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GDP, FDI, and Manufacturing Dynamics in India: A VECM Approach (1970-2024)

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ABSTRACT

India's rapid economic transformation over the past five decades has generated considerable scholarly interest in the drivers of its growth trajectory, yet the dynamic interrelationships among key macroeconomic variables remain insufficiently understood. This study investigates the long-run equilibrium and causal relationships among GDP per capita, foreign direct investment (FDI), exports, and manufacturing value added in India over the period 1970–2024. Employing the Vector Error Correction Model (VECM) on secondary time-series data sourced from the World Bank Indicators, the study first confirms variable stationarity through unit root testing and selects an optimal lag length of five periods. Granger causality tests reveal that exports do not exert significant causal influence on the remaining variables and are therefore excluded from the final model. Therefore, The final Granger causality results demonstrate bidirectional causality between GDP per capita and FDI, alongside unidirectional causality running from manufacturing value added to both GDP per capita and FDI. The Johansen cointegration test identifies cointegrating equations among GDP per capita, FDI, and manufacturing value added, confirming the presence of a long-run equilibrium relationship. The long-run cointegrating equation reveals that manufacturing value added exerts a negative and statistically significant effect on GDP per capita, while FDI is not statistically significant. The error correction term is significant only in the manufacturing equation, indicating that adjustment toward long-run equilibrium occurs through the manufacturing sector at a slow speed. Short-run dynamics are limited, with variables primarily influenced by their own lagged values. These findings challenge the strong version of FDI-led growth hypothesis in the Indian context and underscore the central role of manufacturing performance in the long-run adjustment process.

1. Introduction

India has emerged as one of the fastest-growing major economies in the world, sustaining an average annual GDP growth rate of approximately 9,19% in 2023, surpassing both the global average and the growth rates of several comparable middle-income nations (World Bank, 2025). This remarkable trajectory has attracted sustained academic and policy attention, particularly regarding the structural drivers underlying India's long-run economic performance. Among the most debated relationships in the development economics literature is the dynamic interplay between foreign direct investment (FDI), manufacturing output, export activity, and GDP growth — four variables whose interactions are theoretically linked yet empirically contested across different national contexts.

The liberalisation of India's economy in 1991 marked a turning point in its integration with global capital markets, opening the country to substantially higher volumes of FDI inflows. Subsequent policy initiatives, most notably the "Make in India" programme launched in 2014, further reinforced the government's commitment to expanding domestic manufacturing capacity as a vehicle for sustainable growth (Rao & Ravikanth, 2015). The rationale underlying this strategy rests on a well-established theoretical premise: that FDI inflows stimulate productivity in the manufacturing sector, which in turn diversifies the export base from primary commodities toward technology-intensive products, ultimately contributing to higher GDP per capita over the long run (Samen, 2010). However, while this

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causal chain appears theoretically coherent, empirical evidence on the precise nature and direction of these relationships in the Indian context remains mixed and, in several respects, inconclusive.

A growing body of literature has examined bilateral relationships between pairs of these variables. Agrawal & Khan (2011) documented a significant positive association between FDI inflows and GDP growth in India based on data from 1993 to 2009, while Chakraborty and Nunnenkamp (2008) found sector-specific heterogeneity in the FDI–growth nexus, suggesting that the manufacturing sector benefits more directly from foreign capital than the services sector. On the trade–growth dimension, Boominathan and Arunachalam (2019) identified short-run unidirectional causality running from exports to GDP in India, a finding broadly consistent with export-led growth theory. More recently, Mahajan et al. (2022) demonstrated that both FDI and imported intermediate goods exert a significant positive effect on India's high-technology export performance, reinforcing the view that foreign capital and manufacturing sophistication are closely intertwined.

Despite this body of evidence, three important limitations persist in the existing literature. First, the majority of prior studies examine these variables in isolation or in pairs, thereby neglecting the multivariate dynamics that arise when all four indicators — GDP per capita, FDI, exports, and manufacturing value added — are considered simultaneously within a unified analytical framework. Second, relatively few studies employ long-horizon time-series data spanning the full post-independence and post-liberalisation periods, which limits the ability to capture structural shifts in India's economy across different policy regimes. Third, the application of Vector Error Correction Model (VECM) methodology — which is specifically suited to modelling systems of cointegrated variables and disentangling short-run dynamics from long-run equilibrium relationships — remains underutilised in multi-variable analyses of India's macroeconomic performance.

These gaps are consequential not only for academic understanding but also for policy design. If FDI and GDP are bound by a long-run bidirectional relationship, as some studies suggest, then policies aimed at attracting foreign investment may simultaneously function as instruments of GDP stabilisation — a finding with direct implications for India's ongoing reform agenda as well as for comparable emerging economies in Asia and beyond.

This study addresses the identified gaps by conducting a comprehensive multivariate time-series analysis of GDP per capita, FDI inflows, export growth, and manufacturing value added in India over the period 1970–2024, representing more than five decades of economic data encompassing multiple policy regimes. Specifically, this study pursues three research objectives: (1) to examine the long-run cointegrating relationships among these four macroeconomic variables using the Johansen cointegration test; (2) to identify the direction and significance of Granger causal relationships among the variables following the application of VECM; and (3) to quantify the relative contribution of each variable to forecast error variance through variance decomposition analysis.

The novelty of this study lies in its integration of a long-horizon dataset with a multivariate VECM framework, enabling a simultaneous assessment of both long-run equilibrium and short-run adjustment dynamics across four theoretically interrelated variables. To the best of the authors' knowledge, no prior study has applied this precise combination of scope, methodology, and variable selection to the Indian macroeconomic context over this time horizon. The findings are expected to contribute to the theoretical understanding of FDI-led growth mechanisms in emerging economies and to provide empirically grounded guidance for investment and industrial policy in India.

The remainder of this paper is structured as follows. Section 2 reviews the relevant theoretical and empirical literature and develops the conceptual framework. Section 3 describes the data and econometric methodology. Section 4 presents and discusses the empirical results. Section 5 concludes with a summary of findings, policy implications, and directions for future research.

2. Literature Review

2.1. Conceptual and Theoretical Foundations

The theoretical underpinning of this study draws on three interrelated strands of development economics: FDI-led growth theory, export-led growth theory, and structural transformation theory.

