



# Measuring the impact of import substitution and export promotion on India's GDP growth: an econometric analysis toward Viksit Bharat @2047

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## Abstract

As India approaches the centenary of its independence, the vision of *Viksit Bharat@2047* requires an indigenous growth strategy. India has targeted to be a USD 30 trillion economy by 2047. This paper empirically evaluates whether export promotion and import substitution function as complementary components in the *Viksit Bharat@2047* roadmap. Using annual time-series data for 1991–2025, the study applies the Johansen cointegration approach and a Vector Error Correction Model (VECM) to examine the structural and short-term relationship between real GDP, total exports, and manufacturing value added. Technological upgradation (proxied by ICT imports) is incorporated as a conditioning variable to assess transmission mechanisms. The study found manufacturing exhibits near-unit long-run elasticity with respect to GDP, highlighting its role as a structural anchor. Impulse response analysis reveals that export shocks generate persistent positive shifts in GDP. Moderation analysis further demonstrates that technological capability significantly amplifies the growth impact of exports, suggesting that technological upgrading enhances the productivity gains from global integration. These findings suggest that India's path to *Viksit Bharat@2047* is not a choice between inward industrialisation and outward orientation but a multi-dimensional architecture. The study concludes that *Atmanirbhar Bharat* functions as a strategy of technologically enabled global integration, where manufacturing provides stability, exports drive expansion, and technical modernisation acts as a catalytic force.

**Keywords:** *Viksit Bharat@2047*, VECM, Cointegration, Moderation analysis, Structural transformation, Technological capability

## 1. Introduction

As India approaches its centenary in 2047, the national aspiration of achieving *Viksit Bharat* – a developed economy targets a GDP of approximately USD 30 trillion. This ambitious trajectory requires an indigenous growth strategy that addresses the structural asymmetries emerging from the post-1991 reform era.

The 1991 reforms marked a decisive shift toward trade openness, deregulation, and global integration (Srinivasan & Tendulkar, 2003). However, the reform era also revealed structural asymmetries, particularly the relatively slower expansion of manufacturing compared to services and persistent technological dependence in key sectors (Ahluwalia, 2002; Ghate, Wright, & Balasubramanian, 2013) <sup>[20, 21]</sup>.

At this strategic juncture, a fundamental question arises: Do export promotion and import substitution operate as competing substitutes or as complementary components of a unified growth architecture?

This paper attempts to address this question by modeling India's growth process as a cointegrated system linking real GDP, total exports, and manufacturing value added (MVA) from 1991 to 2025.

The study employs the Johansen cointegration approach and a Vector Error Correction Model (VECM) to identify stable long-run equilibrium relationships and short-run adjustment mechanisms. A distinguishing feature of this research is the incorporation of imported technological capability (proxied by ICT imports) as a conditioning variable to assess how technological modernization facilitates growth transmission. Furthermore, impulse response analysis is utilized to evaluate whether shocks to exports and manufacturing generate temporary stabilization or persistent, frontier-expanding growth. It further implied technological modernation analysis to find how imported technology impact the economic growth. The primary objective is to provide an empirical evaluation of India's structural growth determinants, assessing their consistency with the *Viksit Bharat@2047* vision. Specifically, the research aims to:

- Evaluate if trade integration and industrial deepening form a stable, long-run equilibrium.
- Estimate the mechanics of shock transmission and adjustment speeds between output, exports, and manufacturing.
- Examine how imported technology moderates the growth elasticity of trade and industrial strategies.

By synthesizing these elements, the study provides a quantitative foundation for interpreting Atmanirbhar Bharat not as a strategy of inward isolation, but as one of technologically enabled global integration. The results offer a multi-dimensional roadmap where manufacturing provides structural stability, exports drive expansion, and technological modernization serves as the essential catalytic force for sustained economic transformation.

