Does Share of Manufacturing and Rate of Investment Help in Boosting Exports? Evidence from India Using Cointegration Analysis

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Abstract

Purpose : The current work empirically analyzed the existence of a long-run relationship between India's rate of exports, its rate of investment, and its share of manufacturing. It also tried to understand the impact investment and manufacturing had on exports. The need to look at India's exports from the point of its manufacturing capacity necessitated this empirical exercise.

Methodology : The Reserve Bank of India and the World Bank's data from 1960 to 2020 were used for the analysis. The auto-regressive distributive lag (ARDL) method of cointegration, which was introduced by Pesaran et al. (2001) was utilized to investigate the possibility of a long-term association between the variables. Additionally, the Granger causality test was employed to determine the causal direction of policy effects.

Findings : The ARDL test showed that a long-run relationship existed between India's rate of exports, rate of investment, and share of manufacturing, wherein the latter positively influenced the rate of exports. This indicates that raising the rate of investment and share of manufacturing would have a multiplier effect on exports.

Practical Implications : From a policy standpoint, the study advocated raising the rate of investment and the share of manufacturing to increase India's rate of exports. Our study is not free from limitations and allows scope for future researchers to touch upon the kind of transmission.

Originality : Prior research looked at the role of exports and imports in growth and linkages between FDI and trade openness. This work attempted to understand how the level of manufacturing and rate of investment influenced India's rate of exports.

Keywords : investment, manufacturing, exports, ARDL cointegration, Granger causality

JEL Classification Codes : C32, E22, E61, O11

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In recent decades, a number of economists and policymakers have suggested export-led growth as the "way forward" for many developing economies to progress, citing the strategy's success in China and Japan as inspiration. Economic theories have examined the idea of export-led growth thoroughly. The Hecksher–Ohlin theory of international commerce provides a partial empirical basis for the Ricardian notion of "Comparative Advantage," which is where the idea originated. The makeup of exports matters more in today's economic development than quantity, highlighting the significance of highly specialized and valuable manufactured product exports in the trade equation. Manufacturing, which provides a country with a stable foundation to engage in the export of high-value goods, has been stagnating in India's GDP for the last 20 years, accounting for 13–16% of GDP (in real terms). In contrast, neighboring countries, especially China and Vietnam, have reached GDP percentages that are twice as high as India's over the same period, at 28% and 25%, respectively.

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While many studies have underscored the importance of trade and exports in economic growth and pointed to the extremes of over-reliance in export-led models of growth, there is limited literature addressing the question of how the rate of exports can be scaled up in India, which is a developing country as per the UN standards. India has to expand its manufacturing base in order to become export-ready and increase its share of international trade. This would require a sufficient amount of investment from both the public and private sectors. The goal of this project is to gain a deeper understanding of the investment, manufacturing, and export dynamics in the context of India and to offer potential macro policy-relevant ideas for policymakers and researchers to consider and pursue further.

Background

India's economy has grown rapidly in recent years as market-oriented policies were introduced. Better prospects in several industries had led to a financial inflow into India. For a nation like India to continue growing at a faster rate, capital production is crucial (Bal et al., 2016). While market-oriented policies have existed since the mid-1980s, it wasn't until the Balance of Payment crisis of 1991 that the economy underwent a complete transition toward a market orientation. Prior to it, the system was mostly defined by inward-looking regulations that controlled imports and exports, limiting exposure to other markets.

Meanwhile, building a robust industrial basis was the only priority. The development plans for India after independence placed a strong emphasis on industrialization as a crucial tool for long-term economic prosperity. This was made abundantly plain by the 1956 Industrial Policy Resolution, which outlined a precise plan for promoting economic expansion driven by heavy industry. Import substitution and other quantitative and qualitative controls were used in conjunction with this. The implementation of this economic strategy, which involved intensive industrial planning and concentration, led to the Indian industry being pushed to use lower-quality technology and inadequate competition with its domestic rivals. As a result, state-run PSUs were established to organize the sector.

