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PHARMACEUTICAL EXPORT AND ECONOMIC GROWTH: AN EMPIRICAL ANALYSIS OF INDIA

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ABSTRACT

This study examines the dynamic relationship between Gross Domestic Product (GDP) and pharmaceutical exports in India, utilizing time-series data from 1995-2022. The analysis employs econometric techniques to explore both short-term and long-term relationships between the variables. For stationarity, Phillips-Perron (PP) test is employed, which confirms that both GDP and pharmaceutical exports are integrated of order one, I (1). The Johansen Cointegration Test indicates no long-run equilibrium relationship between the variables. Consequently, a Vector Autoregression (VAR) model is applied to analyze short-term dynamics, with the optimal lag length determined using the Akaike Information Criterion (AIC). The Granger Causality Test reveals no causal relationships between GDP and pharmaceutical exports in either direction, suggesting that changes in one variable do not significantly influence the other in the short term. These findings highlight the need for further exploration of factors driving the pharmaceutical sector's contribution to economic growth, including research and development, foreign direct investment, and government policies. The study provides insights for policymakers and stakeholders to better harness the potential of the pharmaceutical industry in fostering sustainable economic development.

INTRODUCTION

India's pharmaceutical industry is a global powerhouse, earning the moniker "Pharmacy of the world" by manufacturing and exporting affordable, high-quality generic medicines and vaccines. This sector is a key driver of India's economic development, providing essential pharmaceuticals to both developed and developing nations through its robust manufacturing capabilities and competitive pricing strategies (KPMG, 2021). India's pharmaceutical sector substantially contributes to the nation's economic landscape by driving GDP through multiple channels: manufacturing output, job creation, technological innovation via R&D investments, and significant export revenue generation (McKinsey, 2020). The 2005 TRIPS agreement transformed India's pharmaceutical industry by balancing innovation incentives with increased market competition, fundamentally altering the sector's strategic and operational dynamics (Chaudhuri, 2012). These changes have amplified the sector's contribution to the Indian economy, positioning it as a key driver of GDP growth.

India's pharmaceutical exports play a crucial role in strengthening the country's economic foundation by increasing foreign exchange reserves and contributing to overall economic stability (RBI, 2022). The pharmaceutical sector drives broader economic growth through strategic investments and health system development. R&D and infrastructure investments stimulate industrial expansion, creating interconnected economic opportunities (UNCTAD, 2020). Additionally, the sector's contributions to public health enhance human capital, indirectly boosting economic productivity by improving workforce capabilities and potential (World Bank, 2021). This study seeks to explore and analyze the intricate linkages between the growth of the pharmaceutical industry and its contribution to India's GDP. By examining trends in key variables such as pharmaceutical exports, Gross Domestic Production (GDP). The findings of this study are expected to offer valuable insights into the dynamic interplay between the pharmaceutical sector and economic growth, providing evidence-based recommendations for policymakers to leverage this industry's potential for sustainable development.

REVIEW OF LITERATURE

Jayaswal and Rath (2020), The study analyzed pharmaceutical exports' contribution to India's economic growth, focusing on low-cost generic drug production. It concluded that these exports positively impact GDP by generating foreign exchange and improving the trade balance, while emphasizing the critical role of government policies in expanding the export base.

Kumar and Singh (2019), analyzed the export performance of India's pharmaceutical industry and its linkage with GDP growth. Using export and GDP data from 2000 to 2018, their findings indicated a strong correlation between increased exports and the overall economic growth of the country. They also noted the need for innovation-driven strategies to sustain this contribution.

Chakraborty (2018), The research explored FDI's impact on the pharmaceutical industry, revealing that foreign investments enhance manufacturing capabilities and drive innovation in drug development. These investments contribute to economic growth through increased exports and improved public health outcomes**.**

Chaudhuri (2012), The study revealed that R&D investments significantly drive India's pharmaceutical sector's growth, with long-term positive impacts on GDP by enhancing global market

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competitiveness. The TRIPS agreement emerged as a key catalyst, encouraging patent filings and innovation that further propel economic development. Building on these insights, continued strategic investments in research, technology, and intellectual property protection will be crucial for sustaining the sector's momentum and global relevance.

Gupta and Pandey (2021), The research demonstrated that strategic R&D investments in India's pharmaceutical sector drive innovation, creating high-value products that boost both exports and domestic sales, thereby directly contributing to GDP growth.

Singh and Sharma (2016), The study revealed that post-TRIPS implementation, India's pharmaceutical industry saw increased patent filings, stimulating innovation and export-driven GDP growth. However, the researchers warned that sustaining this growth requires continued substantial R&D investments to maintain competitive edge amid heightened market competition.

