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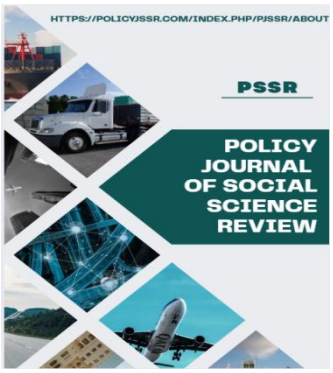

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UNRAVELING EXPORT SOPHISTICATION DRIVERS: AN EMPIRICAL ANALYSIS OF PAKISTAN'S TRADE LANDSCAPE

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Page- 59-79

ABSTRACT

This study highlights the determinants of export sophistication in Pakistan. Time series data has been taken for the years 1996 to 2022. The World Bank's World Integrated Trade Solution (WITS) is the source of data for the Index of Export Sophistication (EXPY). The variables that impact export sophistication are investigated in this research. In the context of Pakistan, there is a dearth of research on estimations and determinants. The purpose of the Augmented Dickey Fuller (ADF) test is to identify the core issue with the unit root. To observe long-term relationships in the underlying variables, this study uses the Auto Regressive Distributive Lag technique. Regression results indicated that term of trade, official exchange rate and foreign direct investment negatively affect the export sophistication in case of Pakistan. While political stability, GDP per capita, globalization and world GDP per capita are positively related with export sophistication in case of Pakistan.

Keywords: *Export Sophistication, Official Exchange Rate, Social Globalization, Foreign Direct Investment, World GDP Per Capita, Term of Trade, Political Stability*

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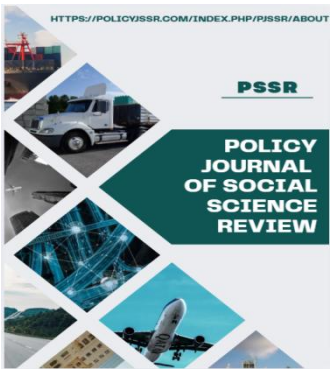

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1. Introduction

Recent trade literature suggests that both export expansion and structural transformation contribute significantly to long-run economic growth. Structural transformation, characterized by export diversification and product sophistication, has emerged as an important engine of economic development. This process involves a gradual shift in exports from primary commodities toward manufactured products that embody greater labor input, technological content, and resource utilization (Khan & Afzal, 2016; Hwang & Lee, 2019; Andreou, 2021). An increasingly sophisticated export basket at a given income level reflects the developmental progress of a country and enhances its capacity to compete in international markets. Countries that maintain export structures more advanced than their income levels often experience accelerated economic growth through greater access to high-value imports, technology transfer, and enhanced productivity. In contrast, economies that remain dependent on simple export baskets frequently encounter slower growth and persistent development challenges (Khan & Afzal, 2016). Similar arguments have been advanced in studies examining trade liberalization, economic performance, and development outcomes in Pakistan and other developing economies (Ali, 2015; Ali, 2018; Audi & Ali, 2018; Ahmad et al., 2022).

Numerous studies have investigated the relationship between export sophistication, technological advancement, and economic growth while developing various measures to evaluate export quality and complexity (Zhu et al., 2010). Export sophistication is generally associated with the income level of exporting countries, implying that products exported by higher-income economies tend to embody greater technological content and value addition. Sophisticated exports stimulate growth by improving productivity, enhancing competitiveness, and facilitating integration into global value chains. Countries specializing in manufactured and value-added products generally achieve greater benefits from international trade than those relying heavily on raw material exports. Consequently, export sophistication provides policymakers with an effective mechanism for narrowing development gaps and strengthening economic resilience. These findings are consistent with evidence highlighting the importance of trade openness, foreign trade expansion, and export diversification in supporting sustainable economic growth across both developed and developing economies (Sun & Chang, 2020; Naik, 2020; Cizakca, 2024; Fayou, 2026; Murat, 2026).

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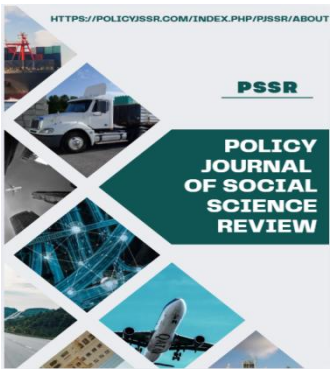

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For Pakistan to fully benefit from integration into the global economy, several structural and policy challenges must be addressed. The Framework for Economic Growth introduced in 2011 emphasized the importance of trade policy reforms, market openness, and improvements in economic governance as prerequisites for sustained development (Reis & Taglioni, 2013). Pakistan's trade policy history has often reflected fluctuations between protectionist measures and liberalization efforts, creating uncertainty for investors and exporters. Previous research has shown that trade liberalization can influence import demand, fiscal management, expenditure patterns, and overall economic performance, making policy consistency essential for long-term success (Ali, 2011; Ali & Naeem, 2017; Siddiqi et al., 2014; Ali, 2022). Furthermore, inadequate infrastructure, limited industrial competitiveness, exchange rate volatility, and weaknesses in the business environment continue to constrain the country's trade potential (Reis & Taglioni, 2013; Ali, 2022; Ali & Hassan, 2026).

Recent evidence also suggests that external economic conditions, trade barriers, geopolitical developments, and regional trade agreements increasingly shape trade outcomes across countries. Studies examining bilateral trade relations, exchange rate dynamics, demographic factors, and trade policy reforms highlight the importance of maintaining a competitive and diversified export sector (Alzahrani & Salah, 2020; Mealli, 2021; Mordecai & Akinsola, 2021; Wang, 2023; Soliman, 2025). In Pakistan's case, initiatives aimed at export diversification and enhanced market access, including preferential trade arrangements with major trading partners, offer significant opportunities for improving trade performance and competitiveness (Hamza et al., 2025). Recent analyses also emphasize the role of exchange rate movements, trade balance adjustments, innovation, and intangible assets in determining export success and economic performance (Alvi & Mudassar, 2025; Ali et al., 2025). Therefore, this study reviews Pakistan's recent trade performance, trade policies, and associated costs while providing a detailed assessment of export growth, trade orientation, and export sophistication within the broader context of international trade and economic development (Arshad & Mukhtar, 2019; Irfan & Sohail, 2021).