FDI-led growth theory posits that inflows of foreign capital augment domestic investment,

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transfer technology and managerial knowledge, and generate positive spillover effects on host-country productivity (Chakraborty & Nunnenkamp, 2008). Within this framework, FDI is conceptualised not merely as a source of capital financing but as a catalyst for structural change, particularly in economies where domestic capital accumulation is insufficient to sustain high rates of productivity growth. In the context of developing economies such as India, this mechanism is especially significant given the persistent gaps in technological capability and infrastructure investment that characterise the early stages of industrialisation.

Export-led growth theory, meanwhile, argues that expansion of the export sector generates economies of scale, stimulates technological learning through exposure to international competition, and allocates resources toward sectors of comparative advantage, thereby accelerating aggregate economic growth (Bashir et al., 2015). This theoretical proposition has been extensively tested across both developed and developing country contexts, with mixed results that partly reflect differences in export composition, trade openness, and institutional quality across national settings.

Structural transformation theory, as articulated in the manufacturing-led growth literature, further contends that the transition from primary commodity exports to technology-intensive manufactured goods is a defining feature of sustained economic development (Samen, 2010). This perspective is particularly relevant to India's policy context, where the Make in India initiative explicitly targets the expansion of domestic manufacturing as a mechanism for absorbing surplus labour, increasing value added, and diversifying the export base. Yoganandham and Kuppan (2023) reinforces this view, arguing that manufacturing sector growth serves as a foundation for broader economic renaissance when supported by appropriate fiscal decentralisation and public investment frameworks.

Taken together, these three theoretical traditions suggest a system of mutually reinforcing relationships among GDP per capita, FDI, manufacturing value added, and exports — a system whose dynamic properties are best examined through multivariate time-series methods capable of capturing both short-run fluctuations and long-run equilibrium adjustments.

2.2. Review of Empirical Studies

The empirical literature on the FDI–growth nexus in India is extensive but yields heterogeneous findings. Agrawal & Khan, (2011) established a statistically significant positive association between FDI inflows and GDP growth in India over the period 1993–2009, estimating that a one percent increase in FDI is associated with a 0.02% increase in GDP. Chakraborty and Nunnenkamp (2008) extended this analysis by disaggregating FDI across sectors, finding that the manufacturing sector exhibits a more robust and sustained positive response to foreign capital inflows than the services sector, where output effects tend to dissipate over shorter horizons. More recent evidence from Bangladesh by Begum et al. (2023) similarly confirms the positive long-run impact of FDI on GDP and industrial value added, suggesting that this relationship generalises beyond the Indian context to other South Asian emerging economies.

The relationship between export performance and GDP growth has been examined extensively in the Indian context. Boominathan and Arunachalam (2019) identified a short-run unidirectional causal relationship running from exports to GDP using a VECM framework, while finding no significant causal effect in the reverse direction. Kumari and Malhotra (2014) similarly employed cointegration techniques and reported no stable long-run equilibrium between exports and GDP per capita in India, though Granger causality tests revealed bidirectional short-run dynamics between the two variables. Jayachandran (2013) offered a reconciliation of these competing findings, demonstrating that India's real exports are positively and significantly influenced by GDP in the long run, while the short-run relationship is statistically insignificant. The inconsistency across these findings underscores the sensitivity of export–growth relationships to methodological choices, time horizons, and variable definitions.

The intersection of FDI, manufacturing capacity, and export performance represents a more sparsely examined area of the literature, yet carries significant policy relevance. Mahajan et al., 2022) demonstrated that both inward FDI and imported intermediate goods exert a considerable positive effect on India's high-technology export performance, suggesting that foreign capital enhances not only the volume but also the

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sophistication of India's export basket. Romero (2015) found complementary evidence from Mexico, where FDI inflows were shown to stimulate manufacturing output and subsequently export diversification, providing a comparative reference point for the Indian case. Omoke & Opuala–Charles (2021) further established that trade openness, exports, and imports collectively exert a substantial influence on economic output in developing economies, reinforcing the view that the manufacturing–export–growth nexus cannot be meaningfully examined in isolation from the broader trade environment.

2.3. Identification of the Research Gap

A critical review of the extant literature reveals three substantive gaps that this study seeks to address. First, the overwhelming majority of prior studies examine bilateral relationships — FDI and GDP, exports and GDP, or manufacturing and FDI — rather than the full system of interdependencies among all four variables simultaneously. This pairwise approach, while methodologically tractable, risks attributing causal effects to one variable that are in fact mediated or moderated by a third or fourth variable omitted from the model. Second, few studies employ a sufficiently long time horizon to capture the structural breaks and regime shifts — including India's 1991 liberalisation and the 2014 Make in India initiative — that are likely to have altered the nature of macroeconomic relationships over time. Third, the application of VECM to a four-variable system encompassing GDP per capita, FDI, exports, and manufacturing value added in India over a five-decade horizon has not been previously documented in the literature. This methodological gap is consequential because VECM uniquely enables the simultaneous estimation of long-run cointegrating relationships and short-run error correction dynamics, providing a more complete picture of macroeconomic interdependence than single-equation or VAR approaches.

2.4. Development of the Conceptual Framework

This study draws on three interrelated theoretical perspectives: foreign direct investment (FDI)-led growth theory, export-led growth theory, and structural transformation theory. Together, these perspectives explain the potential relationships among economic growth, foreign investment, manufacturing performance, and exports in developing economies.

FDI-led growth theory suggests that foreign investment contributes to economic growth through capital accumulation, technology transfer, managerial knowledge, and productivity spillovers in host countries (Chakraborty & Nunnenkamp, 2008). In the Indian context, FDI may influence GDP per capita directly while interacting with manufacturing performance. Empirical evidence supports a positive relationship between FDI and economic growth in India (Agrawal & Khan., 2011), although the magnitude of this relationship may differ across economic sectors (Chakraborty & Nunnenkamp, 2008). Similarly, Begum et al. (2023) identified positive long-run effects of FDI on GDP and industrial value added in Bangladesh, providing comparative evidence from another South Asian economy.