World Bank (2021), The research underscored the pharmaceutical industry's pivotal role in economic development by demonstrating how affordable medicines enhance workforce productivity, thereby contributing to long-term economic growth through improved public health outcomes.

Mukherjee and Das (2017), explored the interplay between pharmaceutical production, public health, and economic growth. Their findings revealed that improved health outcomes, driven by the availability of affordable medicines, have positively impacted GDP by reducing healthcare costs and improving labor productivity**.**

KPMG (2021), The study revealed that government policies like the Production-Linked Incentive (PLI) scheme have strategically boosted the pharmaceutical industry's growth by enhancing domestic production, export competitiveness, and job creation, thereby substantially contributing to India's GDP.

Based on the above review of literature, this study aims to evaluate the relationship between Gross Domestic Product (GDP) and pharmaceutical exports in India. The literature highlights the pivotal role of pharmaceutical exports in driving economic growth through foreign exchange earnings, enhanced trade balances, and industrial expansion. Furthermore, the interplay of critical factors such as research and development (R&D) investments, Foreign Direct Investment (FDI) inflows, and government policy interventions underscores the multifaceted contribution of the pharmaceutical sector to the Indian economy. This study seeks to empirically analyze the extent to which pharmaceutical exports influence GDP growth. By investigating this relationship, the research endeavors to provide a comprehensive understanding of the pharmaceutical sector's role in economic development and offer evidence-based recommendations for policymakers to harness its potential for fostering sustainable economic growth.

DATABASE AND METHODOLOGY

This study adopts a quantitative research approach to examine the relationship between Gross Domestic Product (GDP) and pharmaceutical exports in India, using secondary time-series data for the period from 1995-2022. GDP data is sourced from Reserve Bank of India (RBI), and pharmaceutical export data is obtained from Directorate General of Commercial Intelligence and Statistics (DGCIS). For stationarity, Phillips-Perron (PP) test is conducted to check for unit roots, revealing that both variables are integrated of order one, I(1). The Johansen Cointegration Test is employed to investigate long-run equilibrium relationships between the variables, and in the absence of cointegration, a Vector Autoregression (VAR) model is used to analyze short-term dynamics. The optimal lag length for the VAR model is determined using the Akaike Information Criterion (AIC). To further explore causality, the Granger Causality Test is applied to determine whether one variable predicts the other. All analyses are carried out using EViews software to provide robust insights into the dynamic relationship between GDP and pharmaceutical exports, highlighting their economic interlinkages and potential policy implications.

DATA ANALYSIS AND INTERPRETATION

In time-series analysis, stationarity is crucial, requiring consistent statistical properties—including mean, variance, and autocorrelation—across the entire dataset, which ensures reliable statistical method application and accurate data interpretation (Gujarati, D. N., & Porter, D. C., 2009). To verify data stationarity, the study employed the Phillips-Perron test to assess the statistical properties of the time series as the PP test corrects for serial correlation and heteroscedasticity in the error term, making it more robust in situations where these issues are present (Phillips P.C.B and Perron P. ,1988).

Table 1: Philips-Perron Test Statistics

Variable	Level (P Value)		Fisrt Difference (P Value)		Order of Integration
	Intercept	Trend &Intercept	Intercept	Trend & Intercept	
Ln_GDP	0.5105	0.9986	0.0112**	0.0311**	I(1)
Ln_Phex	0.9999	0.9166	0.0001***	0.0000***	I(1)

Note: *(*) denotes significance at 10%; (**)* **denotes significance at 5%; (***)** denotes significance at 1%, based on MacKinnon (1996) one-sided p-values. (MacKinnon, J. G.,1996)

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The results of the Augmented Dickey-Fuller (ADF) test show that both Ln_GDP and Ln_Phex are non-stationary at the level, as their p-values for the level tests (intercept and trend & intercept) are greater than 0.05, indicating that the null hypothesis of a unit root cannot be rejected. However, when tested at the first difference, both variables become stationary, as evidenced by their p-values (0.0112 for Ln_GDP and 0.0001 for Ln_Phex), which are less than 0.05, allowing the rejection of the null hypothesis. Therefore, both Ln_GDP and Ln_Phex are integrated of order 1 (I(1)), meaning they exhibit a unit root at the level but become stationary after first differencing.

Cointegration Test

Direct regression of non-stationary variables can yield statistically significant but erroneous findings. Testing for cointegration is essential when variables are integrated at the same order (e.g., I(1)I(1)I(1)) to confirm the existence of a genuine long-term relationship and to choose the correct modeling framework. This ensures robustness in economic analysis and policy implications (Engle, R. F., & Granger, C. W. J. 1987). the application of AIC and similar criteria for selecting optimal lag length, particularly in the context of VAR models and cointegration testing (Enders W.,2014). So the lag length is determined based on the Akaike Information Criterion (AIC), which identifies the optimal lag as 1 and employed the Johansen cointegration test, and the results are as follows.