2. Literature Review

Takpara et al. (2023) examined how trade facilitation reform affects Sub-Saharan African export sophistication. This study uses the Economic Complexity Index (ECI) to examine how trade facilitation policy affects SSA export sophistication between 2004 and 2017. The framework includes

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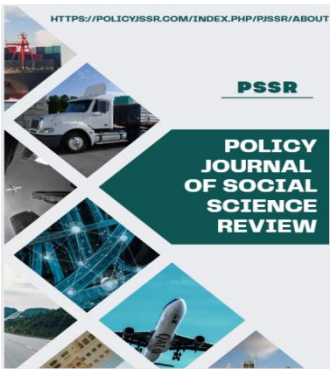

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transport efficiency, business and regulatory climate, physical infrastructure, and ICT. The empirical investigation uses GMM, OLS, and 2SLS. The study found that trade facilitation reforms can improve SSA high-tech exports by increasing ICT, border and transport efficiency, and other issues. The results show that Sub-Saharan Africa should undertake border changes immediately. Thus, the World Trade Organisation must accelerate Trade Facilitation Agreement implementation to achieve this goal.

Rehman et al. (2023) When energy usage is broken down, does OECD export sophistication and variety change? A comprehensive panel model research. In recent years, countries have sought to diversify and strengthen their export growth to boost economic growth. Rising and expanding require energy. In light of current events, this paper examines how renewable and non-renewable energy consumption components affect OECD export diversification and sophistication policies from 1990 to 2019. The study's key contribution is two new export indices: sophistication and diversification. Update the study model to add these indices as dependent variables. The CS-ARDL method also reveals that increasing disaggregated energy consumption in OECD countries can boost export diversity and complexity. Renewable energy has less impact than non-renewable energy. OECD nations' export diversification and sophistication have improved when regressors like human capital, institutional quality, and FDI are incorporated. This study confirms the CS-ARDL findings by solving the panel data endogeneity problem with System GMM (SGMM). This report makes significant policy suggestions based on its findings.

Song et al., (2022) examined Chinese manufacturers' export sophistication, independent innovation, and intermediate imports. We propose regression analysis on a combined dataset of the Chinese Customs Database and the Chinese Industrial Enterprise Database. Empirical testing shows that intermediary imports affect export sophistication for independent innovation. Three components make up outcomes. Beginning with intermediate imports, industrial autonomous innovation is greatly benefited. This promotional job varies greatly depending on business ownership, trade kind, export target country, and technological capabilities. Independent innovation increases export sophistication but diminishes the benefit of intermediate imports. A negative moderating impact exists. Thirdly, intermediate imports benefit new and expanding enterprises most. In contrast, autonomous innovation benefits growing and mature businesses.

Liu et al., (2023) How significant is export sophistication? Adapting to climate change:

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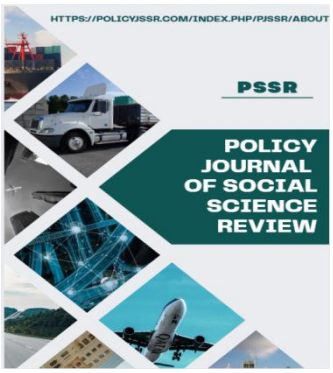

Policy Journal of Social Science Review

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total factor energy efficiency improvements. This analysis uses panel data from 2006–2018 for mainland China alone. The major purpose was to determine how export sophistication influences GTEE. The China Internet Development Report, Wind database, China Statistical Yearbook, China Energy Yearbook, and China Environmental Yearbook were this study's main data sources. Global climate change threatens human life and development. Climate change is complex and affects the energy and economic sectors. Technology must drive solutions. Energy difficulties can be solved by creating total factor energy efficiency. Fixed effect, impulse response function, and threshold regression models were used to examine the complex link between export sophistication and total factor energy efficiency (TFEE). According to the findings, total factor export efficiency (TFEE) increases with export complexity. According to the impulse response study, total factor energy efficiency (TFEE) and export sophistication are positively connected. At varying thresholds of regional corruption score, economic growth, and openness, export sophistication and total factor energy efficiency changed. This essay supports China's export sophistication strategy and illuminates energy efficiency and post-epidemic energy challenges.

The correlation between the export sophistication of new energy vehicles and the upgrading of China's industrial structure was investigated by Cao et al. (2022b) Many automakers, including some in China, are planning to shift their focus from making gasoline-powered cars to developing new energy vehicles in the not-too-distant future. This change is the result of years of coordinated efforts to reduce emissions of greenhouse gases from the transportation industry. Energy vehicle exports across all 31 Chinese provinces are the subject of this panel data analysis, which spans from 2010 to 2020. The export complexity of Chinese domestic energy vehicles is investigated in this paper, with a particular emphasis on processing commerce. The study used both static and dynamic panel models to assess the correlation between export sophistication and industrial upgrading, while excluding intermediate goods. An analysis of the degree of domestic export sophistication within three significant economic regions was conducted using heterogeneity tests. The results show that an increase in export sophistication is beneficial to China's industrial upgrading efforts. Several factors impact China's new energy vehicle sector's long-term performance. These include export sophistication, R&D activities, FDI, average GDP growth rate, market dynamics, human resources, and the sector's overall health. When it comes to regional stratification, the eastern and western areas have a stronger influence on industry

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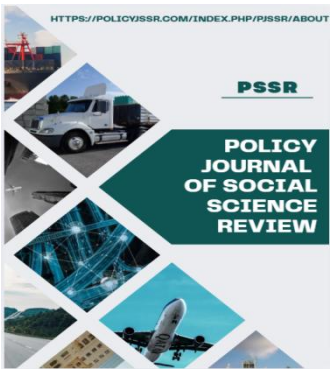

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upgrading from a domestic export sophistication standpoint than the centre region. In particular, industrial upgrading is significantly impacted by every one-unit increase in export sophistication in western regions. This highlights the critical need for new energy vehicles in China to raise the bar on export sophistication to support the country's transition to a more modern manufacturing sector.