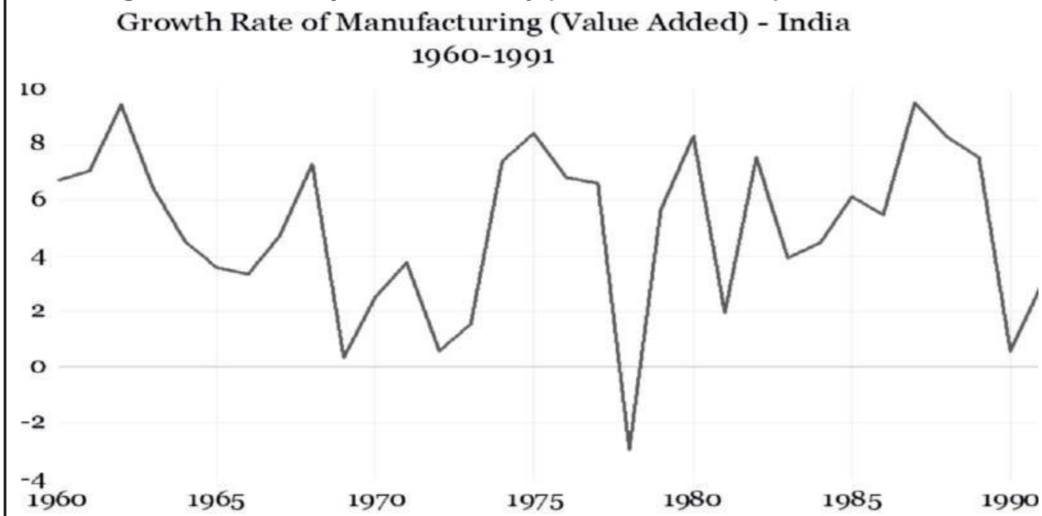
The manufacturing sector as it existed was inadequate to fulfill the needs of the Indian industry, and this resulted in the publication of multiple plans to take the country forward by establishing a strong industrial base. The primary goal of the 1944 Bombay Plan, put out by influential businessmen, was to promote the establishment of both basic industries and consumer goods sectors. It also advocated for a focus on raising living standards and allocating sufficient funds for social overheads. Mahalanobis' Heavy Industry plan came next, and it was eventually included in the Second Five-Year Plan (1956–1961) (Lokanathan, 1945).

A trade limitation meant that only essential capital items, such as machinery and equipment, that the public sector required may be imported despite the emphasis on building a robust industrial base. Unless there was a free exchange by eliminating such quotas and tariffs, such constraints meant that there was little trade to benefit from. When a severe BOP crisis struck India in 1991, this was also later incorporated into the New Economic Policy (Economic Reforms). The manufacturing sector was assessed to have grown value addition on average just 5.18% annually between 1960 and 1991 (Figure 1), while the compound growth rate for the same 30-year period is negative at –2.59%.

Although industrialization was prioritized after 1947 and the manufacturing sector was deregulated in the middle of the 1980s, India did not experience the kind of large-scale industrialization that was observed in East Asia. The manufacturing sector's 15% GDP share, which has not altered much over the past 30 years, is a major problem with India's economic structure. This share is significantly smaller than that in the East Asian countries and much smaller than China's, where the share of manufacturing in GDP is about 35 % (Felipe et al., 2013).

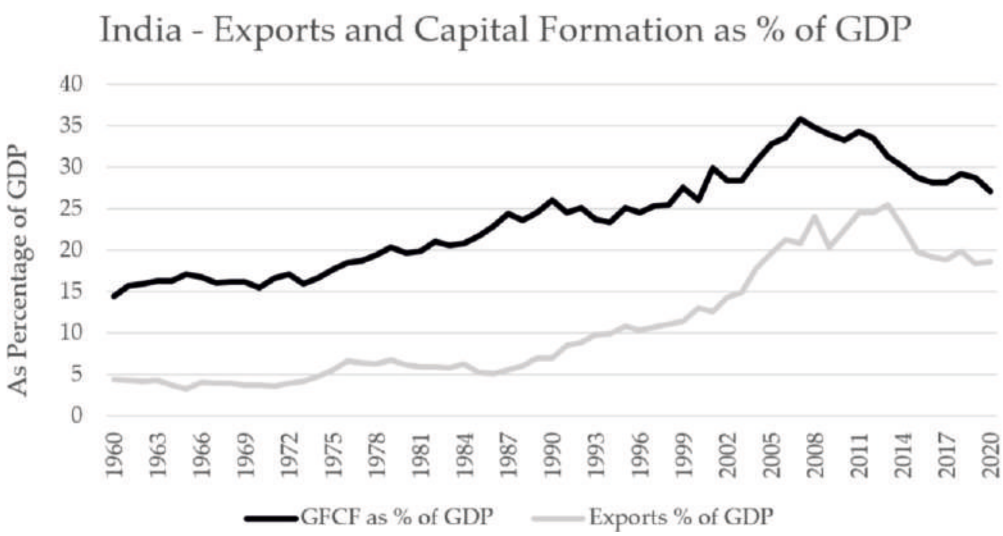
For a coherent growth strategy, it is known that a well-developed industrial base is necessary for which adequate investment has to be pooled from within the economy and later for foreign investment as an add-on to the existing capital pooled to encourage the transfer of technology and resources. In addition to giving domestic