Table 2: Cointegration Test Results Statistics

Variables	Hypothesis	A Trace	Critical Value for % confidence interval (P Value)
	No. Of CE(s)	Test Statistics	
DLn_GDP & DLn_PhEx	None	12.77	20.26(0.3818)
	At Most	1.258	9.16(0.9143)

The Johansen cointegration test results for DLn_GDP and DLn_PhEx indicate no evidence of a long-term equilibrium relationship between the variables. At the "None" hypothesis level, the trace statistic of 12.77 is lower than the critical value of 20.26 at the 5% significance level, with a p-value of 0.3818, showing that the null hypothesis of no cointegration cannot be rejected. Similarly, at the "At Most" hypothesis level, the trace statistic of 1.258 is lower than the critical value of 9.16, with a p-value of 0.9143, further confirming the absence of additional cointegrating relationships. These results suggest that the variables do not move together in the long run, and the analysis should proceed with a Vector Autoregressive (VAR) model to examine short-term dynamics.

Vector Autoregressive Model (VAR)

When cointegration is absent, the variables lack a long-term equilibrium relationship. A VAR model is designed to analyze the short-term interdependencies between variables, making it appropriate in such scenarios. By treating all variables as endogenous and imposing no restrictions, the VAR model effectively examines dynamic relationships without relying on the presence of cointegration. (Sims, C. A.,1980).

Table 3: VAR Results Statistics

Variables	**DLn_GDP (t-Statistics)**	**DLn_Ph_Ex (t-Statistics)**
DLn_GDP(-1)	-0.525352	-0.275170
DLn_Ph_Ex(-1)	-0.004505	-0.177122
Constant	-0.021740	0.142894

The VAR model results examine the short-term dynamics between the first differences of GDP (DLn_GDP) and pharmaceutical exports (DLn_Ph_Ex). In the DLn_GDP equation, the first lag of GDP has a negative but statistically insignificant coefficient (-0.5254), indicating no meaningful short-term effect on its own current value. Similarly, the first lag of pharmaceutical exports (-0.0045) is also statistically insignificant, suggesting no notable short-term influence on GDP. In the DLn_Ph_Ex equation, the first lag of pharmaceutical exports has a negative coefficient (-0.1771), but it is not statistically significant, indicating no substantial self-dependence. Additionally, the first lag of GDP (-0.2752) does not significantly affect pharmaceutical exports. The constant term in both equations is also statistically insignificant, with coefficients of -0.0217 for GDP and 0.1429 for pharmaceutical exports. Overall, the results suggest no significant short-term relationships between GDP and pharmaceutical exports, emphasizing the need for further analysis, such as Granger causality or impulse response functions, to better understand the dynamic interactions.

Granger Causality Test

Since no significant short-term relationships were found between the variables in the VAR model, performing a Granger Causality Test will help assess whether one variable can predict the other (Granger, C. W. J. 1969).

Table 4: Granger Causality Test Statistics

Hypothesis	**F-Statistic**	**p-value**
Ln_GDP does not Granger cause Ln_PhEx	**0.125568**	**0.9391**
Ln_PhEx does not Granger cause Ln_GDP	**0.554509**	**0.7579**

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The results of the Granger Causality Test indicate no significant causality between Ln_GDP and Ln_PhEx in either direction. For the hypothesis that Ln_GDP does not Granger cause Ln_PhEx, the p-value is 0.9391, which is significantly greater than the 0.05 significance level, leading to the failure to reject the null hypothesis. Similarly, for the hypothesis that Ln_PhEx does not Granger cause Ln_GDP, the p-value is 0.7579, also exceeding the significance threshold, resulting in the failure to reject the null hypothesis. These results suggest that changes in GDP do not provide predictive value for pharmaceutical exports, and vice versa, indicating no short-term causal relationship between the two variables.

CONCLUSION

The study explored the relationship between India's GDP and pharmaceutical exports using econometric methods, revealing no significant long-term or short-term correlations despite the sector's economic importance. Employing unit root tests, cointegration analyses, VAR modeling, and Granger Causality Tests, researchers found no substantial interdependencies between the variables. While highlighting the pharmaceutical industry's crucial role in foreign exchange earnings, the research underscores the need for further investigation into potential long-term dynamics, government policies, foreign direct investment, R&D investments, and external factors influencing the sector's economic contribution.

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