An empirical study was conducted by(Huang et al., 2023) to examine the impact of the new energy industry's export sophistication on carbon emissions. From an export sophistication perspective, this research has not delves far enough into the link between the new energy sector and CO_2 emissions. Carbon dioxide (CO2) emissions, regional differences, and the underlying mechanisms are investigated in this research, as are the possible consequences of the export sophistication of the expanding energy sector. The data included in the study comes from 31 major economies around the world and covers the years 1996–2021. The results show that the new energy industry's export sophistication helps lower emissions of carbon dioxide. Even after extensive testing to guarantee the results' veracity, this conclusion stands. Additionally, industrialised nations are more affected by export sophistication's effect on carbon emission reduction than underdeveloped nations. Furthermore, domestic technology advancement is somewhat stymied by the new energy industry's export sophistication, which in turn reduces the efficacy of carbon reduction initiatives. Theoretically, this study's findings can enlighten the worldwide movement towards low-carbon energy.

Researchers looked at how export sophistication affected trade diversification through the mediating function of global value chain participation (Ali & Munir, 2022). A panel of 105 economies covering the years 2011–2018 has been constructed for this study. As an empirical tool, this research makes use of Hansen's (1999) static panel threshold test. Can you modify my text so it is more academic sounding? Kindly do not Taking part in global value chains, increasing export complexity, and diversifying trade are all positively correlated, according to this study. In addition, this research distinguishes between two levels of involvement in global value chains (GVCs) that illustrate how export sophistication impacts trade diversification, leading to three separate regimes: the lower, moderate, and upper regimes. Categories with increasingly decreasing values of the export sophistication coefficient are referred to as "moderate regimes" and "lower regimes," respectively, while the term "upper regime" is used to describe the category with the highest value. Therefore, a non-linear pattern characterises the link between

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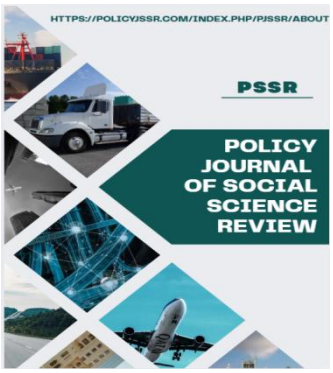

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export sophistication and trade diversification. Research like this suggests that countries should start making high-tech products and becoming more involved in global value chains.

Using data from Chinese domestic manufacturing firms,(Liu & Wang, 2022) investigated the impact of FDI spillovers on export sophistication. In this study, we leverage the worldwide input-output database to create a new metric for measuring net output sophistication, excluding technologies used in imported inputs. While there has been some growth, China's internet sophistication is still much lower than other countries. The impact of Foreign Direct Investment (FDI) on the degree of technological improvement displayed by Chinese domestic firms is examined in this study using modern metrics. This study makes use of information collected between the years 2000 and 2010. The results show that FDI has an effect on local businesses in a competitive way. As local enterprises adjust their production processes to save costs, they may temporarily enhance the level of technical innovation inside the network by minimising their reliance on foreign technology. In any case, new technological developments are essential to maintaining the present increased level of net sophistication. Prolonged rivalry from foreign corporations causes a net decline in the complexity of indigenous enterprises. Our study's findings have important policy implications for developing countries that have plenty of workers and want to boost their exports by luring FDI.

Research from China's manufacturing data suggests that the export sophistication of the home nation may be affected by the host country's foreign direct investment (FDI) restrictions (Ren et al., 2022) . This research delves into the relationship between the home country's level of export sophistication and the host country's FDI restrictiveness index. The impacts of reverse technology spillover (RTS) utilising an intermediary model are examined in this study using two-way fixed-effects models and firm-level microdata. The empirical results show that the home country's export sophistication is significantly affected by the level of FDI restrictiveness in the host nation. Particularly noteworthy are the effects of foreign equity limits, selection and endorsement processes, and additional operational constraints. Still, the local nation's export sophistication has improved thanks in part to the constraints imposed on key foreign professionals. The textile and resource processing industries have seen to be stymied in their pursuit of export sophistication due to the host nations' FDI restrictions, but the mechanical and electronic industries have seen growth in this area. In a similar vein, the degree to which a host country restricts

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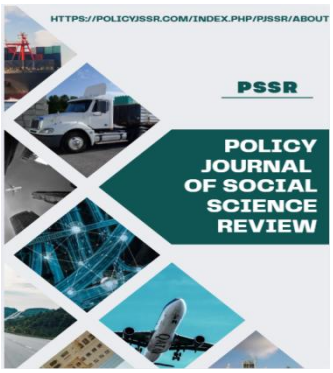

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foreign direct investment (FDI) affects the home country's export sophistication by manipulating resource allocation. There has been a change in export trade models from one that emphasises quantitative competitiveness to one that emphasises quality competition as a result of manufacturing companies improving their export expertise through strategic resource allocation.

