and suggesting policies and future directions, if applicable (Olokoyo et al., 2020). This measurement includes the GDP and foreign trade activities, shown through trade flows (including exports and imports). While net exports are included in accounting for GDP, on the other hand, trade flows show the direction and intensity of the integration of a certain state in the global market. Both may have a positive or negative effect on the economic performance of a country (Chiranjivi and Sensarma, 2025).

By specializing in the products that each country has a comparative advantage in, and by reallocating the resources among the various states, foreign trade plays a vital role in promoting economic development (Belloumi and Alshehry 2020). These kinds of trade flows, driven by comparative advantage, directly impact macroeconomic indicators such as GDP growth, inflation, unemployment, and

trade balances. Nowadays, each country is concentrating on producing only products with the maximum comparative advantage and the least comparative costs (Owolabi, 2011; Sarbapriya, 2011). Based on Ricardo's theory of comparative advantage, a state should invest in producing and exporting only the products that it can offer more efficiently, hence, at a lower opportunity cost than the imported goods and services (Enu and Hagan, 2013). To better comprehend the trade flows among countries based on their factor endowments, the Heckscher- Ohlin trade theory is explained. If a country is rich in skilled labor and capital, it tends to export high-tech products, e.g., electronics or machinery, that require high usage of these factors (Guo, 2025). But if a country is rich in natural resources, it tends to export raw materials such as oil or minerals, which leverage its enhanced natural resources (Guo, 2025). Therefore, trade flows reflect these patterns, so a country rich in skilled labor imports goods that require lower skill levels (e.g., textiles or basic agricultural products) and demand higher labor input. This ensures easier access to a diverse range of goods for clients, leading to a more efficient allocation of global resources.

Trade flows can change and shape different macroeconomic indicators. The direction and impact of international trade determine capital flows to and from nations. Trade surplus often results from countries exporting capital-intensive and skilled labor-intensive goods, causing significant capital accumulation in those countries (Ojo and Adelakun, 2025). Countries running trade deficits often import labor-intensive and less-skilled goods that exert negative effects on capital growth, as well as employment absorption capacity (Ojo and Adelakun, 2025). The relationship of trade flows and factor endowments indicates the extent of capital endowment optimization that countries leverage in international trade. The Heckscher–Ohlin theory states that countries will have a comparative advantage in the production of goods that require factors of production intensively which the country owns in great relative abundance; in that case, the countries would export the goods requiring intensive use of the abundant factor in production and would import the goods requiring intensive use of the other factor (Kunroo, M. H., & Ahmad, I., 2023). Based on this rationale, two-way trade flows could be expected between countries that possess different comparative advantages based on national factor endowments, as well as the macroeconomic variables characteristics accompanying these trade flows, such as national income, employment absorption capacity, and trade balance (Enu and Hagan, 2013).

Several studies analyze the connection between trade flows and macroeconomic indicators by using different methodologies, focusing on various regions and periods of time. Were (2015), by using standard growth regression, contributed to the existing literature with a comparative analysis among African countries. Winters and Masters (2013) provided a compact review of different empirical works on trade flow and economic growth. Besides exports, imports positively

affect the economic growth. Several studies (Kong et al. 2021; Sun and Heshmati 2010) used econometric and non-parametric approaches; the ARDL model for the case of China and found that the growth rate of the volume of trade is positively related to per capita GDP. Also, the international trade volume and structure of high-tech exports positively affect the region's productivity. On the other hand, Blavasciunaite et al. (2020) studied the trade balance effect and trade flows on the economic growth in EU countries using the OLS method of multivariate regression analysis yet received a negative impact among the variables. Same with Belloumi and Alshehry (2020), who studied this relationship for the case of Saudi Arabia from 1971 to 2016, using the autoregressive distributed lag cointegration framework for annual data, resulting in negative effects not only in the economic growth but also in the environmental quality. Differently, Hobbs et al. (2021) analyzed the same relationship for the case of Albania by using different econometric tests, such as the unit root test, the unit root test with a structural break, the Johansen cointegration analysis, the error correction model, and the Granger causality test, resulting in a positive effect only in the short term.