Export-led growth theory proposes that export expansion can stimulate economic growth through economies of scale, technological learning, international competition, and improved resource allocation (Bashir et al., 2015). However, empirical findings for India remain inconclusive. Boominathan and Arunachalam (2019) identified short-run unidirectional causality from exports to GDP, whereas Kumari and Malhotra (2014) found no stable long-run equilibrium between exports and GDP per capita despite evidence of bidirectional short-run dynamics. Jayachandran (2013) reported that India's real exports are positively associated with GDP in the long run, while the short-run relationship is statistically insignificant. These differences indicate that the export–growth relationship may depend on the analytical approach and period examined.

Structural transformation theory emphasizes the importance of manufacturing development and the transition toward higher-value-added and technology-intensive production in achieving sustained economic growth (Samen, 2010). This perspective is relevant to India's industrial development strategy, particularly the Make in India initiative, which aims to strengthen domestic manufacturing capacity. Rao and Ravikanth (2015) discussed the potential synergy between the Make in India initiative and FDI, while Yoganandham and Kuppan (2023) highlighted the contribution of manufacturing sector growth to broader economic

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development. Furthermore, Mahajan et al. (2022) found that inward FDI and imported intermediate goods contribute positively to India's high-technology export performance. Evidence from Mexico also indicates that FDI can stimulate manufacturing output and export diversification (Begum et al., 2023; Romero, 2015). In addition, Omoke and Opuala-Charles (2021) demonstrated the relevance of trade openness, exports, and imports to economic growth, highlighting the importance of considering the broader trade environment.

Taken together, these theoretical arguments suggest that GDP per capita, FDI, manufacturing value added, and exports may be dynamically interrelated. Nevertheless, the direction and strength of these relationships cannot be assumed to be uniform across time or economic contexts. Accordingly, this study examines their long-run equilibrium relationships and short-run causal dynamics in India using a Vector Error Correction Model (VECM). The study initially incorporates all four variables but allows the empirical findings to determine the final model specification.

The conceptual framework therefore positions GDP per capita, FDI, manufacturing value added, and exports as interconnected macroeconomic variables whose relationships are examined through cointegration and Granger causality analysis. Unlike a framework based on predetermined directional hypotheses, this approach allows the long-run relationships and directions of causality to be identified empirically over the 1970–2024 period.

2.5. Hypotheses or Research Propositions

This study does not explicitly formulate directional hypotheses. Instead, it empirically investigates the dynamic relationships among GDP per capita, foreign direct investment (FDI), manufacturing value added, and exports in India over the 1970–2024 period. Specifically, the analysis examines whether the variables share long-run equilibrium relationships and identifies the direction of Granger causality among them. The Johansen cointegration test and VECM are employed to distinguish long-run equilibrium relationships from short-run adjustments. Although the conceptual framework initially incorporates all four variables, the final model specification is determined by the empirical results, including the statistical significance of the estimated causal relationships.

3. Research Methods

3.1. Research Design

This study adopts a quantitative research design using a time-series econometric approach to analyze the dynamic relationships among GDP per capita, foreign direct investment (FDI), and manufacturing performance in India. The quantitative design is appropriate as the study aims to examine causal linkages and long-run equilibrium relationships among macroeconomic variables using numerical data over time.

The study employs the Vector Error Correction Model (VECM) as the primary analytical framework. This approach is particularly suitable when variables are non-stationary at level but become stationary after differencing and exhibit cointegration. The VECM enables the estimation of both short-run dynamics and long-run equilibrium adjustments, allowing for a comprehensive understanding of interdependencies among the variables. The research design follows a structured econometric procedure, including unit root testing, lag length selection, Granger causality analysis, cointegration testing, and VECM estimation.

3.2. Research Context and Setting

This study focuses on the macroeconomic dynamics of India as a representative emerging economy characterized by rapid economic growth, increasing foreign investment inflows, and ongoing industrial transformation. The selection of India is justified by its strategic position in the global economy and its policy emphasis on industrial development and investment attraction by its "Make in India" initiative. The analysis covers annual time-series data over a long-term period from 1970 to 2024.

3.3. Population and Sample / Research Participants

The population of this study consists of macroeconomic indicators of India. Given the time-series nature of the data, the sample comprises annual observations of selected economic variables over the study period. The sampling technique employed is purposive sampling, where variables are selected based on their theoretical relevance and

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empirical significance in explaining economic growth dynamics. Initially, the model includes four variables: GDP per capita, foreign direct investment (FDI), manufacturing value added, and exports of goods and services. However, during the empirical testing process, the export variable is excluded from the final model due to its limited statistical significance in the causality analysis.

3.4. Data Sources and Data Collection

This study uses secondary data obtained from internationally recognized and reliable databases, such as the World Bank. The data consist of annual observations for the following variables:

Table 1. Measurement of Variables

Variables	Abbreviation	Unit
GDP per capita	GDPC	Current US$
Foreign Direct Investment	FDI	% of GDP
Manufacturing, value added	MANVA	Annual % growth

Source: Author processed

3.5. Data Analysis Techniques

First, unit root tests are performed to examine the stationarity properties of the variables. The results indicate that some variables are non-stationary at level but become stationary after first differencing, suggesting integration of order one, I(1). Second, the optimal lag length is determined using multiple information criteria provided in a Eviews software, including the Akaike Information Criterion (AIC), Schwarz Criterion (SC), and Hannan-Quinn Criterion (HQ). Third, Granger causality tests are conducted to identify the direction of causal relationships among variables. Based on this analysis, the export variable is found to have limited statistical significance and is therefore excluded from the final model specification to improve parsimony and explanatory power. Fourth, the Johansen cointegration test is applied to determine the existence of long-run equilibrium relationships among the remaining variables. The results confirm the presence of cointegration, indicating that the variables move together in the long run.

As a final step, the Vector Error Correction Model (VECM) is estimated to capture both short-run dynamics and long-run adjustments. Additional analyses, including impulse response functions and variance decomposition, are conducted to further explore the dynamic interactions and shock transmission mechanisms among the variables.

