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Causalities Between Exports, Imports, and Total Factor Productivity in Developing Countries: The Case of Türkiye, Brazil, India, and South Africa

Gelişmekte Olan Ülkelerde İhracat, İthalat ve Toplam Faktör Verimliliği Arasındaki Nedensellikler: Türkiye, Brezilya, Hindistan ve Güney Afrika Örneği

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ABSTRACT

Theoretical frameworks and practical research have shown that economic growth and employment in developing countries are influenced by their achievements in foreign trade and productivity. The link between exports and TFP can be analysed through various lenses; including competitiveness, innovation and quality enhancement, the learning-by-doing effect, the adoption of cutting-edge technologies, and market competition. The link between imports and TFP can be interpreted through factors such as the need for capital goods, the tastes and demands of consumers, the transfer of knowledge, and the focus on producing specialised goods. The aim of this study was to examine the causality between exports, imports, and total factor productivity in developing countries. For this purpose, time series analyses are performed using data from the economies of Türkiye, Brazil, India, and South Africa. The hypothesis of this study is that in developing countries, there is bidirectional causality between exports, imports, and total factor productivity, both in the short and long term. The series used in the analysis become stationary when the first differences are taken. According to the Johansen Co-integration Test results, there is no long-term causality between exports, imports, and total factor productivity. According to the results of the Granger Causality Test conducted within the framework of the VAR model; there are bidirectional causalities between exports, imports, and total factor productivity in these four developing countries in the short run.

Keywords: Exports, Imports, Total factor productivity, Developing countries, Time series analyzes

Jel Codes: C32, F10, O47

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ÖZ

Teorik ve uygulamalı araştırmalar, gelişmekte olan ülkelerde ekonomik büyüme ve istihdamın, ilgili ülkelerin dış ticaret ve verimlilik performanslarından etkilendiğini göstermektedir. İhracat ile toplam faktör verimliliği arasındaki ilişki; rekabet gücü, inovasyon, yaparak öğrenme etkisi, son teknolojilerin benimsenmesi ve piyasa rekabeti gibi çeşitli açılardan analiz edilebilir. İthalat ile toplam faktör verimliliği arasındaki ilişki ise; sermaye malları ithalatı, tüketicilerin zevk ve tercihleri, bilgi ve teknoloji transferi ve üretimde uzmanlaşma gibi faktörler üzerinden yorumlanabilir. Bu çalışmanın amacı, gelişmekte olan ülkelerde ihracat, ithalat ve toplam faktör verimliliği arasındaki nedenselliği incelemektir. Bu amaçla Türkiye, Brezilya, Hindistan ve Güney Afrika ekonomilerinden elde edilen veriler kullanılarak Zaman Serisi Analizleri yapılmıştır. Çalışmanın hipotezi; gelişmekte olan ülkelerde hem kısa hem de uzun dönemde ihracat, ithalat ve toplam faktör verimliliği arasında çift yönlü nedensellik bulunduğu yönündedir. Analizde kullanılan seriler ilk farkları alındığında durağan hale gelmektedir. Johansen Eşbütünleşme Testi sonuçlarına göre ihracat, ithalat ve toplam faktör verimliliği arasında uzun dönemli bir nedensellik bulunmamaktadır. VAR modeli çerçevesinde yapılan Granger Nedensellik Testi sonuçlarına göre; bu dört gelişmekte olan ülkede ihracat, ithalat ve toplam faktör verimliliği arasında kısa dönmede çift yönlü nedensellikler bulunmaktadır.

Anahtar Kelimeler: İhracat, İthalat, Toplam faktör verimliliği, Gelişmekte olan ülkeler, Zaman serisi analizi

Jel Sınıflandırması: C32, F10, O47

1. Introduction

The performance of developing countries in foreign trade and productivity, aimed at boosting economic growth and employment, has been demonstrated both theoretically and through applied studies. Foreign trade can support economic growth and employment through access to larger markets, efficiency and specialisation, economies of scale, transfer of technology, innovation, resource allocation and price stabilisation (Afonso, 2001). Foreign trade allows countries to expand their markets beyond their borders, giving businesses the opportunity to increase their sales and profits, which in turn can contribute to national economic growth. Through trade, countries can specialise in producing goods and services for more efficient production and potentially higher levels of output, which is a classic concept from David Ricardo's theory of comparative advantage (Adeleye, Adeteye & Adewuyi, 2015). Trading on an international scale can lead to larger production volumes, which can reduce the average cost of production and enhance competitive positioning in the global market. Trade can facilitate the transfer of technology from more developed to less developed countries, which can improve productivity and growth prospects in the latter (Zahonogo, 2016). Exposure to international markets can increase competition and create incentives for innovation, leading to the development of new products and processes that can boost economic growth. International trade enables a more effective distribution of resources, with countries importing products that demand resources in which they are deficient and exporting those that capitalise on their abundant resources. Trade can help stabilise prices by reducing the volatility of seasonal demand fluctuations and providing a wider variety of goods and services (Caleb, Mazanai & Dhoro, 2014).

Total factor productivity measures the efficiency of using all inputs in a production process. It is often considered a proxy for technological progress or changes in efficiency. Total factor productivity can support economic growth and employment through increased output, enhanced competitiveness, investment attraction, resource allocation, and technological innovation (Felipe, 1999). Higher total factor productivity means that more output can be produced from a given set of inputs. This increase in output is a fundamental driver of economic growth. When total factor productivity rises, firms and economies can produce at lower costs, which can increase competitiveness in international

markets, leading to a higher volume of exports and improvements in the trade balance. Economies with rising total factor productivity tend to attract more investment because they promise higher returns. This can increase capital stock, further boosting the economy's productive capacity (Chen, 1997). Improved total factor productivity can lead to more efficient resource allocation by signalling where investments yield the highest returns, which can encourage the movement of resources to more productive uses. Technological innovation often drives TFP growth. As economies innovate, they can experience growth not only in the industries where the innovations occur but also in other sectors that benefit from technological spillovers (Comin, 2010).