Methodology

The study examines the connection between trade flows and macroeconomic factors for the period from 2000 to 2023 in Albania, by leveraging Big Data from large global databases. By focusing on the trade as a percentage of GDP as the primary trade factor, and GDP growth, inflation, and unemployment as key macroeconomic indicators, all the analyses are conducted.

Data Collection

All the data is retrieved from the World Bank using the Python library *wbgapi*, since it offers programmatic access to official large-scale statistics and permits better analysis of historical trends and relationships. The collection of the data is conducted in a structured and automated way. By using a Python function that ensures robustness by handling missing values and possible errors in API retrieval, all macroeconomic factors and trade are fetched individually. The variables used are trade (% of GDP), which serves as the primary indicator of trade openness; unemployment level (total % of labor force), reflecting labor market conditions; inflation (consumer prices, annual %), measuring price stability; and GDP growth (annual %), capturing economic growth.

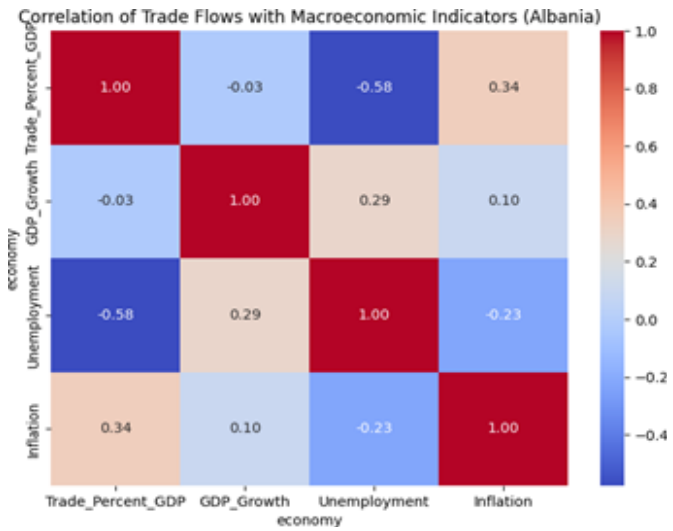
Data Cleaning and Preparation

Once collected, datasets underwent several modifications to ensure accuracy and consistency. Missing values or API retrieval errors were imperfectly handled using a specific Python function providing robustness to the collection process. Return data were then transposed and filtered by years of interest, while all variables were converted into numeric forms. Trade, GDP growth, unemployment, and inflation datasets were later merged after standardizing the format of the year. Rows with missing data were discarded to safeguard the integrity of the analysis.

Exploratory Data Analysis

The first step in this analysis is to assess the relationships present between the various variables in the dataset. To this end, a correlation matrix is conduct and visualize the results using a heatmap created in both Seaborn and Plotly to allow for better observation of the strength and direction of linear associations.

FIGURE 1. Correlation of Trade Flows with Macroeconomic Indicators

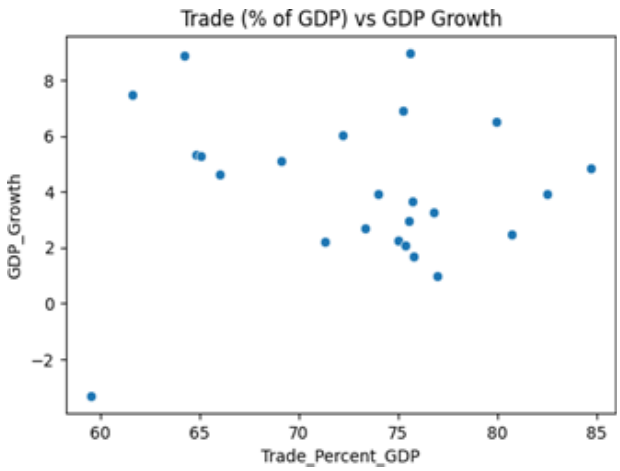


Source: Author's own work.