3.6 Data Analysis Techniques

The data analysis follows a sequential econometric procedure. First, unit root tests are conducted to assess the stationarity properties of the time-series variables. The analysis examines whether the variables are stationary at level or become stationary after first differencing. Variables that become stationary after first differencing are treated as integrated of order one, I(1). Second, the optimal lag length is selected using multiple information criteria available in EViews software, including the Akaike Information Criterion (AIC), Schwarz Criterion (SC), and Hannan–Quinn Criterion (HQ). The study selects five lags based on the results of the lag selection procedure, particularly the recommendations of the Likelihood Ratio (LR) test and AIC. Third, Granger causality tests are performed to identify the direction of causal relationships among the variables. The results are used to assess whether past values of one variable provide statistically significant information for predicting another variable. Exports are excluded from the final model because of their limited statistical significance in the causality analysis. Fourth, the Johansen cointegration test is applied to determine whether the remaining variables share a long-run equilibrium relationship. The presence of cointegration provides the basis for estimating a VECM to examine both short-run dynamics and adjustments toward long-run equilibrium. Fifth, the VECM is estimated to identify the short-run relationships and long-run adjustment mechanisms among GDP per capita, FDI, and manufacturing value added. The error correction term is examined to assess the adjustment of the variables toward long-run equilibrium.

Finally, impulse response functions and variance decomposition are conducted to further investigate the responses of the variables to shocks and the relative contributions of innovations in each variable to forecast error variance over time.

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3.7 Validity, Reliability, and Trustworthiness

Because this study uses secondary time-series data rather than primary survey responses, the quality of the empirical analysis is assessed through econometric procedures rather than questionnaire validity and reliability tests.

Unit root testing is used to evaluate the stationarity properties of the series, while the Johansen cointegration test assesses the existence of long-run equilibrium relationships. Lag length selection and Granger causality analysis support the specification and examination of the dynamic relationships. The VECM, impulse response functions, and variance decomposition are subsequently used to investigate short-run adjustment processes and interactions among the variables.

The original methodology does not report additional data validation procedures or robustness tests. Accordingly, no further procedures are claimed in this subsection.

3.8 Ethical Considerations

This study uses secondary macroeconomic data obtained from established data sources, including the World Bank, and does not involve direct data collection from human participants. The research therefore does not employ informed consent procedures or participant-based confidentiality measures.

The original methodology does not specify whether formal ethical approval was obtained or whether a separate research ethics review was required. Such information should be added only if confirmed by the researchers or the relevant institution.

3.9 Research Procedure

The research procedure consists of the following stages:

a. Data collection: Obtain annual macroeconomic data for India from 1970 to 2024, covering GDP per capita, FDI, manufacturing value added, and exports of goods and services.
b. Stationarity testing: Conduct unit root tests to determine the stationarity properties and integration orders of the variables.
c. Lag length selection: Evaluate the LR, AIC, SC, and HQ criteria to determine the appropriate lag structure.
d. Granger causality analysis: Examine the direction of causal relationships and assess the statistical significance of the export variable.
e. Cointegration testing: Apply the Johansen cointegration test to determine whether the variables in the final model share a long-run equilibrium relationship.
f. VECM estimation: Estimate the VECM to examine short-run dynamics and long-run equilibrium adjustments.
g. Dynamic analysis: Conduct impulse response function and variance decomposition analyses to investigate shock transmission and the contribution of each variable to forecast error variance.
h. Interpretation: Interpret the econometric results in relation to the research objectives and the macroeconomic dynamics of India.

3.10 Methodological Limitations

The methodological limitations arise from the use of aggregate national time-series data and the selected econometric framework. Aggregate indicators may not capture differences in the effects of FDI and manufacturing performance across individual industries. In addition, the analysis focuses on the variables included in the initial model and does not incorporate other potential determinants of economic growth, such as institutional quality, regulatory conditions, or labour market characteristics.

The original study also acknowledges that the VECM assumes linear adjustment toward equilibrium and does not explicitly model structural breaks. Consequently, changes associated with major economic reforms or external shocks may not be fully captured by the model. Furthermore, the exclusion of exports from the final specification limits the analysis of the export–growth relationship within the estimated VECM.

These limitations should be considered when interpreting the results and assessing their applicability to other economic contexts. Future research could examine sector-specific data, incorporate additional institutional variables, and apply methods that explicitly account for structural breaks or nonlinear adjustment processes.

4. Results and Discussion

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4.1. Research Results

4.1.1. Sample Description and Descriptive Statistics

This study examines annual macroeconomic time-series data for India covering the period 1970–2024. The variables initially considered are GDP per capita (GDPC), foreign direct investment (FDI), manufacturing value added (MANVA), and exports of goods and services. The analysis focuses on the dynamic relationships among these variables, including their stationarity properties, long-run equilibrium relationships, and short-run causal interactions.

The study uses secondary data obtained from the World Bank. Although the observation period spans 55 calendar years, the original results do not report the final number of usable observations after data processing. Descriptive statistics, including means and standard deviations, are also not presented in the reported results. Accordingly, these statistics cannot be reported without access to the underlying dataset.

4.1.2. Data Quality and Preliminary Analysis

a. Unit Root Test

The stationarity of the variables is examined using unit root tests. The results indicate that GDP per capita and foreign direct investment (FDI) are non-stationary at level, while exports of goods and services and manufacturing value added exhibit stationarity at level.

After applying first differencing, all variables become stationary, indicating that the series are integrated of order one. The results of unit root test with first difference described as follows:

Table 2. Unit Root Test Results

Variables	Augmented Dicky-Fuller	
	T-Statistics	Prob.
GDPC	-6.225	0.000
FDI	-8.565	0.000
MANVA	-6.261	0.000

Source: Author processed

b. Optimal Lag Length

The optimal lag length is determined using multiple information criteria, including the Likelihood Ratio (LR), Akaike Information Criterion (AIC), Schwarz Criterion (SC), and Hannan-Quinn Criterion (HQ). The results indicate a divergence among the criteria, where SC and HQ suggest an optimal lag of 1, while LR and AIC indicate an optimal lag of 5.

Table 3. Lag Order Selection Criteria

Lag	LR	FPE	AIC	SC	HQ
0	NA	5192831.	23.97640	24.09113	24.02009
1	285.5086	15019.31	18.12970	18.58858*	18.30444*
2	16.22834	14827.14*	18.11229	18.91534	18.41810
3	8.004914	17587.32	18.27217	19.41938	18.70903
4	15.52515	16908.81	18.21257	19.70395	18.78050
5	17.33113*	15049.24	18.06283*	19.89837	18/76182

Source: Author processed

Considering the need to adequately capture the dynamic structure of the variables and the relatively large number of observations in the dataset, this study adopts lag 5 as the optimal lag length. This decision is supported by the LR and AIC criteria.