Wang et al., (2022) Using dynamic system GMM and threshold model techniques, this research empirically investigates the relationship between environmental regulation, foreign direct investment, and export sophistication in China. Researchers have long been interested in the topic of export sophistication (ES), and this study sheds light on the complex methods by which environmental restrictions (ERs) affect ES. However, academics have paid scant attention to how economic reforms (ERs) might pave the way for FDI to improve China's environmental sustainability (ES). This paper proposes a new research paradigm that combines the ideas of economic resilience, environmental sustainability, and foreign direct investment to address this gap in the literature. This study used panel data from Chinese provinces covering the years 2004–2016 to analyse the relationship between FDI, ERR, and ES using the system generalised method of moments (SYS-GMM). After that, the panel threshold model was used to test how different levels of environmental regulations (ERs) affect the improvement of environmental sustainability (ES) as a result of foreign direct investment (FDI). The results are displayed in the following manner: At first glance, it seems that exchange rates (ERs) are a major factor in China's ability to entice international investment, with the main function being to shield the country from pollution caused by developed countries. Foreign direct investment (FDI) might be negatively affected by an overabundance of emergency reserves (ERs). An inverted U-shaped non-linear relationship between ERs and FDI is thus demonstrated. In addition, FDI had an effect on the improvement of the ES, and that effect followed a U-shaped curve. Additionally, it is clear that ERs are vital to the improvement of ES through a U-shaped mechanism. Both "innovation compensation" and "cost offset" have an effect on this connection. An N-shaped relationship was seen between environmental constraints and the improvement of export sophistication as a result of the linkage effect of FDI. Using the data, we proposed a number of policy changes that would improve the ES in the future.

Wang et al., (2022) analysed the changes in Agri-Food export competitiveness using sophistication analysis. A large portion of China's agricultural and food exports come

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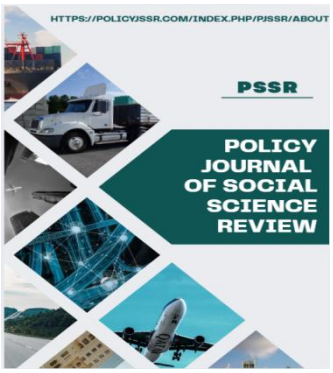

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from the Xinjiang Uygur Autonomous Region. The main objective is to strengthen the competitive edge of exports related to agriculture and food. Agricultural Products (APs) from Xinjiang were analysed for their overall and categorical export competitiveness using the export sophistication index. By contrasting the outcomes with the average across China, we can ascertain the relative export sophistication. According to the research, the Autonomous Prefectures (APs) of Xinjiang mainly export medium and medium-low-sophistication items. We have optimised the structure of the growing scale in its entirety. Horticultural products from Xinjiang continue to stand out, showing no signs of major competition both regionally and nationally. The bulk agricultural products (APs), including meat, fish, beverages, tobacco, and other APs, are not very export competitive when compared to the rest of the country. Horticultural items make up a disproportionate share of Xinjiang's Autonomous Prefectures' exports, suggesting a less than ideal distribution of export competitiveness. You might say that this pattern is "the strong becoming stronger and the weak becoming weaker." The rate of improvement in export competitiveness in Xinjiang's APs has also lagged behind the national average since the COVID-19 outbreak began. These findings stress the need of lawmakers closely monitoring this issue.

Research by (Cao et al., 2022a) examined the connections between China's export sophistication, new energy vehicles, and the upgrading of industrial structure. Using panel data from all 31 provinces in China from 2010 to 2020, this study analyses the energy-related components of automobile exports. The export complexity of Chinese domestic energy vehicles is the subject of this study, which primarily aims to analyse processing commerce. This study uses static and dynamic panel models to examine the association between export sophistication and industry upgrading, while excluding intermediate goods. To further understand the degree of domestic export sophistication across three key economic zones, heterogeneity tests were utilised. Industrial upgrading in China can be achieved by raising the level of export sophistication, according to the study's conclusions. Several factors impact China's new energy vehicle sector's long-term performance. These include export sophistication, R&D activities, FDI, average GDP growth rate, market conditions, human resources, and the sector's overall health. When looking at regional stratification, the eastern and western regions show a stronger correlation between domestic export sophistication and industrial upgrading than the central region. In particular, for every one unit

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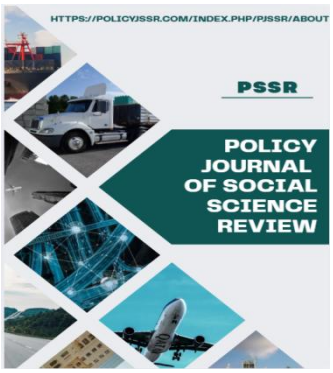

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increase in export complexity, there is a discernible impact on industrial upgrading in western regions. This highlights the critical need for new energy vehicles in China to raise the bar on export sophistication to support the country's transition to a more modern manufacturing sector.

Chinese exports become more complex or diverse as a result of trade-related sectoral infrastructure (Ur Rehman et al., 2021) For the years 1990–2019, this research relies on WDI and UNCTAD yearly data.When determining export sophistication, the PRODY and EXPY indices are used. The study's examination of the symmetric and asymmetric consequences of infrastructure on environmental sustainability (ES) and economic development (ED) is a significant addition to the current literature on these topics. In this research, we use the Dynamically Simulated Autoregressive Distributed Lag (DYS-ARDL) method, a highly developed and dynamic simulation approach. This technique is an improved version of the NARDL and ARDL methods. In order to analyse both the long-run and short-run dynamics, the newly suggested DYS-ARDL dynamic technique set out to overcome the shortcomings of the traditional ARDL model. Keeping all other regressors constant, the recently created dynamic DYS-ARDL model efficiently estimates, simulates, and graphically displays predictions of counterfactual changes in one explanatory variable and its effect on the dependent variable. To top it all off, the DYS-ARDL model's unique approach makes it possible to automatically estimate, simulate, and display graphical trends in positive and negative variations of variables. Also, it's easier to look at the long-term and short-term connections between these factors. Infrastructure, economic sustainability (ES), and environmental degradation (ED) are all interrelated in China, according to this study's results. This analysis shows that China's economic development and environmental sustainability will be greatly enhanced by investing in infrastructure improvements.