The correlation heatmap presents the first overview for exploration of relationships among Albania's trade flows and macroeconomic indicators from 2000 to 2023. The most striking feature is the strong negative relationship between trade as a percentage of GDP and unemployment, −0.58, roughly, which implies that higher trade openness has led to lower unemployment in Albania or has

created a situation where international trade has led to greater absorption of labor or reduced labor market slack. Meanwhile, the correlation between trade openness and GDP growth remains almost null at −0.03, thus highlighting that trade has not directly or consistently influenced annual economic growth. The correlation with inflation, a moderately high positive at 0.34, seems to indicate that greater openness has been associated with slight price pressures, which could be logical, given Albania's demand for imports and consequent exposure to international price fluctuations. The other macroeconomic correlations are less strong, and some are almost unexpected. For example, the positive correlation (0.29) of GDP growth and unemployment contradicts Okun's law (which observes the inverse relationship of unemployment and GDP) (Prachowny, 1993) and might lead to structural economic problems in Albania, like a mismatch between growing sectors and the labor market demands. On the other hand, the weak negative relationship between inflation and unemployment (-0.23) somewhat aligns with the Phillips Curve (which shows the inverse relationship between unemployment and inflation) (Wulwick, 1987). So, overall, the heatmap shows that trade flows significantly impact employment and, to a certain point, inflation, yet their connection to GDP growth is weak. To delve deeper into the interplay between these dynamics, a series of scatter plots were drawn, each pairing trade openness with a macroeconomic indicator. Scatter plots are useful because they allow one to discern non-linearities, clusters, or outliers that mere correlations would consider. Unlike correlation coefficients, which only measure the strength and direction of linear relationships, scatter plots have only the primary function of representing raw data to see whether a consistent pattern exists across the entire period for which data is available (Friendly and Denis, 2005).

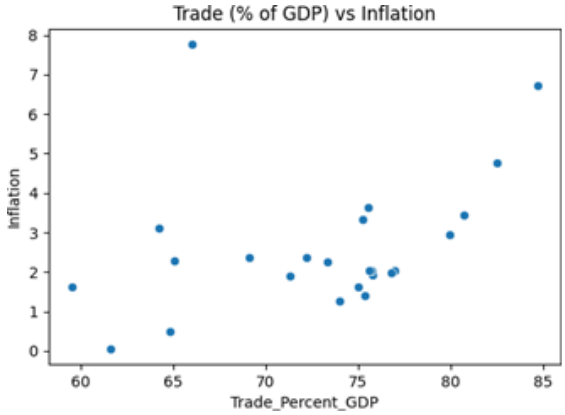
FIGURE 2. Scatter plot: Trade vs GDP Growth



Source: Author's own work.

Figure 2 illustrates the scatter of the trade on the x-axis (as a percentage of GDP) and GDP growth on the y-axis. The distribution of points is quite dispersed, leaving neither a positive nor a negative trend to be identified. This visual confirmation supports the interpretation that, to date, trade openness has remained inconsistent in affecting Albania's annual economic growth.

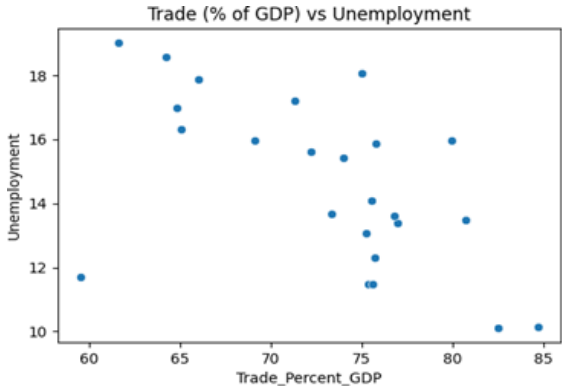
FIGURE 3. Scatter plot: Trade vs Inflation



Source: Author's own work.

The relationship between trade and inflation is portrayed in Figure 3. Despite some dispersion, a slight upward pattern can be detected, suggesting that inflation tends to increase slightly at higher levels of trade openness. This is consistent with the moderate positive correlation (0.34) and may indicate Albania's exposure to imported inflation or international price shocks as the economy became more integrated with global markets.

FIGURE 4. Scatter plot: Trade vs Unemployment



Source: Author's own work.