## 2. Materials & Methods

### 2.1 Trade strategy and structural transformation in India

Export-led growth (ELG) models posit that trade openness enhances productivity via scale economies, learning-by-exporting, and technological spillovers (Feder, 1982<sup>[19]</sup>; Grossman & Helpman, 1991)<sup>[23]</sup>. In the Indian context, studies by Virmani (2004)<sup>[48, 49]</sup> and Rodrik & Subramanian (2005)<sup>[43, 44]</sup> argue that post-reform growth acceleration was associated with external integration and improved productivity dynamics. However, other scholars caution that trade openness alone cannot sustain structural transformation without industrial deepening and institutional reform (Dua & Banerji, 2001<sup>[17, 18]</sup>; Nayyar, 2012)<sup>[34, 35]</sup>.

### 2.2 Cointegration between trade, manufacturing, and growth in India

Empirical investigations into India's trade-growth relationship have yielded mixed results. Bahmani-Oskooee and Alse (1993)<sup>[6]</sup> provide early evidence of cointegration between exports and GDP in developing countries, including India. For the post-liberalization period, Awokuse (2007)<sup>[5]</sup> and Hye (2012) find bidirectional causality between exports and economic growth, suggesting feedback mechanisms rather than unidirectional ELG dynamics.

Indian-specific time-series analyses (Dua and Banerji, 2001; Ghate, Wright, and Balasubramanian, 2013)<sup>[20, 21]</sup> highlight the importance of structural breaks around the 1991 reforms. Pandey and Patnaik (2010)<sup>[40]</sup> emphasize the role of trade composition.

Manufacturing value added has been repeatedly identified as a structural anchor of long-run growth. Drawing on Kaldor's growth laws, Chakravarty and Mitra (2009)<sup>[13, 14]</sup> argue that industrial expansion drives productivity spillovers across sectors.

### 2.3 Imports, technology transfer, and digitalization

The literature increasingly recognizes the growth-enhancing role of imports, particularly capital goods and technology-intensive intermediates (Coe and Helpman, 1995<sup>[15]</sup>; Keller, 2004). For India, Mazumdar and Sarkar (2008)<sup>[30]</sup> find that imported technology contributes significantly to productivity gains in manufacturing. Kathuria (2013)<sup>[25]</sup> emphasizes that integration into global value chains depends critically on technological capability.

The absorptive capacity literature (Cohen and Levinthal, 1990) suggests that technological readiness conditions the

productivity impact of trade exposure. In the Indian context, ICT (Information and Communication Technology) adoption and digital modernization are likely to amplify export competitiveness, consistent with recent empirical findings by Banga (2019)<sup>[7, 8]</sup> on digital trade and services exports

While substantial literature exists on India's export, import and growth relationship, limited studies integrate:

- Long-run cointegration among them,
- Dynamic adjustment mechanisms,
- Imported technological capability as a moderating factor.

### 2.4 Research objectives

The primary objective of this study is to empirically evaluate the structural determinants of India's post-liberalisation growth trajectory and to assess their consistency with the long-term macroeconomic environment, which is an important input to policy formation for the transition towards the Viksit Bharat@2047 vision. Specifically, the research pursues the following objectives:

- Long-Run Structural Cointegration: To evaluate trade integration and industrial deepening form a stable, long-run equilibrium with India's growth trajectory
- Short-term Dynamic Adjustment and Growth Propagation: To estimate the short-run adjustment speeds and the mechanics of shock transmission between output, exports, and manufacturing using a VECM framework.
- Technological Moderation: To examine how modern technological capability condition the growth elasticity of trade and industrial strategies, acting as catalytic transmission mechanisms.

## 3. Empirical results

### 3.1 Data description and variable construction (1991–2025)

This study employs annual time-series data for the period 1991–2025, covering India's post-liberalization phase. The dependent variable is GDP. The core explanatory variables are total exports (goods and services combined) and manufacturing value added (MVA), representing export promotion and domestic industrial deepening, respectively.