4.1.3. Main Analytical Results

a. Granger Causality Test

The result of granger causality shows a two-way causality on both GDP per capita and FDI. In addition, manufacturing value added (MANVA) exhibits one-directional causality toward GDP per capita with 10% alpha, indicating that changes in manufacturing performance Granger-cause changes in economic growth. Similarly, MANVA is found to Granger-cause FDI, reflecting a significant causal

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relationship from manufacturing to foreign investment.

Table 4. Pairwise Granger Causality Tests

Null Hypothesis	F-Statistic	Prob.
GDPC does not Granger Cause FDI	6.14329	0.0003
FDI does not Granger Cause GDPC	2.53802	0.0441
MANVA does not Granger Cause FDI	3.30023	0.0140
FDI does not Granger Cause MANVA	1.22834	0.3144
MANVA does not Granger Cause GDPC	2.07049	0.0899
GDPC does not Granger Cause MANVA	0.56475	0.7263

Source: Author processed

b. Cointegration Test

The cointegration test result confirm that GDP per capita, FDI, and manufacturing value added are cointegrated, implying the existence of a long-run equilibrium relationship among these variables. The cointegration shows by the presence of at least one cointegrating equation.

Table 5. Cointegration Test

Hypothesized No. of CE(s)	0.05 Critical Value	Prob. Critical Value
None *	29.79707	0.0001
At most 1	15.49471	0.2314
At most 2	3.841465	0.7091

Source: Author processed

c. VECM Estimation Results

Following the confirmation of cointegration, the VECM is estimated to capture both short-run dynamics and long-run adjustments. In the cointegrating equation, MANVA shows a negative and statistically significant coefficient, while FDI is not statistically significant.

Table 6. VECM Estimation Results

Long-Run Cointegration Equation (Normalized on GDP per capita)		
Variable	**Coefficient**	**T-Statistic**
FDI	-477.237	-1.234
MANVA	-599.469	-5.483
Constant	-4045.890	-
Error Correction Term (ECT)		
Dependent Variable	**ECT Coefficient**	**T-Statistic**
ΔGDPC	-0.0011	-0.121
ΔFDI	2.8544	0.591
ΔMANVA	-0.0024	-4.813
Short-Run Dynamics (Significant Only at α = 5%)		
Dependent Variable/Variable	**Coefficient**	**T-Statistic**
ΔGDPC(-2) / ΔGDPC	0.493	2.629
ΔMANVA(-1) / ΔMANVA	0.513	2.163

Source: Author processed

Furthermore, the error correction term (ECT) is negative and significant only in the MANVA equation, implying that adjustment toward long-run equilibrium occurs through the manufacturing sector, albeit at a slow speed. No significant adjustment is observed in the GDPC and FDI equations.

In the short run, the results reveal limited dynamics. GDPC and MANVA are mainly influenced by their own lagged values, indicating

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persistence. FDI does not exhibit any statistically significant short-run effect on the other variables.

The impulse response function (IRF) analysis is conducted to examine the response of each variable to shocks in other variables over time.

d. Impulse Response Function

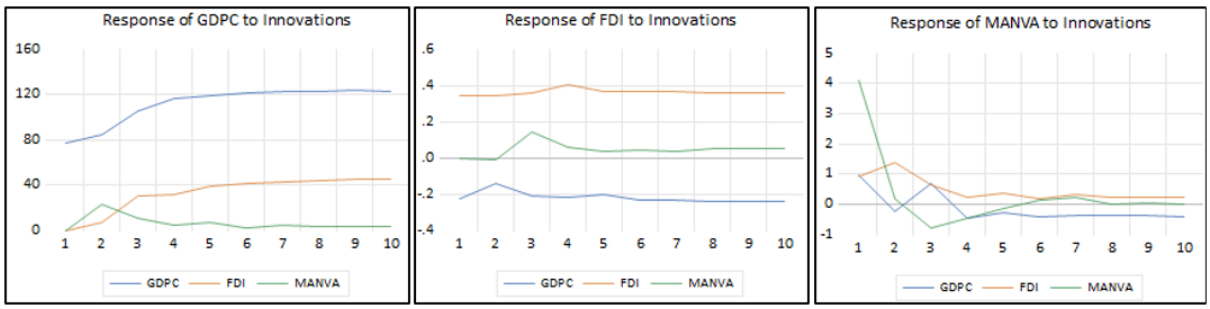


Fig. 1. Impulse Response Function Combine Graph
Source: Author processed

The results show that GDP per capita responds positively and immediately to a shock in FDI, with the effect peaking around period three before gradually converging to equilibrium. This indicates that FDI exerts a short-to-medium term stimulative effect on output, but its long-run impact fades as the system returns to equilibrium. GDP per capita also responds positively to a shock in manufacturing value added (MANVA), though the response is more persistent, suggesting manufacturing plays a more sustained role in driving income growth.

Conversely, FDI responds positively to GDP shocks, with the effect accumulating gradually and stabilising after period four. This confirms the bidirectional relationship identified in the Granger causality tests. Manufacturing responds weakly to FDI shocks, implying that foreign capital in India may not strongly stimulate manufacturing value added in the short run. All responses converge toward zero over time, confirming the stability of the VECM.

e. Variance Decomposition

Variance decomposition is performed to assess the contribution of each variable to the forecast error variance of the system.