In Figure 4, the trade-unemployment relationship tends to offer a greater degree of downward sloping nature: as trade openness improves, trade integration under consideration increases the capacity to create jobs at higher unemployment levels. The visual alignment of the data points endorses the negative correlation coefficient (-0.58) and indicates that the integration of trade may have assisted employment creation or absorption at the labor markets during the studied period.

TABLE 1. Model Summary

Model Summary	Value
R-squared	0.001
Adj. R-squared	-0.045
F-statistic	0.01656
Prob (F-statistic)	0.902
No. of Observations	24
AIC	118.8
BIC	121.2
Durbin-Watson	1.501
Skew	-0.469
Kurtosis	4.023

Source: Author's own work.

TABLE 2. OLS Regression Results

Variable	Coef.	Std. Err.	t	P>|t|	95% Conf. Interval
const	-4.913	6.42	0.765	0.452	[-8.401, 18.227]
Trade_Percent_GDP	-0.0109	0.088	-0.125	0.902	[-0.193, 0.171]

Source: Author's own work.

Therefore, the regression analysis is an avenue to scrutinize and test statistically the relationship between trade openness (trade being calculated as a percentage of GDP) and GDP growth. The coefficient estimate for trade is −0.0109, implying an almost non-existent and negative effect whose significance cannot be accepted statistically (p-value = 0.902). The confidence intervals for the coefficient are stretching into negative and positive values as well, further corroborating the fact that there is no considerable relationship. The R-squared is extremely low at 0.001, meaning that trade openness explains virtually none of the variation in Albania's GDP growth over the period studied. This means the regression supports what is hinted at in the correlation matrix: that trade flows measured as shares of GDP

do not exert a significant linear influence on the economic growth of Albania. On the other hand, the diagnostic statistics suggest no major problems with autocorrelation (Durbin-Watson test of 1.501) or non-normality of residuals (Jarque-Bera test; p- value = 0.382); hence, the insignificance cannot be blamed on model misspecification but rather on a genuine weak relationship in the data.

There emerges an important distinction when examining the exploratory and regression results. Trade openness indeed seems to have a meaningful association with employment and inflation, but, in its effect on GDP growth, it was found statistically negligible. This proposes that the growth dynamics of Albania are likely driven by other factors, namely domestic investment, remittances, or structural reforms, rather than alone by trade flows. These results thus caution policymakers against the presumption that higher trade integration automatically translates into growth; rather, their effort may need to be focused on the building blocks that foster trade into broader economic development, such as labor market flexibility, innovation capacity, and productive capacity.

Results and Discussion

The study shows noticeable patterns in the interaction between trade flows and Albania's macroeconomic indicators during 2000 and 2023. The correlation matrix (Figure 1) reveals an association between trade as a percentage of GDP and GDP growth in the positive sense, suggesting that openness to international trade tends to be associated with good economic performance. Trade, in turn, exhibits a negative correlation with unemployment and, thereby, seems to be conducive to the creation of jobs. On the other hand, the trade-inflation correlation appears weak and erratic, showing that inflation trends are more likely to be steered by domestic policy and external shocks rather than trade volumes per se.

Additional findings arise from the scatter plots. The trade–GDP growth scatter plot (Figure 2), generally inclined upward, is more evidence of a likely positive relationship between openness and growth. While the data points confirm this linkage, their dispersion indicates that structural and policy factors have also intervened in Albania's growth path. The trade–unemployment scatter plot (Figure 4) slopes downward, reconfirming the belief that greater trade integration yields improvements in labor markets. A few outliers set aside; these periods correspond to global and domestic turbulences when unemployment stayed stuck at high levels despite trade growth. Instances, meanwhile, in the trade–inflation scatter plot (Figure 3), have no definite pattern, confirming that trade is not a primary driver of price stability in the Albanian context.

The OLS regression analysis in Table 1 provides additional evidence. The trade variable (% of GDP) stands out as a statistically significant predictor of GDP

growth, with a positive coefficient. This result therefore confirms the view that greater integration into global markets has led to economic growth in Albania. However, the model itself retains a moderate explanatory power, highlighting the fact that trade is one of several factors and, by itself, cannot explain the growth dynamics. Other macroeconomic variables, institutional reforms, and world conditions thus contribute to the remaining defining factors.