Figure 1. ***Growth of Indian Industry (incl. Construction) - 1960 – 1991***



Source : World Bank

Figure 2. ***Exports and GFCF (Capital Formation) as a Percentage of GDP - India (1960–2020)***



manufacturers the necessary machinery and boosting domestic production, this would aid in the creation of essential infrastructure improvements. Consequently, this would give rise to a robust ability to export domestically manufactured items as well (depending on quality and demand in global markets). The ability to export is, therefore, influenced by a number of factors, including aggregate investment, the percentage of manufacturing in overall output, and the demand and current technological level.

Positively increasing patterns are observed when comparing the trends in capital formation (as a proportion of GDP) and exports from the 1960s to the present. Both exports as well as capital formation show similar trends, as observed in Figure 2. We find that the pace is moderate until the mid-1980s, but beyond that point, exports and the rate of investment both increased.[1]

[1] Rate of investment is calculated as the ratio of total gross fixed capital formation to the GDP in that time period.

The share of exports as a percentage of GDP is significantly lower than the rate of investment when looking at the total numbers for apparent reasons. Yet, there's a considerable likelihood that exports will rise as a result of increased domestic investment made possible by rising earnings, with the money so amassed going toward improving industrial capacities and boosting export inventory. The relationship between the manufacturing share, the rate of investment, and the exports-to-GDP ratio must be examined in this context.

Literature Review

There is a lot of literature available on the subject of investment- and export-led growth. The body of research on the necessity of helping developing nations establish robust industrial bases is also this. Several studies were examined as part of the research project in an effort to determine what style of analysis is most useful in examining the relationship between domestic capital formation, manufacturing share, and the rate of exports.

Belloumi (2014) studied the long-run relationship between FDI, trade, and economic growth in Tunisia, using data from 1970 to 2008. The autoregressive distributed lag (ARDL) technique was applied to study the causal relationship between the relevant variables. It considered trade, FDI, labor, capital investment, and economic growth as the variables for the study. It was found that only when FDI was the dependent variable there was a proven existence of a long-run relationship, while other variables showed no cointegration. The model established a positive relationship with *Y* (growth) and *K* (capital investment) while being negatively related to *L* (labor) and *T* (trade). It also applied Granger causality tests to check for the direction of causality and observed that the interaction was a bidirectional one and not unidirectional. The results indicated that trade openness (*T*) and growth (*Y*) impacted FDI, indicating that FDI sentiments were linked to fiscal and state policies.

$$\ln(F_t) = a_0 + \sum_{i=1}^{p} a_{1i} \ln(F_{t-i}) + \sum_{i=0}^{q_1} a_{2i} \ln(K_{t-i}) + \sum_{i=0}^{q_2} a_{3i} \ln(L_{t-i}) + \sum_{i=0}^{q_3} a_{4i} \ln(Y_{t-i}) + \sum_{i=0}^{q_4} a_{5i} \ln(T_{t-i}) + \varepsilon_t$$

Equation 1 : Long-run ECM used in Belloumi (2014); variables have been adjusted using a log functional form.

Conversely, neither trade nor foreign direct investment (FDI) nor growth itself caused the other. *K* was the only major element that contributed to growth (domestic capital investment). The Johannsen cointegration test delivered a confusing result; however, this offered a thorough initial approach to investigating how the ARDL technique might assist in studying numerous variables and solving them.

In the context of India and other nations, studies like Bakari et al. (2019), Raghutla et al. (2018), and Raghutla and Chittedi (2020) used the Granger causality and Johannsen cointegration technique to examine long-term trends between numerous variables. Raghutla et al. (2018) found that in the long run, India's growth was positively driven by trade openness and financial development, indicating that the growing financial market in India has acted as a catalyst by providing access to multiple streams of finance than just the capital and debt markets. Although there was disagreement on the causal relationship, the fundamental conclusion is consistent with the idea that the banking sector's ability to provide financing to manufacturers and exporters was a key factor in the success of the trade. However, the research was inadequate because it neglected to account for the degree to which external factors—like India's exposure to international financial markets and the degree of global financial development—have influenced and accelerated trade openness in India.