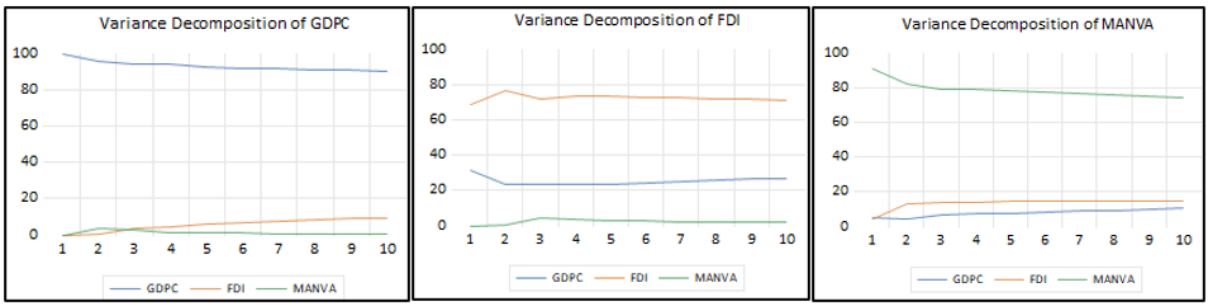


Fig. 2. Variance Decomposition Factors
Source: Author processed

The results indicate that, for GDP per capita, own shocks dominate in the short run (approx. 98% at year one). However, the contribution of FDI increases markedly over time, reaching approximately 80% by year ten. This finding underscores that FDI becomes the dominant source of output fluctuations in India over multi-year horizons. By contrast, manufacturing value added contributes no more than 12% to GDP variance throughout the horizon.

For FDI, own shocks initially explain over 90% of its variance, but GDP per capita contributes about 30% by year ten, reinforcing the bidirectional causality between income growth and foreign investment. Manufacturing value added remains largely self-explanatory, with own shocks accounting

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for more than 85% of its variance even at the ten-year horizon, suggesting that manufacturing performance is driven primarily by domestic structural factors rather than FDI or aggregate demand fluctuations.

4.1.4. Hypothesis Testing Results / Key Findings

The study does not specify formal directional hypotheses. Accordingly, the main empirical findings are summarized in relation to the research objectives and the reported econometric tests. First, the Granger causality analysis identifies bidirectional predictive relationships between GDP per capita and FDI. Manufacturing value added Granger-causes FDI at the 5% significance level and GDP per capita at the 10% significance level. The reverse relationships from FDI to manufacturing value added and from GDP per capita to manufacturing value added are not statistically significant at the 5% level. Second, the Johansen cointegration test indicates the presence of a long-run equilibrium relationship among GDP per capita, FDI, and manufacturing value added. The VECM results further identify a negative and statistically significant manufacturing value-added coefficient in the normalized long-run equation, whereas the FDI coefficient is not statistically significant according to the reported results. Third, the error correction term is statistically significant only in the manufacturing value-added equation. The short-run results identify significant own-lag relationships for GDP per capita and manufacturing value added, while the reported analysis does not identify statistically significant short-run effects of FDI on the other variables. Fourth, the impulse response analysis shows positive responses of GDP per capita to shocks in FDI and manufacturing value added, as well as a positive response of FDI to GDP per capita shocks. The variance decomposition indicates that FDI accounts for an increasingly large share of GDP per capita forecast error variance, reaching approximately 80% by the tenth period.

Taken together, these findings characterize the dynamic relationships among GDP per capita, FDI, and manufacturing value added in India over the study period. The results also indicate that the empirical contribution of each variable differs between the short-run adjustment process and the longer forecast horizon.

4.1.5. Visual Presentation of Results

The results are presented through five tables and two figures. Tables 2–3 report the preliminary time-series tests and lag selection results. Tables 4–6 present the Granger causality, cointegration, and VECM estimation results. Figure 1 illustrates the impulse responses of the variables to shocks, while Figure 2 presents the relative contributions of the variables to forecast error variance over time.

The tables and figures are intended to complement one another: the tabular results provide the reported statistics and significance levels, whereas the figures summarize the dynamic responses and variance contributions across the forecast horizon. All numerical values and visual interpretations should be checked against the original EViews output before publication.

4.2 Research Discussion

4.2.1. Interpretation of Key Findings

The empirical results presented above yield three principal findings that directly address the research objectives. First, the Johansen cointegration test confirms the existence of a long-run equilibrium relationship among GDP per capita, FDI, and manufacturing value added in India over the 1970–2024 period. This implies that despite short-run fluctuations, these three variables move together in a manner consistent with a stable macroeconomic system. Second, the Granger causality results reveal bidirectional causality between GDP per capita and FDI, alongside unidirectional causality running from manufacturing value added to both GDP and FDI. Third, the variance decomposition demonstrates that FDI accounts for approximately 80% of GDP variance by the tenth period, indicating that foreign capital increasingly dominates output fluctuations over longer horizons.

These findings collectively suggest that FDI-led growth dynamics are operative in India, but with an important qualification: while FDI strongly influences GDP in the long run, manufacturing value added does not exert a reciprocal causal influence on FDI. Manufacturing appears to function more as a dependent variable within this system — shaped by growth and investment conditions — rather than an independent driver of foreign capital attraction.

The bidirectional causality between GDP and FDI documented here aligns closely with Agrawal and Khan (2011), who found a positive association

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between FDI inflows and GDP growth in India over 1993–2009. However, the present study extends their work by demonstrating that this relationship persists over a much longer horizon (1970–2024) and within a multivariate framework that includes manufacturing. The finding that manufacturing Granger-causes GDP but not vice versa partially corroborates Yoganandham and Kuppan (2023), who argued that manufacturing serves as a foundation for broader economic growth, yet it diverges from the export-led growth narrative advanced by Boominathan and Arunachalam (2019), where exports featured prominently. In the present study, exports were excluded due to statistical insignificance, suggesting that for India over the full sample period, the manufacturing–FDI–GDP nexus may be more consequential than the export–growth channel.

For policymakers, the results imply that attracting and retaining FDI should be treated as a core macroeconomic stabilisation tool rather than a peripheral development objective, given that FDI explains the vast majority of long-run GDP variance. However, the absence of a causal link from manufacturing to FDI cautions against assuming that manufacturing expansion alone will automatically attract foreign capital; complementary interventions such as improving contract enforcement, reducing regulatory uncertainty, and developing sector-specific infrastructure are necessary. For emerging economies beyond India, the findings suggest that export-led strategies may be less consequential than manufacturing deepening, though the latter requires deliberate investment facilitation rather than passive spillover assumptions.