To capture transmission mechanisms, imports of information and communication technology (ICT) goods are incorporated. ICT imports proxy imported technological upgrading and digital capability.

All variables are transformed into natural logarithms to interpret estimated coefficients as elasticities and to stabilize variance.

### 3.2 Econometric framework

The econometric framework employs a multi-layered time-series approach aligned with the research objectives. It starts by testing the stationarity of the observed time series using the Augmented Dickey-Fuller (ADF) test. The results are presented in the table below.

**Table 1:** Augmented Dickey–Fuller (ADF) test results (first differences)

Variable	Test Specification	ADF Statistic ( $\tau$ )	1% CV	5% CV	10% CV	Decision	Order of Integration
$\Delta$ LGDP	Drift	-4.296	-3.58	-2.93	-2.60	Reject $H_0$ (1%)	I(1)
$\Delta$ LEXP	Drift	-3.522	-3.58	-2.93	-2.60	Reject $H_0$ (5%)	I(1)
$\Delta$ LMVA	Drift	-3.824	-3.58	-2.93	-2.60	Reject $H_0$ (1%)	I(1)

**Note**

$H_0$ : Series has a unit root (non-stationary) Critical values correspond to the  $\tau_2$  statistic (ADF with drift). Lag length selected using AIC.

The Augmented Dickey–Fuller (ADF) test results for the first-differenced series indicate that the null hypothesis of a unit root is rejected for all core variables. These findings, combined with evidence of non-stationarity in levels, confirm that all variables are integrated of order one, I(1).

Since all variables are I(1), the next step is to test for cointegration to check if a stable long-term relationship exists among them. This is done using the Johansen cointegration method.

**Long-run structural relationship**

**Long-run cointegrating relationship**

**Table 1:** Johansen trace test results for cointegration rank

Null hypothesis	Test statistic	10% CV	5% CV	1% CV	Decision (5% level)
$r = 0$	42.62	32.00	34.91	41.07	Reject
$r \leq 1$	13.52	17.85	19.96	24.60	Do not reject

The Johansen trace test indicates a cointegration rank of one ( $r = 1$ ), implying the existence of a unique long-run equilibrium relationship among the variables. The corresponding normalised cointegrating vector is reported in Table 2 below.

**Table 2:** Long-Run Cointegrating Relationship (Johansen Estimate) Dependent (Normalized) Variable: LGDP

Variable	Coefficient	Interpretation
LGDP	1.000	Normalization (reference variable)
LEXP	0.119	Weak positive association in long-run equilibrium
LMVA	-1.154	Strong negative loading (relative to GDP normalization)
Constant	-0.680	Equilibrium intercept

**From the first eigenvector**

$$GDP + 0.119LEXP - 1.154LMVA - 0.680 = 0$$

Rearranged:  $LGDP = 1.154LMVA - 0.119LEXP[1] + 0.680$

The estimated cointegrating vector represents a stable long-run equilibrium condition linking real GDP, exports, and manufacturing value added. As this relationship is derived from the normalized eigenvector, the coefficients should be interpreted as equilibrium proportions rather than causal elasticities. The results indicate that manufacturing value added exhibits a strong association with GDP, with a coefficient close to unity ( $LMVA \approx 1.154$ ), suggesting that manufacturing forms the structural backbone of long-term output. In contrast, exports enter the equilibrium relationship with a relatively smaller magnitude ( $LEXP \approx 0.119$ ), implying a complementary

role within the growth process.

Taken together, the results suggest that while the Indian growth process is anchored in domestic industrial performance, it remains integrated with external trade dynamics, forming a balanced long-run growth structure.

While the cointegration relationship establishes the existence of a stable long-run relationship among GDP, exports and manufacturing, it does not provide information on how the system responds when deviations occur.

In reality, economic systems are frequently subject to shocks, and the key question is how quickly and through which variable the system restores balance. To address this, the analysis now turns to the error correction mechanism. It captures the speed and direction of adjustment back to equilibrium.