Bakari et al. (2019) explored how domestic investment, exports, and imports impacted Brazil's economic growth. Equation 2 shows the linear, logarithmic model that was implemented in the paper, which utilized absolute values of the relevant variables.

$$\log(Y_t) = \beta_0 + \beta_1 * \log(GFCF) + \beta_2 * \log(X_t) - \beta_3 * \log(M_t)$$

Equation 2 : Logarithmic model applied by Bakari et al. (2019).

where, Y_t meant growth, GFCF stood for domestic investment, and X_t and M_t meant exports and imports, respectively and concluded that as per the Johannsen cointegration test and the vector error correction model (VECM) that was used, in the long run, domestic investment and exports had a positive effect on growth while imports had a negative effect. On the other hand, investment was positively influenced by both growth and imports in the case of Brazil. It also found that exports were not impacted in the long run by growth and investment. It is clear from this that depending on the country's inherent economic structure and level of export-orientation, the rate of exports responds accordingly.

Raghutla and Chittedi (2020) tested the hypothesis of export-led growth (ELG) and import-led growth using panel data for the BRICS group of countries using the Johannsen test of cointegration. The research discovered that, in contrast to the other countries in the group, Brazil did not exhibit any signs of trade-led growth. Brazil, China, and India fit the growth-led imports model, whereas South Africa and Russia fit the ELG model.

Saikia (2013) examined the determinants of India's export performance between 1981 and 2011 using the ARDL cointegration approach. The model featured India's exports (in real terms) as the dependent variable and its GDP, the income of foreign countries (FGDP), real and effective exchange rate (REER), trade liberalization index (TLI), and foreign direct investment (FDI) as independent variables. The long-term association between exports and REER, TLI, and GDP was positive; however, the link between exports and FDI and *F*-GDP was negative, suggesting that quality factors and the composition and utilization of FDI are important in terms of export push. The study highlights the need to increase the quality of goods produced domestically, but it doesn't address the state of the current manufacturing ecosystem or the amount of manufacturing capacity that India has to offer to provide the much-needed boost. In light of this, it is crucial to examine the correlation between India's manufacturing share and export growth rate, as well as the amount of manufacturing-led exports that are feasible under the current circumstances.

Kumari and Malhotra (2015) employed the ARDL technique to see if the ELG hypothesis could be observed in India, Bangladesh, Pakistan, and Sri Lanka using World Bank data. The study concluded that through VECM, such a hypothesis was valid for Bangladesh and Sri Lanka countries only in the long run, while for India, there was only a short-run relationship between exports and GDP per capita. Pakistan's economic progress did not show any long or short-run relationship vis-à-vis exports. As far as imports were concerned, the hypothesis was validated only in the case of Bangladesh, where it positively impacted its GDP per capita. This suggests that a country's population size may have an impact on its long- or short-term relationships with variables; therefore, a per-capita basis method needs to be specified in a specific context and used appropriately. Furthermore, although ELG in India was found to be effective in the short term, this suggests that, in the long term, the kind of exports matters and contributes to growth in particular ways that the model does not account for. In this case, it could be more useful to break down growth using the Keynesian framework (consumption, investment, government expenditure, and net exports) for each country in order to examine the differences in growth patterns.

As can be seen from the preceding overview of the vast literature on the topic, there is sufficient evidence to support a causal inference showing that imports also have an impact on growth and that exports also have an impact on growth. Still, there's a lot to learn about the macroeconomic dynamics that interact with exports and other factors. This paper examines this aspect from a fresh perspective and aims to contribute to the existing literature by examining whether the share of manufacturing and the rate of investment (or domestic capital formation) have any bearing on exports, particularly for India, given the emphasis on increasing manufacturing levels under programs like "Vocal-for-Local" and "Make-in-India."

Methodology

This study examines the long-term relationship between India's manufacturing sector share, capital formation rate, and export rate. It does this by applying the Granger causality test, which was applied by Kumari and

Malhotra (2015), after applying the Augmented-Dickey Fuller (ADF) test, which is followed by the ARDL bounds cointegration test as proposed in Pesaran et al. (2001), Saikia (2013), and the Granger causality test.

The main goal is to determine whether domestic capital formation and the proportion of manufacturing have a meaningful influence on India's export growth rate. The factors that are taken into consideration for the study in this research are the manufacturing-GDP ratio, the exports-GDP ratio, and the rate of investment (GFCF–GDP ratio). The years 1960–2020 are the ones being examined. The Reserve Bank of India and the World Bank's database are the sources of the information.