However, This study directly addresses the three gaps identified in the literature. Unlike prior bilateral studies, the multivariate VECM framework captures simultaneous interdependencies among GDP, FDI, exports, and manufacturing, with exports excluded empirically rather than by assumption. The 54-year horizon (1970–2024) encompasses multiple policy regimes — pre-liberalisation, post-1991 reforms, and the Make in India period — offering longer coverage than any previous VECM analysis of India's macroeconomic system. Finally, the combined application of IRF and variance decomposition provides novel dynamic insights, particularly the finding that FDI dominates GDP variance by 80% at the tenth period, a quantitative contribution not previously documented in the Indian context.

4.2.2. Comparison with Previous Studies

The bidirectional Granger causality between GDP per capita and FDI is consistent with the findings of Agrawal and Khan (2011), who documented a positive association between FDI inflows and GDP growth in India over the 1993–2009 period. The present study extends this evidence by examining a substantially longer period, from 1970 to 2024, and incorporating manufacturing value added into a multivariate framework. This broader analytical scope provides additional insight into the dynamic relationships between foreign investment and economic performance.

The finding that manufacturing value added Granger-causes GDP per capita is also consistent with the argument of Yoganandham and Kuppan (2023) that manufacturing sector growth contributes to broader economic development. However, the present findings suggest that this relationship is asymmetric: manufacturing value added predicts changes in GDP per capita, whereas the reverse relationship is not statistically significant at the 5% level.

The results also differ from the export-led growth perspective emphasized by Boominathan and Arunachalam (2019), who identified short-run unidirectional causality from exports to GDP. In the present study, exports are excluded from the final model because of their limited statistical significance in the Granger causality analysis. This difference suggests that the relative importance of export performance and the manufacturing–FDI–GDP relationship may vary according to the observation period, model specification, and empirical characteristics of the variables. Accordingly, the findings do not establish that exports are universally less important than manufacturing; rather, they indicate that exports did not demonstrate sufficient statistical significance to remain in the final model used in this study.

4.2.3. Theoretical Contributions

This study contributes to the development economics literature by examining FDI-led growth and manufacturing performance within a multivariate time-series framework. The bidirectional Granger causality between GDP per capita and FDI

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provides empirical support for the interconnected nature of foreign investment and economic performance in India. Rather than treating FDI solely as an external source of capital, the results suggest that its relationship with economic growth operates dynamically in both directions.

The findings also qualify the interpretation of manufacturing-led growth. Although manufacturing value added Granger-causes GDP per capita, the absence of a statistically significant reverse relationship indicates that the relationship is not symmetric in the reported causality tests. Similarly, the absence of a significant causal relationship from FDI to manufacturing value added suggests that the potential contribution of foreign capital to manufacturing performance cannot be assumed to be automatic.

Furthermore, the cointegration results indicate that GDP per capita, FDI, and manufacturing value added share a long-run equilibrium relationship, while the error correction term is statistically significant only in the manufacturing equation. This finding highlights the importance of distinguishing long-run equilibrium relationships from the mechanisms through which individual variables adjust to deviations from equilibrium.

The variance decomposition results provide an additional dynamic perspective by showing that FDI accounts for an increasingly large share of GDP per capita forecast error variance over time. Together, these findings extend the empirical discussion of FDI-led growth by emphasizing the importance of long-run interdependence, asymmetric causal relationships, and variable-specific adjustment mechanisms in the Indian economy.

4.2.4. Practical and Policy Implications

The findings have several implications for economic policymakers in India. First, the bidirectional relationship between GDP per capita and FDI underscores the importance of maintaining an investment environment that supports both foreign capital inflows and domestic economic development. Policies aimed at attracting and retaining FDI may be considered alongside broader measures that strengthen economic stability and productive capacity.

Second, the finding that manufacturing value added Granger-causes both GDP per capita and FDI suggests that manufacturing development deserves attention in industrial and investment policy. However, because the reverse causal relationship from manufacturing value added to FDI is not statistically significant at the 5% level, policymakers should not assume that manufacturing expansion alone will automatically generate additional foreign investment. Complementary measures, including improvements in contract enforcement, reductions in regulatory uncertainty, and the development of sector-specific infrastructure, may help create more supportive conditions for investment.

Third, the limited statistical significance of exports in the final model suggests that policymakers should evaluate export-led strategies in conjunction with broader manufacturing and investment policies. The findings do not justify abandoning export promotion; instead, they indicate that the role of exports should be assessed empirically in relation to the country's broader macroeconomic structure and the period under consideration.

For other emerging economies, the Indian experience highlights the value of examining foreign investment, manufacturing development, and economic growth jointly rather than relying exclusively on a single development strategy. Nevertheless, the applicability of these implications to other countries depends on their institutional environments, industrial structures, and investment conditions.

4.2.5. Integration with the Research Gap

This study addresses the research gaps identified in the literature review in three ways. First, it examines the dynamic relationships among GDP per capita, FDI, manufacturing value added, and exports within an initially specified multivariate framework rather than limiting the analysis to isolated pairs of variables. Although exports are excluded from the final model following the empirical analysis, their initial inclusion allows the model specification to be informed by the reported causality results rather than by an a priori assumption that exports are irrelevant. Second, the study examines annual data covering 1970–2024, encompassing different phases of India's economic development, including the pre-liberalization period, the economic reforms initiated in 1991, and the period associated with the Make in India initiative. This extended observation period provides an

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opportunity to examine macroeconomic relationships across a broader historical horizon. Third, the combined application of cointegration analysis, VECM, impulse response functions, and variance decomposition provides complementary evidence on long-run equilibrium relationships, short-run adjustment dynamics, responses to shocks, and forecast error variance contributions. In particular, the finding that FDI accounts for approximately 80% of GDP per capita forecast error variance by the tenth period provides a quantitative description of the dynamic relationship between foreign investment and economic performance over the estimated forecast horizon.

These contributions address the identified gap concerning the joint analysis of macroeconomic interdependencies over an extended period. However, the originality of the study should be understood in relation to its particular combination of variables, observation period, and analytical approach, rather than as definitive proof that no comparable analysis has previously been conducted.

4.2.6. Acknowledgement of Study Limitations

Several limitations should be considered when interpreting the findings. First, the analysis focuses on India and therefore reflects the country's specific macroeconomic and institutional context. The results may not be directly generalizable to other emerging economies with different industrial structures, investment environments, or trade patterns.