The significance of TFP lies in its ability to offer insights into economic growth beyond what can be explained by the accumulation of capital and labour alone. Economists use TFP analysis to assess the impact of policies, investments in human capital, technological progress, and other factors on economic performance. However, measuring TFP can be challenging due to the difficulty of accurately quantifying inputs like technology and human capital quality, as well as attributing output growth to these factors. Despite these challenges, TFP remains a pivotal concept in economic analysis, highlighting the importance of innovation, efficiency, and technology in driving economic progress. It serves as a reminder that long-term growth depends not only on increasing the quantity of inputs but also on improving their quality and the effectiveness with which they are employed (Nadiri, 1970). Estimating TFP involves addressing methodological challenges such as simultaneity and selection bias. Fixed Effects Estimation controls for unobserved firm-specific effects but struggles with dynamic labour allocation. Instrumental Variables and GMM tackle the endogeneity of inputs using external instruments, requiring strong and valid instruments for consistency. Olley-Pakes Algorithm uses investment decisions as proxies for unobserved productivity, incorporating a selection model for firm exits, but is limited to firms with non-negative investment. Levinsohn-Petrin Algorithm uses intermediate inputs as proxies, overcoming limitations related to investment data. Each method has its advantages and limitations, and the choice depends on data availability and specific research needs (Van Beveren, 2012).

The aim of this study was to examine the causality between exports, imports, and total factor productivity in developing countries. For this purpose, Time Series Analyses are performed using data from the economies of Türkiye, Brazil, India, and South Africa. For the Time Series Analysis, data availability was the determining factor in selecting the developing countries. The hypothesis of the study; in developing countries, there is bidirectional causality between exports, imports, and total factor productivity both in the short and long term. The contribution of this study to the existing literature likely centres on providing a detailed empirical analysis of the causality between exports, imports, and TFP in developing countries. This focus not only adds new insights, given the diverse economic contexts of these countries, but also potentially advances methodological applications within the field. By exploring the hypothesis of bidirectional causality between trade and productivity, this study could offer theoretical advancements and practical policy implications, particularly highlighting how trade can leverage economic growth and productivity improvements in developing economies. The use of data from the World Bank and the Federal Reserve Bank of St. Louis further underpins the study's empirical contributions. This study differentiates itself from similar research primarily through its unique selection of countries, offering a fresh geographical perspective on the interplay between exports, imports, and TFP in developing economies. This hypothesis potentially extends existing theories. Furthermore, the potential policy implications derived from its findings could provide actionable insights for economic planners and policymakers in the studied regions,

marking a significant difference from similar research by tailoring recommendations to the specific economic contexts of the included countries. The study consists of an introduction, theoretical framework, literature review, method and data set, application, and conclusion.

2. Theoretical Framework

Exports refer to the act of sending goods or services produced in one country to another country for trade. It is one of the main components of international trade. When a country exports, it sells its domestic products to foreign markets, which in turn generates revenue, increases gross domestic product, and contributes to economic growth. Exports can be tangible goods like cars, agricultural products, electronics, and clothing, or intangible services such as tourism, education, and financial services (Appleyard & Field, 2014). Imports refer to the act of bringing goods or services into a country from abroad for selling or using them within the domestic market. This process is a fundamental component of international trade. When a country imports, it purchases products that may not be available domestically, offer higher quality, or are more cost-effective than locally produced equivalents. Imports can include various goods and services. Governments typically regulate the importation of goods and services by imposing tariffs, quotas, and other trade barriers. Trade balance, determined by the balance of imports and exports, plays a significant role in a country's economic performance (Salvatore, 2019). Total Factor Productivity quantifies the effectiveness in using all inputs such as labour, capital, materials, energy and services that are used together in the production process. It represents the part of output that cannot be explained by the quantity of inputs used in production. TFP is an important indicator of an economy's long-term technological progress or technological dynamism because it measures how efficiently and intensively the inputs are utilised in the production process. Growth factor productivity means that an economy can produce more output without increasing the number of inputs (Isaksson, 2007).

The relationship between exports and total factor productivity can be viewed using competitiveness, innovation and quality, learning-by-doing, access to advanced technologies, and competition. A higher total factor productivity means that an economy is efficiently using its resources to produce goods and services. This efficiency can make its goods more cost competitive, thereby increasing their export potential (Hatemi-J & Irandoust, 2001). Economies with higher total factor productivity often have technological advancements and better production practises. This can lead to higher-quality goods, making them more attractive in the international market (Mendi, 2007). Engaging in international markets might lead to improvements in production processes. Exporting firms often gain more experience and learn to optimise their processes, leading to an increase in total factor productivity. Exporting can expose firms to global best practises and advanced technologies, which can be adopted to improve their productivity (Fernandes & Isgut, 2005). Exposure to international competition can motivate firms to enhance their efficiency, thus leading to improvements factor productivity.