Empirical Analysis and Results

The analysis is divided into four sections. The first one deals with the simple correlation and stationarity tests. The second section deals with undertaking a cointegration test using the ARDL – Bounds test as put forth by Pesaran et al. (2001) and pursued by Saikia (2013), the third section follows up with model stability and the final section deals with Granger causality tests.

Correlation and Tests of Stationarity

To determine how the variables under observation are correlated with one another, multiple correlation was calculated (using the Karl Pearson method). This is the outcome that was produced:

The exports-to-GDP ratio was shown to have relatively little correlation with the share of manufacturing in the economy despite a very large level of correlation between the ratio and the rate of investment (as indicated in Table 1). Further research is necessary to determine whether there is a long-term relationship between the amount of domestic capital formation and exports.

Results from Tests of Stationarity

The ADF test was used to determine whether unit root was present in each of the three variables. Using the Akaike information criterion (AIC) and SIC criterion, a lag of one was selected as the test's lag duration. According to the test, there was 0% differencing, and all three variables were non-stationary, or $I(1)$ at level.

Table 1. ***The Results in Multiple Correlation***

	Correlation Coefficient
Exp.	
Inv.	0.922***
Manuf.	0.0805
N	61

Note. * implies p-value < 0.05, ** implies p-value < 0.01, *** implies p-value < 0.001.

Table 2. ***Augmented Dickey-Fuller Test Results for First Difference of all Three Variables***

Variable	Critical Value ($\alpha = 0.05$)	Obtained ADF Statistic	p-value of ADF
Log*Exports*	–2.9126	–4.1765	0.0016*
Log*Inv*.	–2.9117	–8.2628	0.0000*
Log*Manuf*.	–2.9117	–7.1328	0.0000*

Note. * indicates the statistic obtained to be significant.

It became evident from this that in order to achieve stationarity or to be $I(0)$, all three variables needed to be differenced. When the variables were log-transformed to eliminate the model stability problems, the same thing happened. All three were $I(0)$ at the initial differencing, as seen in Table 2.

ARDL Cointegration Model

The lag-length criterion test must be carried out prior to the ARDL cointegration – Bounds test in order to determine the maximum length of the lags for each variable in the model. The outcome that was attained was as follows:

According to Hannan–Quinn, Schwarz, and AIC, a lag of 1 was the best option for the variables' ARDL cointegration, as indicated by the lag-length test results, which are displayed in Table 3.

Table 3. ***Lag-length Selection Criteria***

ag	Log*L*	*ILR*	*F*	*AIC*	*SC*	*HQ*
0	78.96111	NA	1.33E–05	–2.712897	–2.604396	–2.670831
1	261.5211	339.0400*	2.71e–08X	–8.911469*	–8.477465*	–8.743206*
2	265.6039	7.144776	3.24E–08	–8.735852	–7.976345	–8.441393
3	271.7761	10.14016	3.61E–08	–8.634862	–7.549852	–8.214206
4	275.6003	5.87284	4.41 e–08	–8.450011	–7.039498	–7.903158
5	280.3226	6.746207	5.25E–08	–8.297237	–6.561222	–7.624188

Note. LR : sequential modified LR test statistic (each test at 5% level) ; FPE : Final prediction error, AIC : Akaike information criterion, SC : Schwarz information criterion, HQ : Hannan–Quinn information criterion, * indicates lag order selected by the criterion.

Results from ARDL Cointegration

The initial ARDL model was created by taking into account the log transformations of the variables because non-log original ratio models typically exhibit low acceptance, failing the bounds test, weak stability, serial autocorrelation, and heteroskedasticity. Logarithmic transformations are therefore required in order to conduct the research and use the ARDL model. Equation (3) displays the fundamental functional form that was used.

$$\text{Ln}\,(\mathit{Exports}) = \alpha + \beta_1 * \text{Ln}\,(\mathit{Investment}) + \beta_2 * \text{Ln}\,(\mathit{Manuf.}) + \varepsilon_t$$

Equation 3 : Basic functional form of the ARDL model.

The ARDL (*p, q,* and *r*) model that was generated was of the order (1,0,1), which was selected based on the Schwarz criterion. This indicated that in the model, the dependent variable, i.e., Ln (*Exports*), had a lag of 1 while the first regressor, Ln(*Investment*), did not have any lag, and the second regressor, i.e., Ln (*Manuf.*) had a lag of 1.