3. Data Source and Methodology

The global integrated trade system (WITS) run by the world bank is the source of data used by the Index of Export Sophistication (EXPY). One indicator of institutions, political stability, uses data collected from the World Bank's Worldwide Governance Indicator (WGI). The KOF Globalisation Index (Swiss Economic Institute) is the source for data on economic and social globalisation.The World Development Indicator (WDI) is the source for data on FDI, Official Exchange Rate (OFER), Term of Trade, World GDP Per Capita, and World GDP Per Capita Overall. The years 1996–2022, inclusive, are used as the basis for the time series data

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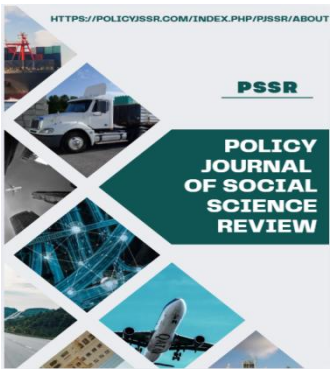

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Estimators for Pakistan are derived using time series data collected from 1996 to 2022 using Ordinary Least Square (OLS). It is necessary to verify the variable's stationarity while dealing with time series analysis. Spurious regression occurs when regression is performed on non-stationary series, which can lead to misleading findings.

Any time there is a temporal pattern in the data, non-stationarity becomes a concern. This type of data does not yield accurate results when used in regression analysis. According to(Phillips, 1986), this type of regression yields erroneous findings in cases where the underlying variables do not exhibit any signs of cointegration. Results from Ordinary Least Square (OLS) regression are satisfactory in cases where the variables are cointegrated and stationary. Time series data can be checked for non-stationarity using a number of unit root tests. A couple of the most well-known ones are the tests proposed by (Dickey & Fuller, 1981).This research uses the ADF test to guarantee that the data is stationary.

A number of assumptions are checked by diagnostic tests, including serial correlation, normality, model specification, and heteroskedasticity. You can see how these tests came out in the results of the current study. These results indicate that the residual series of the ARDL model is normally distributed and does not display heteroskedasticity. According to (Mubeen & Ahmad, 2016), the model's specifications were also validated using Ramsey's RESET test.We employ the Error Correction Model for short-term results.

3.1. Econometrics Model

$$EXPY_t = \beta_0 + \beta_t TOT_t + \beta_2 OFEX_t + \beta_3 WGDP_t + \beta_4 KOFSOGI_t + \beta_5 GFCFCON15US_t + \beta_6 FDINETIN_{ti} + \beta_7 POLSTAB_t + \mu_t$$

t= 1996, 1997, 1998,.....2022

TOT=Term of Trade

OFEX= Official Exchange Rate

WGDP= World GDP Per Capita

KOFSOGI=Globalization (Index)

GFCFCON15US=Gross Capital Formation

FDINETIN=Foreign Direct Investment

POLSTAB=Political Stability

Table 1:

Descriptive Statistics

	EXPY	TOT	OFEX	WGDP	KOFSOGI	GFCFCON15US	FDINETIN	POLSTABL
Mean	13452.62	128.7571	89.92975	9250.927	36.5645	3.36E+10	1.183571	-2.107298
Median	13359.73	106.8617	85.76860	9279.127	36.14615	3.31E+10	0.792914	-2.325397
Maximum	14328.42	273.0755	162.9063	10941.96	43.38970	4.87E+10	3.668323	-1.104805
Minimum	12581.72	92.88670	41.11153	7197.880	33.45840	2.34E+10	0.375528	-2.810035
Std. Dev.	463.0806	48.65347	35.19156	1086.534	2.957144	7.19E+09	0.946318	0.554238

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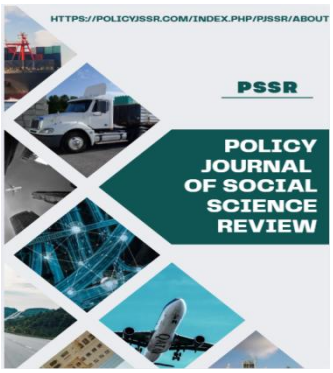

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Skewness	0.034879	1.917280	0.744259	-0.228147	0.909142	0.263164	1.628273	0.605664
Kurtosis	2.371360	5.585847	2.696579	2.049774	2.867144	2.228064	4.377635	2.020079
Jarque-Bera	0.366717	19.60792	2.115435	1.018539	3.046824	0.800164	11.46106	2.225266
Probability	0.832470	0.000055	0.347247	0.600934	0.217967	0.670265	0.003245	0.328692
Sum	295957.7	2832.656	1978.454	203520.4	804.4196	7.40E+11	26.03856	-46.36055
Sum Sq. Dev.	4503317.	49710.36	26007.36	24791699	183.6387	1.09E+21	18.80586	6.450764
Observations	22	22	22	22	22	22	22	22

The descriptive statistics of the data utilised in the study are explained in the table that was discussed earlier. The data is clearly structured for analysis based on these results.