The relationship between imports and TFP can be understood by means of demand for capital goods, consumer preferences, knowledge spillovers, competition, economies of scale and specialization (Halpern, Koren & Szeidl, 2005). Countries with rising total factor productivity might experience growth and industrialisation, leading to increased demand for capital goods. If these goods are not produced domestically, imports will rise. An economy with higher total factor productivity usually has a higher income level. As incomes rise, the demand for diversified and high-quality products may increase, leading to more imports if domestic industries do not cater to these needs

(Vacu & Odhiambo, 2020). Imports can introduce new technologies and practises to domestic industries. Interacting with foreign firms and products can lead to knowledge spillovers, benefiting local industries and boosting total factor productivity (Hanel, 2000). Imported goods can intensify domestic competition, urging local firms to boost their efficiency and productivity for effective competition. Importing intermediate goods can reduce production costs and allow firms to achieve economies of scale, thus boosting TFP. By importing specific goods and services, countries can specialise in certain areas, which can improve efficiency and enhance total factor productivity (Sharma, 2014).

There are two primary methods for measuring TFP. Growth Accounting Method separates economic growth into the contributions of factors of production and technological change, which is often referred to as the Solow Residual. It is a direct approach that quantifies how much the economic growth can be attributed to increased inputs and how much to improvements in efficiency or technology. Growth regressions relate productivity growth to a set of explanatory variables, such as human capital and technological innovation, within a regression framework. (Ahmed & Bhatti, 2020). Index number methods, like the Malmquist productivity index, measure productivity changes over time by comparing input and output vectors across different periods. Originally developed in a consumption context, it has been applied to assess productivity in production settings. However, the index has a notable flaw: it inaccurately measures productivity changes in the presence of non-constant returns to scale, either overstating or understating true productivity changes depending on the direction of input growth relative to scale economies (Grifell-Tatjé & Lovell, 1995). The TFP data used in this study were obtained from the Federal Reserve Bank of St. Louis database. In that database, TFP is measured using data on labour and capital stocks, alongside real GDP data from the Penn World Table (PWT). The methodology involves adjusting real GDP by the Törnqvist quantity index of factor endowments, which allows for the isolation of productivity differences between countries or over time, attributing changes in output not directly to inputs of labour and capital but to efficiency gains or technological improvements. This approach provides a means to compare economic productivity across countries and time, distinguishing between growth attributable to increased inputs and that due to enhanced productivity or technological progress (Feenstra, Inklaar & Timmer, 2015).

3. Literature Review

The relationship between exports and total factor productivity (TFP) has been extensively studied in the field of economics. Melitz (2003) investigated how trade affects productivity within industries. The research indicates that trade leads to resource shifts within industries and boosts overall industry productivity, implying that exporting can enhance TFP. Another study by Cisneros-Reyes et al. (2018) focussed on the Mexican leather footwear industry and its international trade activity. The authors found a strong relationship between TFP and exports, indicating that higher export levels are associated with increased productivity. Similarly, Mohammadi and Abooali (2013) investigated the long-term relationship between TFP and non-oil exports in Iran. The results of their study show that there is a direct and significant relationship between TFP and non-oil exports, and that improvements in TFP can increase exports. Kim et al. (2009) examined the link between imports, exports, and TFP in Korea. The study reveals that imports affect TFP growth, which in turn can boost productivity. However, there is no evidence that exports affect TFP in the same way. Furthermore, Herzer (2007) reviewed numerous studies on the link between trade and productivity and found a statistically

significant positive relationship between trade and TFP or labour productivity. This supports the notion that exports can contribute to improvements in TFP. Evidence from these studies shows that there is a positive relationship between exports and TFP. Higher export levels can lead to increased productivity and improvements in TFP.

The relationship between imports and total factor productivity (TFP) has been extensively studied. Several studies have provided insights into the impact of imports on TFP. Amiti & Konings (2007) on trade liberalisation and imported intermediate goods, based on Indonesian data, revealed that reduced output tariffs could enhance productivity by intensifying import competition. Additionally, affordable imported materials might boost productivity due to factors like learning, diversity, or quality. This indicates a potential positive impact of imports on TFP. Goldberg et al. (2008) investigated how imported intermediate goods relate to the growth of domestic products in India. Although the specific findings regarding the relationship between imports and TFP are not mentioned, the study provides valuable insights into the overall impact of trade liberalisation on productivity. Niu and Zhang (2023) analysed the effect of intermediate good imports and TFP on enterprise innovation. While the focus is on innovation, the study acknowledges the relationship between imports and TFP, and imports of intermediate goods can enhance TFP through innovation. Wang et al. (2021) explored how the complexity of imported items affects TFP. The study showed that as China imported more complex products, there was a notable boost in TFP and technological advancement. This implies that importing, especially more intricate goods, can positively impact TFP. Lu and Su (2023) focussed on the influence of imported embedded technology on TFP in China's manufacturing industry. Although the specific findings regarding the relationship between imports and TFP are not mentioned, the study highlights the importance of objectively examining the impact of imported embedded technology on TFP, suggesting that embedded technology imports can potentially affect TFP. These studies provide evidence that imports have a positive relationship with TFP. Lower output tariffs, cheaper imported inputs, complex imported products, intermediate goods imports, and imported embedded technology are all factors that can potentially contribute to improvements in TFP.

Some applied studies that investigated the causality and relationship between exports, imports, and total factor productivity are shown in Table 1.