**3.3 Adjustment mechanisms**

**Table 3:** Error Correction Term (ECT) estimate

Equation	ECT coefficient (Std. error)	t-Statistic	10% threshold (1.65)	5% threshold (1.96)	1% threshold (2.58)	Significance
$\Delta$ LGDP	0.0138 (0.1398)	0.10	No	No	No	Not significant
$\Delta$ LEXP	1.4886 (0.4671)	3.19	Yes	Yes	Yes	***
$\Delta$ LMVA	0.5011 (0.1970)	2.54	Yes	Yes	No	**

The Vector Error Correction Model (VECM) results highlight distinct roles for each variable in maintaining the long-run relationship. Specifically, the error correction term for is 0.0138 ( $p = 0.1398$ ), which is not statistically significant, suggesting that GDP does not adjust meaningfully to short-

term disequilibrium and instead acts as the system's "equilibrium anchor." In contrast, shows a strong and highly significant adjustment coefficient of 1.4886, identifying exports as the primary channel through which the system restores balance. Finally, exhibits a significant but more

moderate adjustment of 0.5011, indicating that while manufacturing value-added contributes to the stabilization process, its corrective role is less aggressive than that of the export sector.

While these results describe the internal adjustment dynamics of the system, they do not fully capture the role of external or enabling factors that may influence how effectively these adjustments translate into growth. In particular, the extent to which trade and industrial responses are amplified or constrained by technological capability remains an important empirical question. To address this, the model incorporates ICT imports as an exogenous conditioning variable, allowing the analysis to identify whether imported technological capability acts as a transmission mechanism within the growth process.

**Table 4:** Impact of ICT Imports (Exogenous Variable in VECM)

Dependent variable	Coefficient	Std. error	t-statistic	Significance
$\Delta LGDP$	0.0027	0.0154	0.18	Not significant
$\Delta LEXP$	0.1502	0.0516	2.91	**
$\Delta LMVA$	0.0503	0.0218	2.31	*

**Notes:**

- $\Delta$  denotes first differences (short-run dynamics).

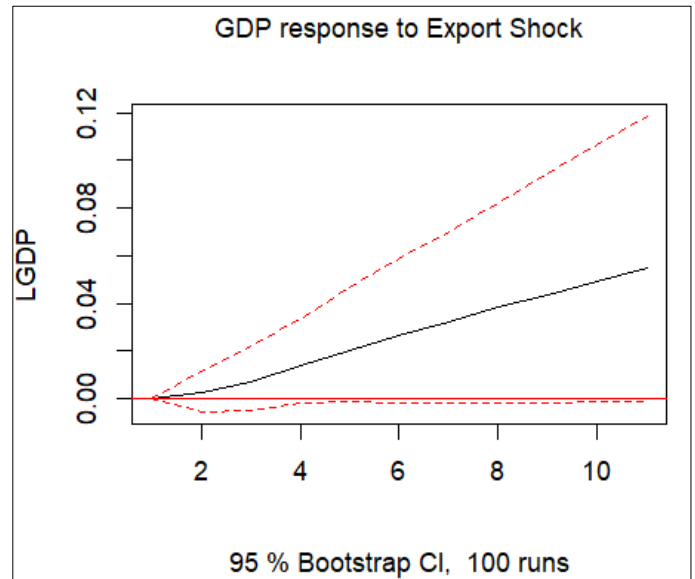
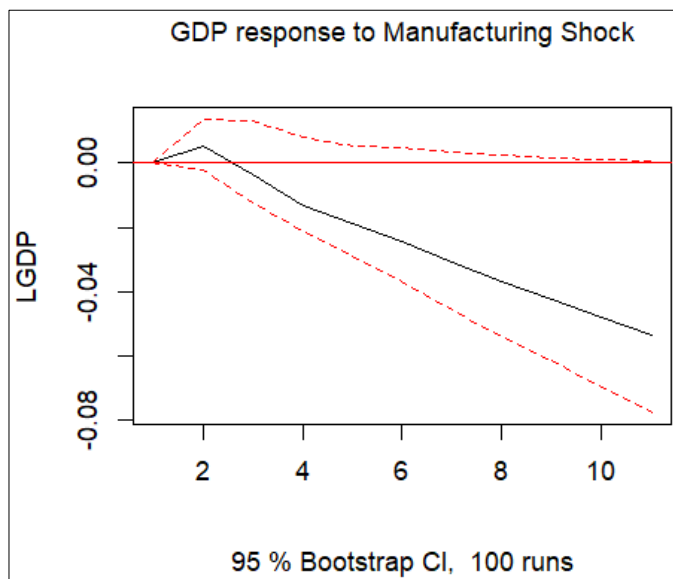
- ICT (LICT) is included as an exogenous conditioning variable in the VECM.