The fundamental ARDL set of equations is as follows, given there are three variables:

- $F_x\,(\Delta(Exp._t) = f(\Delta\,(Rate\ of\ Inv._t), \Delta\,(Share\ of\ Manufacturing)\,)$
- $F_y\,(\Delta\,(Rate\ of\ Inv._t) = f(\Delta\,(Rate\ of\ Inv_t), \Delta\,(Share\ of\ Manufacturing))$
- $F_z\,(\Delta\,(Manuf._t) = f(\Delta\,(Rate\ of\ Inv._t), \Delta\,(Exports))$

Mathematical expressions for the following Equations 4–6 are as follows:

$$\text{Ln}(Exp.) = C + \beta_1.(\text{Ln}(Exp._{-1})) + \beta_2.(\text{Ln}(Inv.)) + \beta_3.(\text{Ln}(Manuf.)) + \beta_4.(\text{Ln}(Manuf._{-1})) + \varepsilon_t$$

Equation 4 : Impact of manufacturing and investment on the rate of exports.

$$\text{Ln}(Inv.) = C + \beta_1.(\text{Ln}(Inv._{-i})) + \beta_2.(\text{Ln}(Exp.)) + \beta_3.(\text{Ln}(Manuf.)) + \varepsilon_t$$

Equation 5 : Relation between investment, exports, and manufacturing.

$$\text{Ln}(Manuf.) = C + \beta_1.(\text{Ln}(Manuf._{-1})) + \beta_2.(\text{Ln}(Inv.)) + \beta_3.(\text{Ln}(Exp.)) + \beta_4.(\text{Ln}(Exp._{-1})) + \beta_5.(\text{Ln}(Exp._{-2})) + \beta_6.(\text{Ln}(Exp._{-3})) + \beta_7.(\text{Ln}(Exp._{-4})) + \varepsilon_t$$

Equation 6 : Role of lagged exports and investment in manufacturing.

All models displayed a high goodness of fit (R^2) when the original ARDL model was created, and the equations were generated, as shown in Table 4. However, some of the coefficients in each model proved to be unimportant, with p-values higher than the generally recognized critical level of 0.05. After analyzing the models, the most pertinent one was the one that used exports as the dependent variable, with exports being the primary variable of interest and its relationship to investment rates and the percentage of manufacturing in GDP.

$$\text{Log}(Exp._t) = 0.8390*\text{Log}(Exp._{t-1}) + 0.43225*\text{Log}(Inv._t) + 0.38838*\text{Log}(Manuf.) - 0.536532790732*\text{Log}(Manuf._{t-1}) - 0.577507088268$$

Equation 7 : Result of the ARDL model obtained from Table 4.

Table 4. *Results of ARDL Estimation*

Variables	Coefficient	Std. Error	*t*-Statistic	Prob*
LNEXPORTS (–1)	0.839088	0.050598	16.58338	0
LNINV.	0.432258	0.133076	3.248207	0.002
LNMANUF.	0.388386	0.28763	1.350299	0.1825
l – NMIANUF. (*–l*)	–0.536533	0.315857	–1.698656	0.095
C	–0.577507	0.476241	–1.212636	0.2305
R-squared	0.984424	Mean dependent var.		2.189743
Adjusted *R*-squared	0.983291	*SD* dependent var.		0.652602
SE of regression	0.084357	Akaike info criterion		–2.027863
Sum squared resid	0.391385	Schwarz criterion		–1.853335
Log-likelihood	65.8359	Hannan–Quinn criteria.		–1.959596
F-statistic	869.018	Durbin–Watson stat.		2.039256

Note. * implies that *p*-values and any subsequent tests do not account for model selection.

The model has an order of (1,0,1) and represents a constrained constant. This means that what we get from the model's coefficients has less to do with linear coefficients and more to do with the elasticities of the corresponding regressors in relation to exports. Manufacturing has a 0.38 investment elasticity, but exports have a 0.43 one. The model suggests that a higher elasticity of manufacturing becomes essential to influence the rate of exports (given its current domination by services). The cointegration equation obtained as part of the initial ARDL test is reported below in Equation (8). Moreover, the levels equation produced when restricting "no trend" and a constrained constant is displayed in Table 5.

Table 5. *Levels Equation*

Levels Equation Case 2: Restricted Constant and No Trend				
Variables	**Coefficient**	**Std. Error**	***t*-Statistic**	**Prob.**
LNINV.	2.686301	0.293424	9.155016	0
LNMANUF.	–0.920672	1.137442	–0.809423	0.4218
C	–3.588965	2.976806	1.205643	0.2331

Note. EC = Ln*Exports* – (2.6863*Ln*Inv*. –0.9207*Ln*Manuf*. –3.5890)

$$\Delta(\text{Log}(Exports) = -0.1609118 * (\text{Log}(Exports_{-1}) - (2.6863 * \text{Log}(Inv.) - 0.92067 * \text{Log}(Manuf._{-1}) - 3.5889))$$

Equation 8 : Cointegration equation.