Taken together, the results are in line with the broader literature regarding emerging economies, where trade openness generally fosters growth and reduces unemployment but has a more limited effect directly on inflation. The Albanian case would mirror the opportunities and limitations that trade presents as a tool of development.

Limitations

While limitations exist, these do not diminish the study's strong contributions. For instance, future studies can investigate other macroeconomic indicators besides the ones used in the study. Although they are central variables and have the highest amount of available data, other indicators can be considered. Focusing only on Albania represents a limitation and a contribution at the same time. While its geography might restrict the generalizability of the results, it offers valuable country- level evidence and contributes to the existing literature.

Conclusion

This study aims to reveal the relationship between trade flows and macroeconomic indicators, and the extent to which trade flows contribute to macroeconomic performance in Albania by using Big Data. Moving away from a closed to an open economy, the Albania case study captures a selection of opportunities and obstacles of globalization occurring within the context of a small and developing economy. By collecting and utilizing a large amount of data and resorting to automated retrieval methodology, the empirical analyses shed light on long-range tendencies and evaluate connections often underexploited by classical techniques, delivering novel empirical findings on the matter that deepen the existing policy and intellectual discussions. Empirical findings confirm that trade openness is positively related to GDP growth and negatively related to the unemployment rate, implying that trade is indeed a powerful engine of growth. The second, however, contradicting finding of the study is where trade openness is found to negatively correlate with inflation, implying that trade openness plays a limited role in achieving price stability compared to the power exercised by domestic

macroeconomic policies and external disturbances, highlighting that trade integration offers strong benefits for the economy and labor market, but does not in itself serve as adequate measure to improve macroeconomic stability.

The research makes an important contribution both concerning empirical findings and methodological aspects. Big Data tools accurately and in a timelier manner, and comprehensively, may help create a clearer, more holistic, and accurate portrait, drastically changing the situation where limited data availability was hampering comprehensive understanding. Thus, providing a country-specific analysis for Albania showcases how data availability and characteristics can help steer policymakers towards establishing a strategic framework to accommodate sustainable economic development. Nevertheless, some limitations of the study occur. The determined negative coefficients demonstrate moderate explanatory power and model robustness, alongside the specific country scope limiting exposure to variation in results for the generalization of findings. Limitations highlight the potential for further work introducing newer explanatory variables, emphasizing sector-specific trade, and comparing them.

Trade acts as a sustainable engine of growth and employment creation, as the recent case study of Albania has highlighted, but requires occurring in tandem with comprehensive domestic policy formulation and ongoing policy refinement through institutional development. Utilizing trade flows interrogation through contemporary cognition approaches may well facilitate the journey toward achieving long-term sustainable development goals in a more resilient and secure manner.

References

Abdi, A. H., Zaidi, M. A. S., Halane, D. R., & Warsame, A. A. (2024). *Asymmetric effects of foreign direct investment and trade openness on economic growth in Somalia: Evidence from a non-linear ARDL approach*. Cogent Economics & Finance, 12(1), 2305010. doi:10.1080/23322039.2024.2305010

Belloumi, M., & Alshehry, A. (2020). *The impact of international trade on sustainable development in Saudi Arabia. Sustainability*, 12(13), 5421. doi:10.3390/su12135421

Blavasciunaite, D., Garsviene, L., & Matuzeviciute, K. (2020). *Trade balance effects on economic growth: Evidence from European Union Countries*. Economies, 8(3), 54. doi:10.3390/economies8030054

Chiranjivi, G. V. S., & Sensarma, R. (2025). *The spillover effects of global macroeconomic variables on trade flows: a wavelet-based study for India. Journal of Financial Economic Policy*. doi:10.1108/JFEP-10-2024-0301

Cohen, R. (2016). *Economic Transformation in Albania. In East-Central European Economies in Transition* (pp. 579-598). Routledge. doi:10.4324/9781315481777