Table 1. Literature Review

Authors	Dataset	Methodology	Results
Fu, X. (2005)	1990-1997 Chinese manufacturing sector	Panel Data Analysis	No statistically significant relationship was not found between exports and TFP.
Wilhelmsson, F., & Kozlov, K. (2007)	1996-2002 Russian manufacturing sector	Panel Data Analysis	Exports affects TFP positively.
Ogunleye, E. O. and Ayeni, R. K. (2008)	1970-2003 Nigerian Economy	Granger Causality Analysis	Bidirectional short-run causality is determined between exports and TFP.
Liao, H., & Liu, X. (2009)	1963-1998 East Asian Economies	ARDL Bounds Test and Modified Wald Test	A positive relationship exists between TFP and exports in the long term. In Korea, Singapore, and Taiwan, there is a bidirectional causality between TFP and exports in the short run. In other countries, the causality runs from TFP to exports in the short run.
Bigsten, A., & Gebreeyesus, M. (2009)	1996-2004 Ethiopian manufacturing sector	Panel Data GMM Analysis	There is a positive relationship between exports and TFP.
Uçak, H., & Arısoy, İ. (2011)	1980-2007 Turkish Economy	Error Correction Model and Granger Causality Test	Exports and imports positively affect TFP eventually.
Gonçalves, D. and Martins, A. (2016)	2010-2014 Portuguese manufacturing sector	Panel Data Analysis	Exports have a positive effect on TFP.
Gömleksiz, M., ahbaz, A. and Mercan, B. (2017)	1993-2014 OECD Countries	Panel Co-integration Model and Panel Causality Test	Trade openness positively affects TFP. Imports of high technology have a one-way causality with TFP.
eştepe, H., Arslan, E. and Yazc, M. (2020)	1990-2017 Developing Countries	Panel Causality Analysis	There is a unidirectional causality from TFP to exports.

The gap in the literature primarily revolves around the nuanced exploration of the causal relationship between exports, imports, and TFP in developing countries. Previous research has extensively examined the connexions between trade and TFP, highlighting various mechanisms through which trade can influence productivity, such as access to larger markets, technology transfer, and enhanced efficiency. However, the comprehensive assessment of bidirectional causality between trade and

productivity, especially within the distinct economic contexts of these developing nations, remains less explored. The need for this study arises from the critical yet underexplored intersection of trade and TFP within the unique economic contexts of developing countries. Despite the extensive body of research highlighting the mechanisms through which trade impacts productivity, including market expansion, efficiency gains, and technological advancements, there remains a significant gap in understanding the bidirectional causality between trade and productivity in these countries. This study addresses this gap by offering a detailed empirical analysis of causality relationships, thereby providing new insights that can enrich the existing literature. This exploration is expected to extend the understanding of how trade leverages economic growth and productivity improvements, thus fulfilling a crucial need in economic research by tailoring recommendations to the distinct needs and challenges faced by developing countries.

4. Methodology and Dataset

Time Series Analysis refers to various techniques used to analyse time-ordered data points. These data points or observations are typically collected at regular intervals and are used to study patterns, trends, and cycles in the data over time. The goal is often to understand the underlying structure of the time series to make forecasts or predictions about future values (Aydın, 2022). The time series application part of this study continues with the Augmented Dickey-Fuller Unit Root Test for stationarity, Johansen Test for cointegration, Granger Causality Test, Lagrange Multiplier Test and Jarque-Bera Test for the countries.

In econometrics, stationarity is a crucial concept when dealing with time series data. A time series is considered stationary when its underlying statistical characteristics remain constant throughout time. In other words, the mean, variance, and autocorrelation structure of the dataset remain constant over time. Stationarity is important because many statistical inferences and methods assume stationarity to provide valid results. When dealing with non-stationary time series, it is easy to obtain results showing a relationship between two variables when in fact there is no relationship between them. This can lead to incorrect conclusions like spurious regression (Brockwell & Davis, 2016). The Augmented Dickey-Fuller Unit Root Test is a statistical method employed to determine whether a unit root exists within a time series dataset. The test determines whether a given time series is stationary and considers higher-order autoregressive processes in the data.

Co-integration in econometrics is a statistical property of time series variables that indicates a long-term relationship between them. Specifically, if two or more non-stationary time series are cointegrate, a stable equilibrium relationship exists among those series, even if they individually appear to be trending over time. Co-integration is particularly useful in modelling economic relationships in which variables tend to move together eventually (Dolado et al., 1992). The Johansen cointegration test is a powerful tool in multivariate time series analysis, allowing researchers to identify and model multiple long-run relationships among nonstationary variables simultaneously (Johansen, 1991).

The Granger Causality Test is utilised to determine whether a one-time series possesses the ability to forecast another series over time, functioning as a statistical test of hypothesis. In this context, the term "causality" does not imply a direct cause-and-effect relationship in the traditional sense, but rather a predictive capacity. If variable X is found to be Granger-cause Y, this indicates that historical data of X provides predictive insights into Y that are not solely available through the historical values of Y (Hiemstra & Jones, 1994). A basic bivariate Granger causality model can be

represented using a Vector Autoregression (VAR) approach. The Granger causality test involves calculating the following pair of equations (Gujarati, 2010):

Equation for Y_t: $Y_t = \alpha_0 + \Sigma_{i=1}^{p} \alpha_i Y_{t-i} + \Sigma_{i=1}^{p} \beta_i X_{t-i} + \epsilon_{Y_t}$
Equation for X_t: $X_t = \gamma_0 + \Sigma_{i=1}^{p} \gamma_i X_{t-i} + \Sigma_{i=1}^{p} \delta_i Y_{t-i} + \epsilon_{X_t}$
Here:
Y_t and X_t are the values of the two time series at time t.
p is the lag order selected based on a criterion like AIC or BIC.
α_0 and γ_0 are the intercept terms.
α_i and γ_i are the coefficients of the lags of the dependent variable in each equation.
β_i and δ_i are the coefficients of the lags of the other variables in each equation.
ϵ_{Yt} and ϵ_{Xt} are the error terms assumed to be white noise.

The Lagrange Multiplier Test is a diagnostic tool used to test the null hypothesis that there is no specification error in a model, particularly regarding omitted variables or the presence of autocorrelation. In a more general sense, the LM test is applied in various econometric contexts to test model specifications against alternatives (Matsushita & Otsu, 2022). The Jarque-Bera Test is a method used to evaluate how well a dataset aligns with the normal distribution. It specifically cheques if the data are likely sourced from a normal distribution by examining its skewness and kurtosis. This test is commonly applied in econometrics and finance, particularly to verify if the residuals from regression analyses follow a normal distribution (Thadewald & Büning, 2007).