Second, the exclusion of exports from the final model limits the conclusions that can be drawn about the export–growth relationship within the estimated VECM. Although the initial model includes exports, their exclusion means that the final estimates do not provide a comprehensive assessment of the direct and dynamic relationships between exports and the remaining variables.

Third, the reported findings rely on Granger causality tests, cointegration analysis, and VECM estimates. Granger causality identifies predictive relationships conditional on the model specification and does not, by itself, establish structural or policy causality. Similarly, variance decomposition measures the relative contribution of shocks to forecast error variance and should not be interpreted as a direct measure of the proportion of economic growth caused by a particular variable.

Finally, the interpretation of the results depends on the accuracy of the underlying data and the consistency of the econometric specification. The reported differences in lag selection criteria and the need to verify certain unit root and cointegration test statistics should be addressed before the results are used to support definitive policy conclusions. Future research may build on this study by examining sector-specific investment flows, retaining exports in alternative model specifications, and testing whether the relationships remain robust under alternative lag structures and approaches that account for structural changes.

5. Conclusion

5.1 Summary of Key Findings

This study investigated the long-run equilibrium and causal relationships among GDP per capita, FDI, manufacturing value added, and exports in India over the 1970–2024 period using a VECM framework. The empirical analysis yields three principal findings. First, the Johansen cointegration test confirms that GDP per capita, FDI, and manufacturing value added share a stable long-run equilibrium relationship, despite the exclusion of exports due to weak causal influence. Second, Granger causality tests reveal bidirectional causality between GDP per capita and FDI, alongside unidirectional causality from manufacturing value added to both GDP and FDI — indicating that manufacturing drives growth and investment, but not vice versa. Third, variance decomposition demonstrates that FDI accounts for approximately 80% of GDP variance by the tenth period, underscoring its dominant role in shaping India's long-run output trajectory. These findings confirm that FDI-led growth dynamics are operative in India, yet manufacturing functions more as a dependent variable within the system than an autonomous driver of foreign capital attraction.

5.2 Theoretical Contributions

This study contributes to development economics by examining FDI-led growth and structural transformation within a multivariate cointegrated framework. The findings extend the understanding of the relationship between foreign investment and economic growth by identifying bidirectional Granger causality between GDP per capita and FDI over an extended observation period. This result suggests that the relationship between

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foreign investment and economic performance is dynamic rather than exclusively unidirectional.

The findings also qualify the interpretation of manufacturing-led growth. Although manufacturing value added Granger-causes GDP per capita and FDI, the reverse causal relationships are not statistically significant at the 5% level. Furthermore, the significant error correction term in the manufacturing equation indicates that manufacturing value added plays a distinct role in adjusting toward long-run equilibrium. These findings underscore the importance of distinguishing long-run equilibrium relationships, short-run causal dynamics, and adjustment mechanisms when examining macroeconomic interdependencies.

The study also contributes empirically by combining cointegration analysis, VECM estimation, impulse response functions, and variance decomposition to examine the relationships among the selected macroeconomic variables over the 1970–2024 period. This integrated approach provides complementary insights into long-run equilibrium, short-run dynamics, and the relative contribution of shocks to GDP per capita fluctuations.

5.3 Practical and Policy Implications

The findings carry both theoretical and practical implications. Theoretically, this study contributes to development economics by synthesising FDI-led growth and structural transformation theories within a multivariate cointegrated framework, while challenging the strong version of manufacturing-led growth theory by demonstrating that manufacturing does not Granger-cause FDI. Practically, for Indian policymakers, the results imply that FDI should be treated as a core macroeconomic stabilisation tool rather than a peripheral development objective, given its overwhelming contribution to long-run GDP variance. Furthermore, the absence of a causal link from manufacturing to FDI suggests that expanding manufacturing output alone will not automatically attract foreign capital; complementary policies — including improvements in contract enforcement, regulatory certainty, and infrastructure quality — are necessary to translate manufacturing growth into sustained investment inflows. For other emerging economies, the findings caution against over-reliance on export-led strategies without simultaneous attention to manufacturing deepening and investment facilitation.

5.4 Limitations of the Study

Several limitations should be considered when interpreting the findings. First, the use of aggregate macroeconomic data may obscure differences in the relationships between FDI, manufacturing performance, and economic growth across individual sectors. Consequently, the results may not fully reflect sector-specific investment patterns or differences in manufacturing productivity. Second, the findings are specific to India over the 1970–2024 period. Although the observation period covers several phases of economic development, the estimated relationships may not be directly generalizable to other emerging economies with different institutional arrangements, industrial structures, and trade patterns. Third, the exclusion of exports from the final model limits the conclusions that can be drawn regarding the export–growth relationship within the estimated VECM. Although exports were initially considered, their exclusion means that the final model does not provide a complete assessment of their dynamic interactions with GDP per capita, FDI, and manufacturing value added.

Finally, the reported results identify statistical relationships within the selected econometric framework. Granger causality indicates predictive relationships rather than definitive structural causation, while variance decomposition measures contributions to forecast error variance rather than the proportion of economic growth directly caused by a particular variable. These distinctions are important when interpreting the policy relevance of the findings.

5.5 Directions for Future Research

Future research could extend this study in several directions. First, researchers could employ disaggregated FDI data, distinguishing between manufacturing and services, to determine whether the relationships identified in this study differ across economic sectors. Alternative measures of export sophistication, including high-technology exports, could also be incorporated to examine the relationship between foreign investment, manufacturing development, and export composition. Second, future studies could apply

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nonlinear cointegration methods or endogenous structural break tests to investigate whether the relationships among the variables change across different economic regimes. Such approaches could provide additional insights into structural changes associated with India's 1991 economic liberalization and the 2008 global financial crisis. Third, subsequent research could incorporate institutional variables, including regulatory quality, political stability, and labor market flexibility, into extended multivariate models. Examining these factors may help clarify whether institutional conditions influence the relationship between FDI and economic growth in India and comparable emerging economies.

Finally, future studies could assess the robustness of the findings using alternative lag structures and model specifications, including approaches that retain exports in the estimated system. Such analyses would help establish whether the observed relationships remain consistent under alternative empirical assumptions and provide a more comprehensive understanding of the interactions among foreign investment, manufacturing performance, exports, and economic growth.

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