The model is clearly appropriate for the given data, as seen in Figure 3. There is a possibility of a long-term association employing the manufacturing and investment variables in addition to the dependent variable's delays, as the dependent variable's fitted values nearly match the actual values. Passing the residual, stability, and ARDL Bounds test, as well as other model tests, is the actual challenge.

Table 6 displays the results of the ARDL bounds test that was conducted. The hypotheses for the test are as follows:

➯ **H0 :** No long-run relationship exists between exports and capital formation and share of manufacturing in India.

Figure 3. ***Actual Plot versus Fitted Plot (Using the Model)***

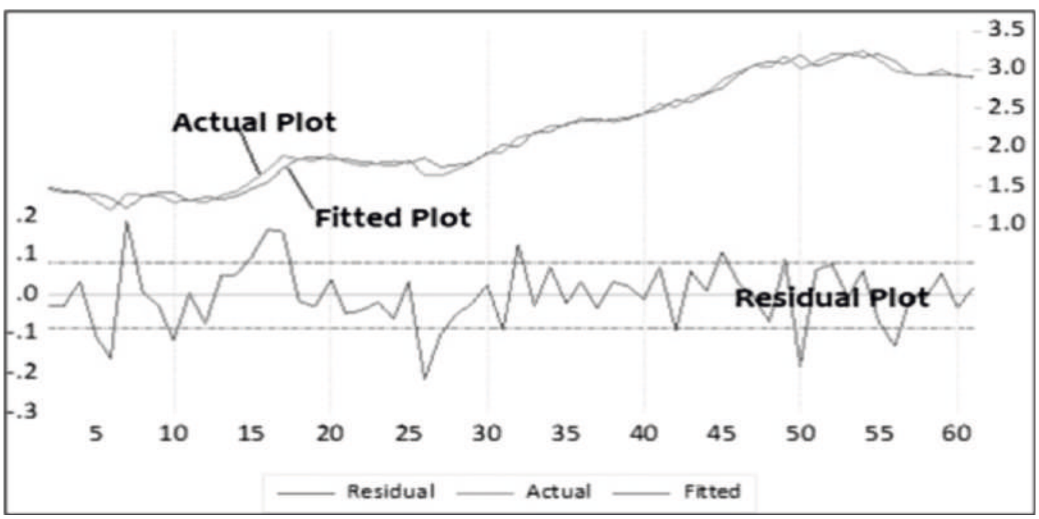


Table 6. ***ARDL Bounds Test Results (α = 0.05)***

***F*-Bounds Test**	Null Hypothesis : No levels of relationship.			
Test Statistic	**Value**	**Significance**	***I*(0)**	***I*(1)**
F-statistic	4.107595	10%	2.63	3.35
K	2	5%	3.1	3.87
		2.50%	3.55	4.38
		1%	4.13	

↳ **H1 :** A long-run relationship exists between exports and capital formation and share of manufacturing in India.

At the 5% level of significance, Table 6 demonstrates that the *F*-statistic computed as part of the boundaries test is 4.107, which is greater than the upper bound of 3.87. As a result, the null hypothesis (H0) of no long-run relationship between the considered variables is rejected.

An error-correcting mechanism that has been replicated in Table 7 must be constructed in order to satisfy the adjustment equation for the aforementioned model.

The speed of adjustment in the event of disequilibrium is represented by the Coint.Eq(–1)*, which is negative under the assumption of a no-trend and has a coefficient estimate of –0.160. This implies the speed of adjustment toward long-run equilibrium is 160% or in other words, the system corrects itself at a speed of 160% within one period. The respective *t*-statistic is –4.16 and is significant.