ICT imports do not exert a statistically significant direct effect on GDP in the short run. However, they have a positive and significant impact on export growth and a moderate positive effect on manufacturing. This suggests that imported technological capability operates indirectly by strengthening external competitiveness and supporting industrial activity, rather than directly influencing aggregate output (GDP). There is an indirect technology-driven transmission to growth.

To understand the dynamic transmission of these effects—particularly whether shocks generate temporary adjustments or persistent changes in output—the analysis now turns to impulse response functions (IRFs). This framework allows us to trace the time-path of GDP following shocks to exports and manufacturing, thereby distinguishing between stabilization effects and sustained growth impulses.

**3.4 Impulse response analysis: stabilization versus expansion**

Impulse response functions (IRFs) offer dynamic insight into how shocks propagate through the system.



**Fig 1**

A positive manufacturing shock initially raises GDP, reflecting short-run complementarities between industrial expansion and aggregate output. However, the response gradually converges toward equilibrium, indicating that manufacturing shocks are absorbed through adjustment. Beyond period 3, the most likely outcome is a negative impact. But since the Upper Confidence Interval (the top red line) is still above the zero line, we cannot technically say manufacturing "causes" a decrease in GDP with 95% certainty.

A sudden boom in the manufacturing sector might lead to expensive imported raw materials, increasing the trade deficit and dragging down GDP in the short term.

In contrast, export shocks generate persistent and progressively increasing positive responses in GDP. The cumulative upward

trajectory suggests that export expansion produces frontier-expanding effects rather than merely temporary demand impulses. This dynamic behavior aligns with export-led growth mechanisms driven by productivity spillovers, scale economies, and integration into global value chains.

Together, these results point to a dual-engine growth model in which manufacturing ensures structural depth and stability, while export expansion drives sustained output enhancement.

**3.5 Technological moderation and conditional export-led growth**

Exports contribute to growth only when supported by sufficient technological capability.

**Table 5:** Moderation regression result

Variable	Coefficient	Std. error	t-Statistic	p-value	Significance
Intercept	24.5247	1.6337	15.01	<0.001	***
LEXP	-0.9408	0.1907	-4.93	<0.001	***
LICT	-0.5782	0.1235	-4.68	<0.001	***
LEXP × LICT	0.0908	0.0124	7.33	<0.001	***

**Model statistics**

Adjusted  $R^2 = 0.983$ ; F – statistic = 652.7 \*\*\*

The estimated model is:-

$$LGDP = 24.52 - 0.94 LEXP - 0.58 LICT + 0.091 (LEXP \times LICT) + e$$

The presence of a statistically significant interaction term implies that the effect of exports on GDP is not constant, but depends on the level of ICT imports.

The marginal effect of exports on GDP is:

$$\frac{\partial LGDP}{\partial LEXP} = -0.94 + 0.091 \cdot LICT$$

At low levels of ICT, the marginal effect of exports is negative. As ICT increases, the effect becomes progressively stronger. Beyond a certain threshold, the effect turns positive.