In the application part of this study; Time Series Analyses are performed to determine the causality between exports, imports, and total factor productivity (TFP) for Türkiye, Brazil, India, and South Africa. In these analyses, export and import data were obtained from the World Bank database and TFP data were obtained from the Federal Reserve Bank of St. Louis database. An explanation of the variables is shown in Table 2.

Table 2. Variables

Variable	Explanation	Source of Data
TFP	Total Factor Efficiency (Fixed Prices)	Federal Reserve Bank of St. Louis
EX	Export (Fixed Prices)	World Bank
IM	Import (Fixed Prices)	World Bank

5. Findings

5.1. Time Series Analysis for Türkiye

The results of the Augmented Dickey-Fuller Unit Root (ADF) Test performed for stationarity using the 1987-2019 period data of the Turkish economy are shown in Table 3.

Table 3. Augmented Dickey-Fuller Unit Root Test

	Level		First Difference	
Variable	Stats.	P	Stats.	P
TFP	-2.678	0.0779	-7.151	0.0000
EX	-1.276	0.6401	-5.788	0.0000
IM	-1,440	0.5630	-7.145	0.0000

According to the ADF Test results shown in Table 3, the series becomes stationary when the first differences are taken. The results of the Johansen Co-integration Test operated following stationarity are shown in Table 4.

Table 4. Johansen Co-integration Test

Selection-Order criteria			
FPE	AIC	HQIC	SBIC
4	4	1	1
Max. Rank	Eigenvalue	Trace Statistic	
0	.	27.6889*	
1	0.55610	5.7605	

According to Table 4, because there is no co-integration in the model, no long-term causality has been determined between the variables. The results of the Granger Causality Test driven to test the short-term causality between the variables are shown in Table 5.

Table 5. Granger Causality Test

Equation	**Excluded**	**chi2**	**Probe > chi2**
d_tfp	D.ex	13,715	0.033
d_tfp	I am	22.711	0.001
D_ex	d.tfp	16,543	0.011
D_ex	I am	32,303	0.000
D_im	d_tfp	21.33	0.002
D_im	D_ex	20.95	0.002

According to the Granger Causality Test results; the H0 hypothesis, which states that there is no short-run causality, is rejected for all variables. Therefore, there are bidirectional causality between exports, imports, and total factor productivity in the short run for the Turkish economy.

Table 6. Other Tests

Test		**chi2**	**Probe > chi2**
Lagrange Multiplier Test	Lag1	7.3312	0.60268
	lag2	6.9145	0.64602
Jarque-Bera Test	d_tfp	0.441	0.80204
	D_ex	3.091	0.79739
	D_im	0.574	0.75040
	ALL	6.477	0.37192

According to the Lagrange Multiplier Test results shown in Table 6, the H0 hypothesis, which states that there is no autocorrelation in the model, is accepted. Jarque-Bera Test results show that the H0 hypothesis is accepted, so the normal distribution is provided.

5.2. Time Series Analysis for Brazil

The results of the ADF Test performed for stationarity using the 1987-2019 period data of the Brazilian economy are shown in Table 7.

Table 7. Augmented Dickey-Fuller Unit Root Test

	Level		First Difference	
Variable	**Stats.**	**P**	**Stats.**	**P**
TFP	-1.335	0.6131	-7.039	0.0000
EX	-1.066	0.7286	-7.607	0.0000
IM	-2.056	0.2627	-6.553	0.0000

According to the ADF Test results shown in Table 3, the series becomes stationary when the first differences are taken. The results of the Johansen Co-integration Test operated following stationarity are shown in Table 8.

Table 8. Johansen Co-integration Test

Selection-Order criteria			
FPE	AIC	HQIC	SBIC
1	1	1	1
Max. Rank	Eigenvalue	Trace Statistic	
0	.	19.5129*	
1	0.55610	6.8204	
2	0.18322	1.9113	

According to Table 8 because there is no co-integration in the model, no long-term causality has been determined between the variables. The results of the Granger Causality Test driven to test the short-term causality between the variables are shown in Table 9.

Table 9. Granger Causality Test

Equation	**Excluded**	**chi2**	**Probe > chi2**
d_tfp	D.ex	63,637	0.000
d_tfp	I am	57,524	0.000
D_ex	d.tfp	42,554	0.000
D_ex	I am	52,533	0.000
D_im	d_tfp	80.068	0.000
D_im	D_ex	62,593	0.000

According to the Granger Causality Test results; the H0 hypothesis, which states that there is no short-run causality, is rejected for all variables. Therefore, there are bidirectional causality between exports, imports, and total factor productivity in the short run for the Brazilian economy.

Table 10. Other Tests

Test		**chi2**	**Probe > chi2**
Lagrange Multiplier Test	Lag1	5.7404	0.76559
	lag2	6.9775	0.63946
Jarque-Bera Test	d_tfp	1,028	0.59818
	D_ex	5.302	0.07058
	D_im	0.249	0.88299
	ALL	6.579	0.36158

According to the Lagrange Multiplier Test results shown in Table 10, the H0 hypothesis, which states that there is no autocorrelation in the model, is accepted. Jarque-Bera Test results show that the H0 hypothesis is accepted, so the normal distribution is provided.

5.3. Time Series Analysis for India

The results of the ADF Test performed for stationarity using the 1987-2019 period data of the Indian economy are shown in Table 11.