Enu, P., & Hagan, E. (2013). *The impact of foreign trade on economic growth in Ghana* (1980-2012). International Journal of Academic Research in Economics and Management Sciences, 2(5). doi:10.6007/IJAREMS/v2-i5/371

Friendly, M., & Denis, D. (2005). *The early origins and development of the scatterplot. Journal of the History of the Behavioral Sciences*, 41(2), 103-130. doi:10.1002/jhbs.20078

Giannone, D., Lenza, M., & Primiceri, G. E. (2021). *Economic predictions with big data: The illusion of sparsity*. Econometrica, 89(5), 2409-2437. doi:10.3982/ECTA17842

Guo, B. (2025). *Exploring the Heckscher-Ohlin Theory Again: World Trade Structure, Factor Demand Law, and General Trade Equilibrium*. Factor Demand Law, and General Trade Equilibrium (August 25, 2025). doi:10.2139/ssrn.5421834

Hobbs, S., Paparas, D., & E. AboElsoud, M. (2021). *Does foreign direct investment and trade promote economic growth?* Evidence from Albania. Economies, 9(1), doi:10.3390/economies9010001

Kong, Q., Peng, D., Ni, Y., Jiang, X., & Wang, Z. (2021). *Trade openness and economic growth quality of China: Empirical analysis using ARDL model*. Finance Research Letters, 38, 101488. doi:10.1016/j.frl.2020.101488

Kunroo, M. H., & Ahmad, I. (2023). *Heckscher-ohlin theory or the modern trade theory: how the overall trade characterizes at the global level?* Journal of Quantitative Economics, 21(1), 151-174. doi:10.1007/s40953-022-00330-x

Nam, H. J., & Ryu, D. (2024). *Does trade openness promote economic growth in developing countries?* Journal of International Financial Markets, Institutions and Money, 93, 101985. doi:10.1016/j.intfin.2024.101985

Ohakwe, C. R., & Wu, J. (2025). *The impact of macroeconomic indicators on logistics performance: A comparative analysis using simulated scenarios*. Sustainable Futures, 9, 100567. doi:10.1016/j.sftr.2025.100567

Ojo, O. O., & Adelakun, O. J. (2025). *Global market opportunities for SMEs: Export/import perception and trade growth in Lesotho*. Southern African Journal of Entrepreneurship and Small Business Management, 17(1), 1-12. doi:10.4102/sajesbm.v17i1.953

Olokoyo, F. O., Ibhagui, O. W., & Babajide, A. (2020). *Macroeconomic indicators and capital market performance: Are the links sustainable?* Cogent Business & Management, 7(1), 1792258. doi:10.1080/23311975.2020.1792258

Owolabi Akeem, U. (2011). *Performance evaluation of foreign trade and economic growth in Nigeria*. Research Journal of Finance and accounting, 2.

Prachowny, M. F. (1993). *Okun's law: theoretical foundations and revised estimates*. The review of Economics and Statistics, 331-336. doi:10.2307/2109440

Sarbapriya, R. (2011). *Explaining Cointegration and Causality between Foreign Trade and Economic Growth: Econometric Evidence from India*. International Journal of Contemporary Business Studies, 2(10), 126-142.

Sun, P., & Heshmati, A. (2010). *International trade and its effects on economic growth in China* (No. 5151). IZA Discussion Papers. doi:10.5281/zenodo.17194

Wang, X. (2024). *Applying big data analytics techniques and meta-analysing the impact of cross-border data flows on international trade competitiveness.* Journal of Combinatorial Mathematics and Combinatorial Computing, 123. doi:10.61091/jcmcc123-30

Were, M. (2015). *Differential effects of trade on economic growth and investment: A cross-country empirical investigation.* Journal of african trade, 2(1), 71-85. doi:10.1016/j.joat.2015.08.002

Winters, L. A., & Masters, A. (2013). *Openness and growth: still an open question?* Journal of International Development, 25(8), 1061-1070. doi:10.1002/jid.2973

Wulwick, N. J. (1987). *The Phillips curve: which? whose? to do what? how?*. Southern Economic Journal, 834-857. doi:10.2307/3207828.