Table 2:

Unit Root at Level and First Difference

AT Level						
Variable Name	**Intercept**			**Intercept and time trend**		
	ADF test stat	**p-value**	**lags**	**ADF test stat**	**p-value**	**lags**
EXPY	-1.615741	0.4611	0	-1.966232	0.5927	0
TOT	-1.712262	0.4140	0	0.305657	0.9976	0
OFEX	2.924465	1.0000	0	1.193765	0.9999	0
WGDP	-0.214986	0.9251	0	-4.051375	0.0189	0
KOFSOGI	-1.518703	0.5079	0	-1.521694	0.7944	
GFCFCON15US	-0.649258	0.8431	0	-2.037052	0.5558	0
FDINETIN	-1.552512	0.4924	0	-1.651018	0.7449	0
POLSTAB	-1.366075	0.5776		-0.932625	0.9315	0
At 1st Difference						
Variable Name	Intercept			Intercept and time trend		
	ADF test stat	p-value	lags	ADF test stat	p-value	lags
ΔEXPY	-3.628416	0.0121	0	-3.389605	0.0747	0
ΔOFEX	-2.279912	0.1857	0	-3.170311	0.1129	0
ΔWGDPC	-6.275912	0.0000	0	-6.275912	0.0000	0
ΔKOFECGI	-4.241221	0.0031	0	-4.233841	0.0141	0
ΔGFCFCON15US	-3.445207	0.0184	0	-3.388137	0.0749	0
Δ FDINETIN	-3.393275	0.0206	0	-3.325939	0.0842	0
ΔTOT	-2.858551	0.0641	0	-3.724949	0.0385	0
ΔPOLSTAB	-2.621107	0.1062	0	-3.326875	0.0920	0

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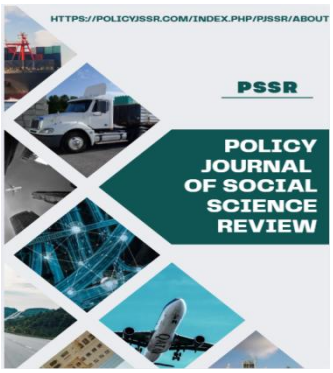
Volume. 4, issue No. 6 (2026)



Policy Journal of Social Science Review

ISSN Online:3006-4635

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We employ the ADF test for unit root to ensure stationarity, and the Schwarz information criterion for maximum lag selection.These findings indicate that while no variables are stationary at the level, they are all stationary on the first difference.The lack of a unit root indicates that the series is stationary, as shown by its stationarity.

Table 3:

Co-integration Wald -Test

F-Statistic (Wald-Test) =17.33577		
Level of Significance	**The Critical Value Bounds***	
	Lower Bound	**Upper Bound**
5%	2.17	3.21
10%	1.29	2.89

The results of a Wald-based F-statistic-based cointegration analysis are presented in this work. When testing whether or not the variables are cointegrated, the Wald-based F-statistic is used. At the 5% level of significance, the Wald statistic is determined to be 17.33577, which is higher than the upper bound test result of 3.21. This finding lends credence to the idea of cointegration.

Table 4:

Long Run Relationships for the Selected ARDL (1, 1, 1, 1, 1, 1, 1, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TOT	-4.733431	3.410564	-1.387874	0.1869
OFEX	-14.47779	5.582149	-2.593588	0.0212
WGDP	0.026057	0.288470	0.090329	0.9293
KOFSOGI	75.52200	63.85322	1.182744	0.2566
GFCFCON15US	1.38E-08	2.61E-08	0.528971	0.6051
FDINETIN	-179.9627	191.9010	-0.937789	0.3643
POLSTABL	206.6383	203.6208	1.014819	0.3274
C	12545.94	3695.888	3.394568	0.0044

Foreign direct investment (FDI), official exchange rate (OFEX), and terms of trade all have negative effects on Pakistan's export sophistication.There is a positive correlation between Pakistan's export sophistication and social globalisation, political stability, GDP, and GDP per capita of world.

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Volume. 4, issue No. 6 (2026)

Policy Journal of Social Science Review

ISSN Online:3006-4635

ISSN Print: 3006-4627

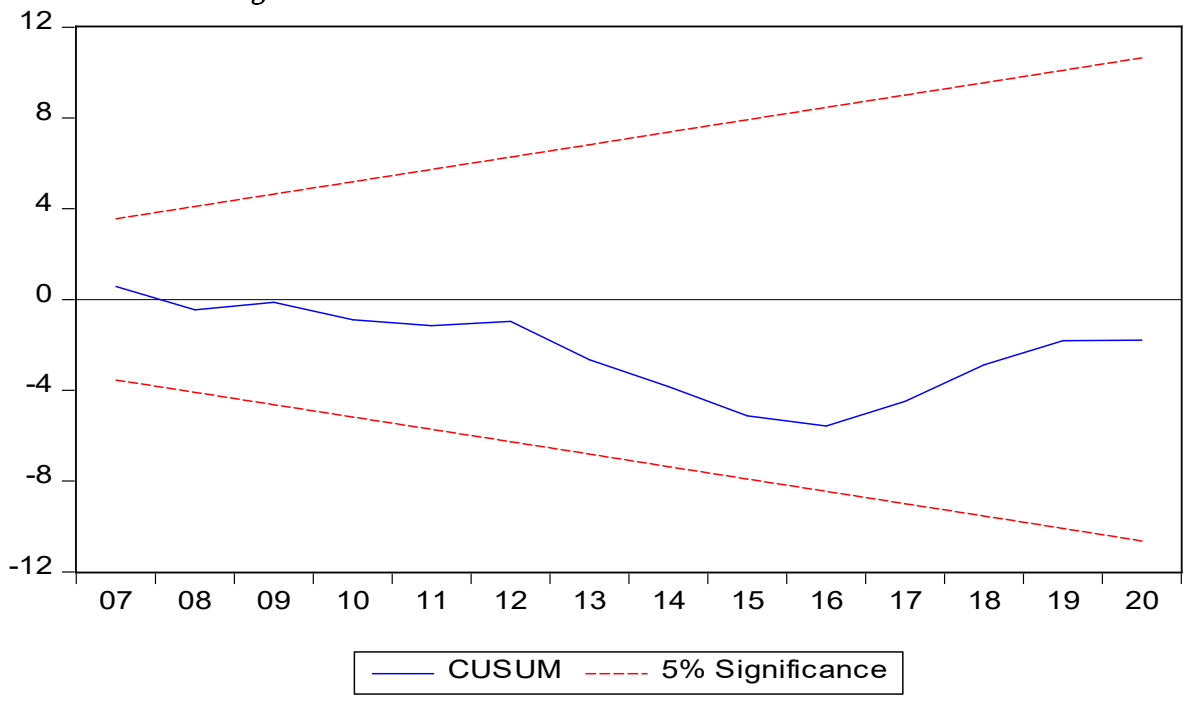
Table 5:

Diagnostic Tests

Normality Test (Jarque-Bera Statistics)	Jarque-Bera Statistics = 1.684195	Probability =0.4308096
Serial Correlation (Breusch- Godfrey Serial Correlation LM Test)	F-Statistics 0.000664	Probability = 0.9798
Heteroskedasticity Test (Based on the regression of squared residuals on squared fitted values)	F-Statistic 0.988982	Probability = 0.4772
Model Specification Test (Ramsey RESET Test)	F-Statistics = 3.045889	Probability = 0.1045

The assumptions of normality, serial correlation, heteroskedasticity, and model specification are checked using diagnostic tests.

Figure 1: Plot of Cumulative Sum of Recursive Residuals



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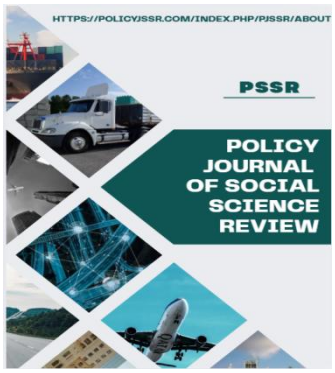

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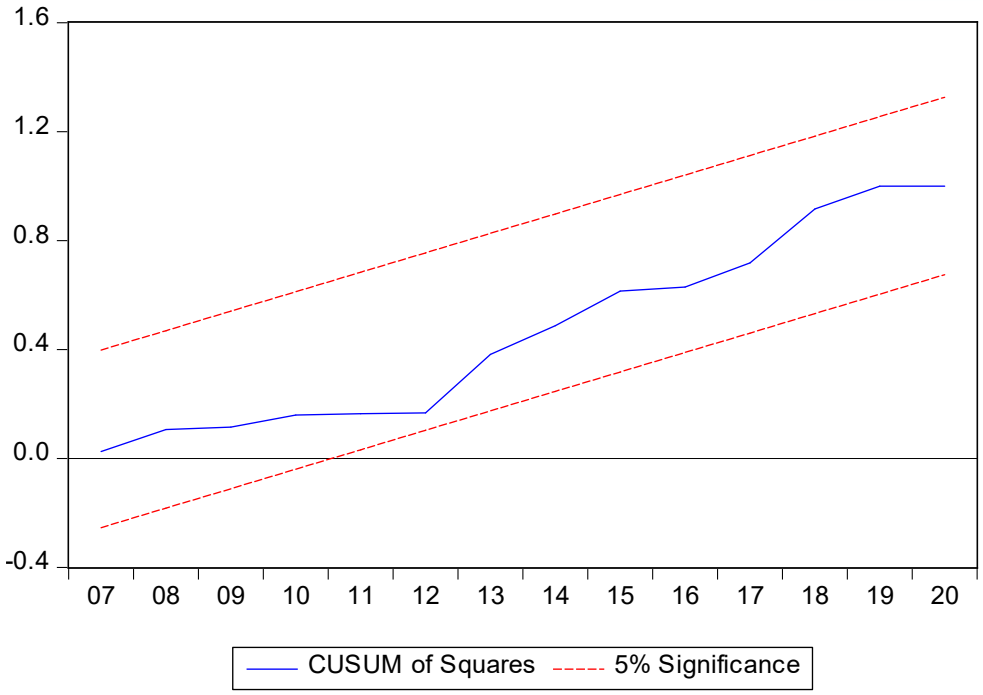

The plot of CUSUM is within the boundaries at 5 percent level of significance, hence these statistics confirms that model is correctly specified.

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Volume. 4, issue No. 6 (2026)

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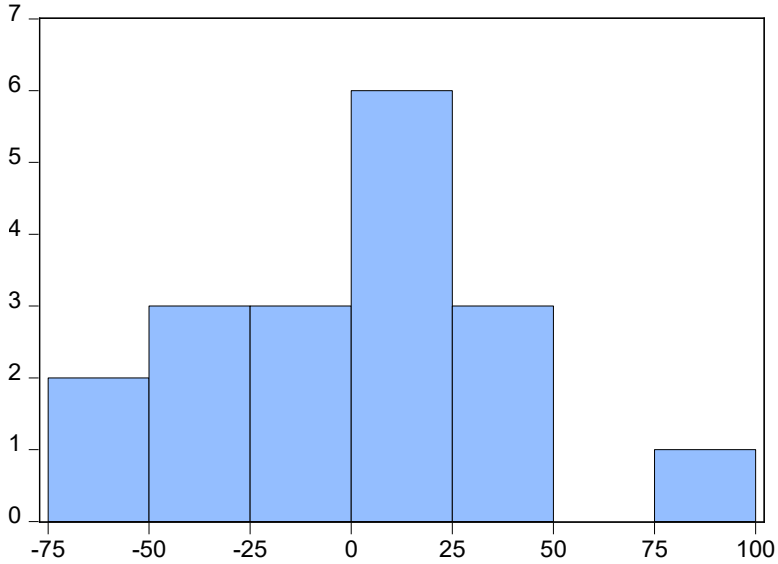

Series: Residuals	
Sample 2003 2020	
Observations 18	
Mean	-2.48e-12
Median	5.599874
Maximum	81.00790
Minimum	-68.58877
Std. Dev.	37.91307
Skewness	0.074672
Kurtosis	2.643674
Jarque-Bera	0.111954
Probability	0.945561

Table 6:

Short Run Estimates for the Selected ARDL (1, 1, 1, 1, 1, 1, 1, 1, 1)

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(TOT)	39.92337	2.888992	13.81914	0.0052
D(OFEX)	10.88499	2.235649	4.868830	0.0397
D(WGDP)	-0.292426	0.095884	-3.049788	0.0928
D(KOFSOGI)	7.011341	9.212587	0.761061	0.5261
D(GFCFCON15US)	-1.81E-09	4.65E-09	-0.390105	0.7341
D(FDINETBOP)	-3.22E-08	1.85E-08	-1.744335	0.2232
D(POLSTABL)	-708.6280	86.89866	-8.154648	0.0147
CointEq(-1)*	-0.518160	0.027411	-18.90361	0.0028

If a shock happens in the short run, the variable will converge towards long run equilibrium, according to the statistically significant negative -0.518160 value of the ECM lag. The convergence rate is 51% each annum.