Table 11. Augmented Dickey-Fuller Unit Root Test

	Level		First Difference	
Variable	**Stats.**	**P**	**Stats.**	**P**
TFP	-0.256	0.9316	-5.828	0.0000
EX	0.948	0.9937	-7.064	0.0000
IM	1,191	0.9959	-6,972	0.0000

According to the ADF Test results shown in Table 11, the series becomes stationary when the first differences are taken. The results of the Johansen Co-integration Test operated following stationarity are shown in Table 12.

Table 12. Johansen Co-integration Test

Selection-Order criteria			
FPE	AIC	HQIC	SBIC
1	1	1	1
Max. Rank	Eigenvalue	Trace Statistic	
0	.	23.9718*	
1	0.55610	7.9628	
2	0.18322	0.3756	

According to Table 12 because there is no co-integration in the model, no long-term causality has been determined between the variables. The results of the Granger Causality Test driven to test the short-term causality between the variables are shown in Table 13.

Table 13. Granger Causality Test

Equation	**Excluded**	**chi2**	**Probe > chi2**
d_tfp	D.ex	79,792	0.000
d_tfp	I am	94.002	0.000
D_ex	d.tfp	131.54	0.000
D_ex	I am	163.25	0.000
D_im	d_tfp	51,137	0.000
D_im	D_ex	63,254	0.000

According to the Granger Causality Test results; the H0 hypothesis, which states that there is no short-run causality, is rejected for all variables. Therefore, there are bidirectional causality between exports, imports, and total factor productivity in the short run for the Indian economy.

Table 14. Other Tests

Test		**chi2**	**Probe > chi2**
Lagrange Multiplier Test	Lag1	9.7750	0.36900
	lag2	6.8531	0.65241
Jarque-Bera Test	d_tfp	0.684	0.71041
	D_ex	2,406	0.30027
	D_im	0.223	0.89433
	ALL	3.313	0.76862

According to the Lagrange Multiplier Test results shown in Table 14, the H0 hypothesis, which states that there is no autocorrelation in the model, is accepted. Jarque-Bera Test results show that the H0 hypothesis is accepted, so the normal distribution is provided.

5.4. Time Series Analysis for South Africa

The results of the ADF Test performed for stationarity using the 1987-2019 period data of the South African economy are shown in Table 15.

Table 15. Augmented Dickey-Fuller Unit Root Test

	Level		First Difference	
Variable	**Stats.**	**P**	**Stats.**	**P**
TFP	0.053	0.9627	-5,202	0.0000
EX	-0.945	0.7729	-6.262	0.0000
IM	-0.677	0.8525	-6.839	0.0000

According to the ADF Test results shown in Table 15, the series becomes stationary when the first differences are taken. The results of the Johansen Co-integration Test operated following stationarity are shown in Table 16.

Table 16. Johansen Co-integration Test

Selection-Order criteria			
FPE	AIC	HQIC	SBIC
2	2	2	1
Maxi. Rank	Eigenvalue	Trace Statistic	
0	.	20.7588*	
1	0.55610	5.7044	
2	0.18322	0.0116	

According to Table 16 because there is no co-integration in the model, no long-term causality has been determined between the variables. The results of the Granger Causality Test driven to test the short-term causality between the variables are shown in Table 17.

Table 17. Granger Causality Test

Equation	**Excluded**	**chi2**	**Probe > chi2**
d_tfp	D.ex	33,374	0.000
d_tfp	I am	66,473	0.000
D_ex	d.tfp	53.124	0.000
D_ex	I am	41,836	0.000
D_im	d_tfp	78,264	0.000
D_im	D_ex	40,995	0.000

According to the Granger Causality Test results; the H0 hypothesis, which states that there is no short-run causality, is rejected for all variables. Therefore, there are bidirectional causality between exports, imports, and total factor productivity in the short run for the South African economy.

Table 18. Other Tests

Test		**chi2**	**Probe > chi2**
Lagrange Multiplier Test	Lag1	9.4556	0.39632
	lag2	8.6884	0.46652
Jarque-Bera Test	d_tfp	1,387	0.49974
	D_ex	1,833	0.39986
	D_im	2,837	0.24207
	ALL	6.058	0.41676

According to the Lagrange Multiplier Test results shown in Table 18, the H0 hypothesis, which states that there is no autocorrelation in the model, is accepted. Jarque-Bera Test results show that the H0 hypothesis is accepted, so the normal distribution is provided.

6. Conclusion

Exports, imports, and total factor productivity are interconnected components of a country's economic structure. Their relationship can be multifaceted, and the direction of influence can be bidirectional. A higher TFP implies efficient use of resources, which can make a country's products more cost competitive, increasing exports. In addition, advanced technologies and improved production practises associated with higher TFP can lead to higher-quality goods, further enhancing export potential. Engaging in international markets can induce "learning-by-doing" effects where firms optimise their production processes, increasing TFP. Exporting can also expose firms to international best practises and technologies that can be adopted to boost productivity. A country with a higher TFP might see increased demand for both consumer and capital goods, leading to increased imports, especially if the desired goods are not produced domestically. Importing can expose a country to advanced technologies, best practices and diversified products, leading to knowledge spillovers and potentially increasing TFP. Furthermore, importing intermediate goods can lead to efficiency gains and higher TFP.

The aim of this study is to identify causality between exports, imports, and total factor productivity in developing countries. For this purpose, time series analyses were performed using data from the economies of Türkiye, Brazil, India, and South Africa. The series used in the analysis become stationary when the first differences are taken. According to the Johansen Co-integration Test results, there is no long-term causality between exports, imports, and total factor productivity. According to the results of the Granger Causality Test conducted within the framework of the VAR model; there are bidirectional causalities between exports, imports, and total factor productivity in these four developing countries in the short run.