Setting the marginal effect equal to zero:

$$0.94 + 0.091 \cdot LICT = 0$$

$$LICT \approx 10.36$$

The growth impact of exports becomes positive only when ICT capability crosses 10.36, critical threshold.

The results reveal a non-linear growth mechanism in which exports do not automatically translate into economic growth. Instead, their effectiveness is conditioned by the level of technological capability.

These findings suggest that export-led growth is not a standalone strategy, but operates effectively only when complemented by technological deepening. ICT imports thus act as an enabling factor that amplifies the productivity and value-added content of exports.

This mechanism is particularly relevant in the context of India's rapid technological expansion and emphasis on technological self-reliance under the *Atmanirbhar Bharat* strategy.

**4. Discussion: A multi-dimensional growth architecture**

Taken together, the empirical findings reveal a structured hierarchy within India's growth process:

- Manufacturing value added anchors long-run equilibrium.
- Exports generate persistent frontier expansion.
- Imported technological capability amplifies the effectiveness of export integration.

Within the broader vision of *Viksit Bharat@2047*, the findings imply that sustainable high growth requires not merely increased openness or protection, but a coordinated strategy combining industrial depth, export competitiveness, and

imported technological capability. In this sense, *Atmanirbhar Bharat* emerges empirically as a strategy of technologically enabled global integration rather than inward isolation.

Taken together, the results imply that the strategic objective of *Atmanirbhar Bharat* should be interpreted as technologically enabled global integration rather than inward isolation. Industrial self-reliance enhances structural stability, export expansion drives frontier growth, and imported technological modernization amplifies both channels. The road to 2047 therefore requires coordinated policy across industrial, trade and technological domains.

While the study provides empirical insight into India's structural growth dynamics, several limitations warrant consideration.

ICT imports are used as a proxy for technological integration with the external world. While this measure captures digital integration and technology acquisition, it may not fully reflect domestic innovation capacity or productivity-enhancing adoption. Incorporating measures of R&D expenditure, patent activity, or firm-level digital intensity could enrich the analysis. Secondly, while the study identifies complementarities between industrial deepening, export expansion, and imported technological capability, it does not explicitly quantify welfare outcomes or employment effects. Given the developmental objectives of *Viksit Bharat@2047*, future research may extend the analysis to inclusive growth metrics.

Despite these limitations, the study contributes to the literature by integrating trade strategy, industrial policy, and technological modernization within a unified empirical framework. It offers quantitative evidence that India's growth architecture is neither purely export-led nor solely inward-oriented, but structurally multi-dimensional and dynamically interconnected.

**5. Conclusion: Complementarity in India's Growth Strategy Toward 2047**

This study empirically examined whether export promotion and import substitution function as competing or complementary strategies in shaping India's long-run growth trajectory. Using cointegration analysis and a Vector Error Correction Model over 36 years, the findings reveal a structurally integrated growth architecture.

The presence of a stable cointegrating relationship among GDP, exports, and manufacturing confirms that trade integration and industrial deepening are jointly embedded in India's equilibrium growth path. Manufacturing emerges as a structural anchor, exhibiting strong long-run association with output. At the same time, impulse response analysis shows that export shocks generate persistent increases in GDP, suggesting that external integration expands the growth frontier rather than merely providing short-term demand stimulus.

Crucially, the moderation results indicate that imported technological capability significantly amplifies the growth impact of exports. Export-led growth is therefore conditional on technological integration. Manufacturing provides stability, exports drive expansion, and imported technological modernization enhances productivity transmission.

The evidence challenges the traditional trade-off between inward industrialization and outward orientation. Instead, India's pathway toward *Viksit Bharat@2047* appears multi-dimensional: structural depth through manufacturing, sustained expansion through export competitiveness, and technological upgrading as a catalytic force.

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