4. Results and Conclusion

In the long run, empirical evidence suggests a relationship between export

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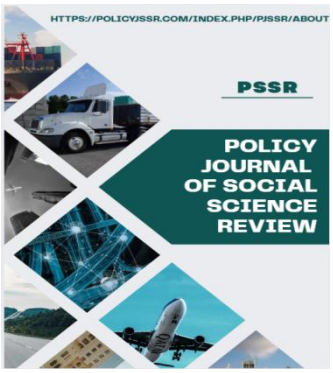
Volume. 4, issue No. 6 (2026)



Policy Journal of Social Science Review

ISSN Online:3006-4635

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sophistication, official exchange rate, social globalization, FDI, world GDP per capita, term of trade, political stability, and GDP per capita. A statistically significant lag of the error correction component with a right-hand negative sign is shown by the estimations of the error correction model. The variables will converge towards their long run equilibrium if any shock happens in the short run, according to the coefficient of the lag of the error correction term.

Regarding Pakistan, the impact of terms of trade on export sophistication is negative and insignificant. A drop in the technological quality and complexity of Pakistan's exported commodities occurs when the terms of trade worsen, which happens when export prices fall relative to import prices. This has a negative effect on export sophistication. A dependence on resource-intensive or low-tech industries that are vulnerable to changes in global prices is one possible explanation. To rephrase, changes in trade conditions do not reliably predict or explain changes in the complexity of exports within Pakistan's framework.

As an example, Pakistan's export sophistication is negatively and significantly impacted by the official exchange rate. When Pakistan's official currency rate falls, it has a negative effect on export sophistication, which drags it down. In layman's terms, the technical worth and sophistication of the country's exported goods could fall if the official exchange rate drops. Some possible explanations include the fact that some companies are less competitive than others or that the cost of importing technology or components for better products has increased.

For Pakistan, the impact of global GDP per capita on export sophistication is both positive and insignificant. The level of export sophistication in Pakistan is directly proportional to the growth in global GDP per capita. To put it plainly, the technical or sophisticated character of Pakistan's exported goods seems to be directly proportional to the world's wealth (as assessed by GDP per capita). The increased availability of technology and resources, along with the growing demand for more sophisticated products in wealthy economies, could be the causes of this phenomenon.

An "insignificant effect" occurs when, from a statistical standpoint, we cannot draw reliable conclusions from the observed correlation between global GDP per capita and export sophistication. Export sophistication in Pakistan seems to be relatively unaffected by changes in global GDP per capita, according to the data that is currently available.

In the instance of Pakistan, the impact of social globalisation on export sophistication is both positive and

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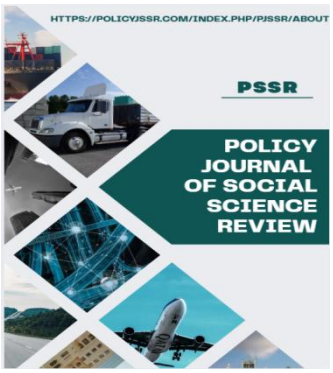

Policy Journal of Social Science Review

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ISSN Print: 3006-4627

insignificant. Given the positive association, it can be inferred that Pakistan's export sophistication is increasing in tandem with the intensity of social globalisation. When people from different countries work together and share knowledge and cultural practices, this phenomenon is called social globalisation. According to this model, if social aspects are more heavily included on a worldwide scale, it will lead to Pakistan's exported products being more complex and technologically advanced. The expansion of international trade, the sharing of technical know-how, or joint ventures with international partners might all be to blame for this occurrence.

The impact of FDI on export sophistication in Pakistan is negative and negligible. There seems to be a negative correlation between the amount of FDI flowing into Pakistan and the technical sophistication of the products that the country exports. Several factors contribute to this trend, such as the industries that are attracting FDI and the challenges that local businesses may have when trying to integrate FDI with their operations to boost their degree of sophistication.

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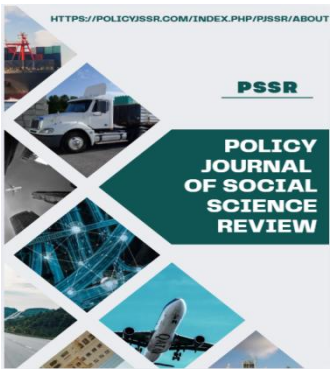

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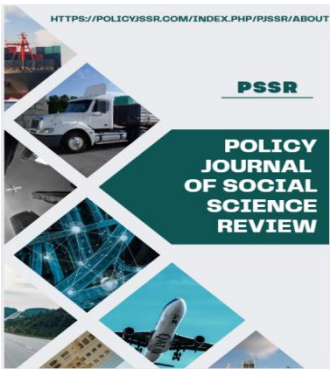

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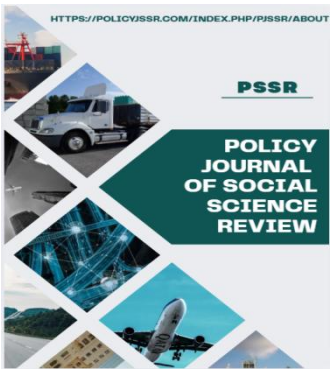

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