This study underscores the bidirectional short-term causality between exports, imports, and TFP across the analysed countries. This is in line with research arguing that trade openness, both through exports and imports, can act as a catalyst for productivity growth. Exports facilitate access to larger markets, promote efficiency through specialisation and potentially introduce firms to more competitive environments that incentivize innovation and quality improvements. Imports play a critical role in bringing advanced technologies, capital goods and novel practices to the domestic market, fostering knowledge spillovers and technological advancements that can elevate TFP. These findings resonate with the broader understanding that trade integration, by stimulating competition, innovation, and knowledge exchange, can significantly contribute to productivity gains in developing economies, reinforcing the symbiotic relationship between trade policies and productivity enhancement strategies.

The study's discovery of no long-term causality between exports, imports, and TFP marks a notable divergence from the consensus in the existing literature on the subject. Many studies have posited a significant long-term relationship between trade and productivity enhancements, underpinning theories of economic development that emphasise the role of trade liberalisation and integration into global markets as crucial for sustained economic growth and productivity improvements. This discrepancy may indicate that unique structural, policy or economic factors are at play in these particular emerging economies that may be counteracting the long-term effects of trade on productivity observed elsewhere. This underscores the complexity of the trade-productivity nexus and suggests that while the short-term benefits of trade on productivity are evident in these countries, the long-term effects may be contingent upon other contributing factors such as the quality of

institutions, level of technological adoption, and education, which were not directly addressed in this study. This highlights the necessity for a nuanced understanding of the conditions under which trade impacts productivity, suggesting that the relationship may not be universally applicable or may require certain thresholds of development, policy frameworks, or complementary investments in human capital and infrastructure to manifest fully in the long term.

In light of these results, some policy recommendations can be developed. Increasing public and private investment in R&D can lead to technological advancements, driving up TFP, making domestic goods more competitive for export, and reducing the need for certain imports. Tax incentives or grants for industries involved in R&D can be offered, and educational institutions and research centres can be supported. Maintaining open trade policies that expose domestic industries to global best practises and technologies can increase TFP. Engaging in free trade agreements, reducing tariffs and minimising non-tariff barriers can be implemented. The import of machinery, technology, and other capital goods that can enhance production processes can be facilitated. Tax breaks or reduced tariffs on imported capital goods and technology can be offered for implementation. Protecting intellectual property to encourage innovation can boost TFP by creating stringent intellectual property laws, joining international intellectual property agreements, and ensuring efficient enforcement. Investments can be supported in infrastructure to support both production and trade. Efficient transport, energy, and communication infrastructure can significantly enhance TFP by allocating budgets for infrastructure projects and encouraging public-private partnerships. Trade facilitation can make trade processes more efficient to boost both imports and exports by modernising customs procedures, adopting digital technologies for trade documentation, and improving port and logistic services.

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REFERENCES / KAYNAKLAR

Adeleye, J. O., Adeteye, O. S., & Adewuyi, M. O. (2015). Impact of international trade on economic growth in Nigeria (1988-2012). *International journal of financial research, 6*(3), 163-172.

Afonso, Ó. (2001). The impact of international trade on economic growth. *Investigação–Trabalhos em Curso*, 106.

Ahmed, T., & Bhatti, A. A. (2020). Measurement and determinants of multi-factor productivity: A survey of literature. *Journal of Economic Surveys, 34*(2), 293-319.

Amiti, M. and Konings, J. (2007). Trade liberalization, intermediate inputs, and productivity: evidence from Indonesia. *American Economic Review, 97*(5), 1611-1638.

Appleyard, D. R., & Field, A. J. (2014). *International economics*. McGraw-Hill.

Aydin, S. (2022). Time series analysis and some applications in medical research. *Journal of Mathematics and Statistics Studies, 3*(2), 31-36.

Brockwell, P. J. and Davis, R. A. (2016). *Introduction to time series and forecasting*. Springer Texts in Statistics.

Bigsten, A., & Gebreeyesus, M. (2009). Firm productivity and exports: Evidence from Ethiopian manufacturing. *The Journal of Development Studies, 45*(10), 1594-1614.

Caleb, G., Mazanai, M., & Dhoro, N. L. (2014). Relationship between international trade and economic growth: A cointegration analysis for Zimbabwe. *Mediterranean Journal of Social Sciences, 5*(20), 621.

Chen, E. K. (1997). The total factor productivity debate: determinants of economic growth in East Asia. *Asian-Pacific Economic Literature, 11*(1), 18-38.

Cisneros-Reyes, Y., Rocha-Ibarra, J., & Hidalgo, M. (2018). Characteristics of mexican leather footwear industry and its international trade activity, correlation of productivity, and competitiveness. *European Scientific Journal Esj, 14*(22), 63.

Comin, D. (2010). Total factor productivity. In S. N. Durlauf & L. E. Blume (Eds.). *Economic growth*. London: Palgrave Macmillan.

Çeştepe, H., Arslan, E., & Yazıcı, M. (2020). Toplam Faktör Verimliliği, Ekonomik Büyüme ve İhracat İlişkisi: Gelişmekte Olan Ülkeler Örneği. *Yönetim ve Ekonomi Dergisi, 27*(3), 495-510.

Dolado, J. J., Ericsson, N. R., & Kremers, J. J. M. (1992). The power of cointegration tests. *International Finance Discussion Paper, 1992*(431), 1-33.

Feenstra, R. C., Inklaar, R., & Timmer, M. P. (2015). The next generation of the Penn World Table. *American economic review, 105*(10), 3150-3182.

Felipe, J. (1999). Total factor productivity growth in East Asia: A critical survey. *The Journal of Development Studies, 35*(4), 1-41.

Fernandes, A. M., & Isgut, A. (2005). Learning-by-doing, learning-by-exporting, and productivity: evidence from Colombia. *Available at SSRN 695444*.

Fu, X. (2005). Exports, technical progress and productivity growth in a transition economy: a non-parametric approach for China. *Applied economics, 37*(7), 725-739.

Goldberg, P. K., Khandelwal, A. K., Pavcnik, N., & Topalova, P. (2010). Imported intermediate inputs and domestic product growth: Evidence from India. *The Quarterly journal of economics, 125*(4), 1727-1767.

Gonçalves, D., & Martins, A. (2016). The determinants of TFP growth in the Portuguese manufacturing sector. *GEE Papers, 62*.

Gömleksiz, M., Şahbaz, A., & Mercan, B. (2017). Toplam faktör verimliliğinin belirleyicileri üzerine ampirik bir inceleme: Seçilmiş OECD ülkeleri örneği. *Eskişehir Osmangazi Üniversitesi İktisadi ve İdari Bilimler Dergisi, 12*(2), 65-82.

Grifell-Tatjé, E., & Lovell, C. K. (1995). A note on the Malmquist productivity index. *Economics letters, 47*(2), 169-175.

Gujarati, D. N. (2010). *Temel Ekonometri*. (Çev. Ü. Şenesen, G. Günlük Şenesen). İstanbul: Literatür Yayıncılık.

Halpern, L., Miklos, K., & Szeidl, A. (2005). Imports and productivity. *CEPR Discussion Papers no. 5139*.

Hanel, P. (2000). R&D, interindustry and international technology spillovers and the total factor productivity growth of manufacturing industries in Canada, 1974-1989. *Economic Systems Research, 12*(3), 345-361.

Hatemi-J, A., & Irandoust, M. (2001). Productivity performance and export performance: a time-series perspective. *Eastern Economic Journal, 27*(2), 149-164.

Herzer, D. (2007). How does trade composition affect productivity? evidence for Chile. *Applied Economics Letters, 14*(12), 909-912.

Hiemstra, C. and Jones, J. D. (1994). Testing for linear and nonlinear granger causality in the stock price-volume

relation. *The Journal of Finance, 49*(5), 1639-1664.

Isaksson, A. (2007). Determinants of total factor productivity: a literature review. *Research and Statistics Branch, UNIDO, 1*(101), 672.

Johansen, S. (1991). Estimation and hypothesis testing of cointegration vectors in gaussian vector autoregressive models. *Econometrica, 59*(6), 1551.

Kim, S., Lim, H., & Park, D. (2009). Imports, exports and total factor productivity in Korea. *Applied Economics, 41*(14), 1819-1834.

Liao, H., & Liu, X. (2009). Export-total factor productivity growth nexus in East Asian economies. *Applied Economics, 41*(13), 1663-1675.

Lu, Y. and Su, H. (2023). Research on embedded technology import and the growth of tfp in china's manufacturing industry based on the panel data from 1992 to 2020. *Advances in Economics Management and Political Sciences, 4*(1), 92-102.

Matsushita, Y. and Otsu, T. (2022). A jackknife lagrange multiplier test with many weak instruments. *Econometric Theory*, 1-24.

Melitz, M. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica, 71*(6), 1695-1725.

Mendi, P. (2007). Trade in disembodied technology and total factor productivity in OECD countries. *Research Policy, 36*(1), 121-133.

Mohammadi, T. and Abooali, S. (2013). An empirical study on long-term relationship between total factor productivity and non-oil exports in Iran. *Management Science Letters*, 2643- 2650.

Nadiri, M. I. (1970). Some approaches to the theory and measurement of total factor productivity: a survey. *Journal of Economic Literature, 8*(4), 1137-1177.

Niu, R., & Zhang, Y. (2023, March). Analysis on the Mechanism of Intermediate Goods Import and Total Factor Productivity on Enterprise Innovation. In *Proceedings of the 4th Management Science Informatization and Economic Innovation Development Conference, MSIEID 2022, December 9-11, 2022, Chongqing, China*.

Ogunleye, E. O., & Ayeni, R. K. (2008). The link between export and total factor productivity: Evidence from Nigeria. *Social Sciences, 1*, 9-18.

Salvatore, D. (2019). *International economics*. John Wiley & Sons.

Sharma, C. (2014). Imported intermediate inputs, R&D, and productivity at firm level: Evidence from Indian manufacturing industries. *The International Trade Journal, 28*(3), 246-263.

Thadewald, T. and Büning, H. (2007). Jarque–bera test and its competitors for testing normality – a power comparison. *Journal of Applied Statistics, 34*(1), 87-105.

Uçak, H., & Arısoy, İ. (2011). Türkiye ekonomisinde verimlilik, ihracat ve ithalat arasındaki nedensellik ilişkisinin analizi. *Ege Akademik Bakış, 11*(4), 639-651.

Vacu, N., & Odhiambo, N. M. (2020). The determinants of import demand: a review of international literature. *Acta Universitatis Danubius. Œconomica, 16*(5).

Van Beveren, I. (2012). Total factor productivity estimation: A practical review. *Journal of economic surveys, 26*(1), 98-128.

Wang, N., Liu, W., Sun, S., & Wang, Q. (2021). The influence of complexity of imported products on total factor productivity. *Mobile Information Systems, 2021*, 1-7.

Wilhelmsson, F., & Kozlov, K. (2007). Exports and productivity of Russian firms: In search of causality. *Economic Change and Restructuring, 40*, 361-385.

Zahonogo, P. (2016). Trade and economic growth in developing countries: Evidence from sub-Saharan Africa. *Journal of African Trade, 3*(1-2), 41-56.

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