Residual and Stability Diagnostics

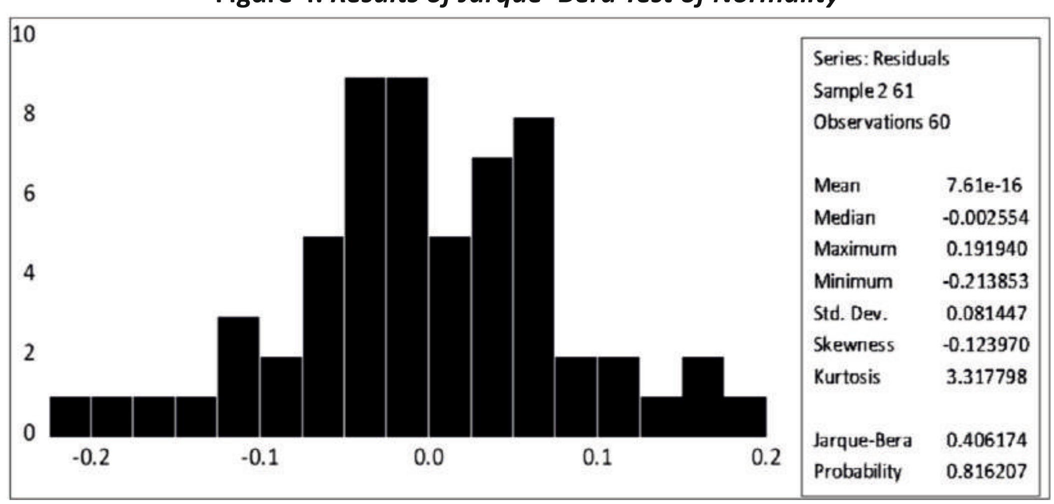
The residuality diagnostics have to be checked next. In addition to the CUSUM and CUSUM squares tests, this

Table 7. ***Results of Error Correction Model Regression***

ECM Regression Case 2 : Regression - Constant and No Trend				
Variables	**Coefficient**	**Std. Error**	***t*-Statistic**	**Prob**
D(*LnManuf*)	0.388388	271147	1432382	0.1577
CointEq.(–1)*	–0.160912	0.038857	–0.4162521	1
R-squared	0.199982	Mean dependent Var.		0.023845
Adjusted *R*-squared	0.186188	*SD* Dep. Var.		0.09106
SE of regression	0.082146	Akaike Info criterion		–2.127863
Sum squared resid	0.391385	Schwarz criterion		–2.058052
Log-likelihood	65.8359	Hannan–Quinn criterion		–2.100556
Durbin–Watson Stat.	2.039256			

Note. * *p*-value incompatible with *t*-distribution : This implies that the *t*-statistic obtained does not necessarily follow *t*-distribution, but rather Dickey–Fuller.

Figure 4. ***Results of Jarque–Bera Test of Normality***



entails assessing the model for serial autocorrelation, heteroskedasticity, and normality. First, the model's assumption of normalcy was examined using the Jarque–Bera test. Figure 4 shows that the estimate's *p*-value was 0.81, higher than 0.05, rejecting the null hypothesis that the generated model was non-normal.

After this, the null hypothesis of the Breusch–Godfrey autocorrelation test was that there was no serial autocorrelation for up to two lags. The hypotheses taken up for the test were as follows:

- **H2 :** No serial autocorrelation exists up to two lags.
- **H3 :** Serial autocorrelation exists up to two lags.

The observed R^2 obtained from the ARDL model reported a probability of 0.516 (p-value > 0.05), implying the model was free from serial autocorrelation, as seen in Table 8.

The next test involved testing the ARDL model for heteroskedasticity. Breusch–Pagan test was conducted with the null assumption being there was no homoskedasticity. In order to provide evidence of homoskedasticity in the model, the null hypothesis is rejected based on the findings shown in Table 9.

- **H4 :** In this scenario, heteroskedasticity does not exist.
- **H5 :** The model exhibits the presence of heteroskedasticity.

Table 8. ***Breusch–Godfrey Test for Serial Autocorrelation***

Breusch–Godfrey Serial Correlation LM Test			
Null hypothesis : No serial correlation at up to 2 lags			
F-statistic	0.597102	Prob. *F*(2.53)	0.5541
Obs.* *R*-squared	1.322137	Prob. $\chi^2(2)$	0.5163

Table 9. ***Breusch–Pagan Test of Heteroskedasticity***

Breusch–Pagan–Godfrey Test for Heteroskedasiticity			
Null hypothesis : Homoskedasticity exists.			
F-statistic	0.502121	Prob. *F* (4.55)	0.7343
Obs. * *R*-squared	2.113879	Prob. $\chi^2(4)$	0.7148
Scaled explained SS	2.05849	Prob. $\chi^2(4)$	0.725

The next phase is stability diagnostics, which includes the CUSUM and CUSUM-squares tests. Plots made as part of Figure 5 are used to visualize the stability of the selected model.

The model under consideration is structurally stable, as shown by the charts shown in Figure 5 (both charts have to be read together). This is implied by the graphs, where the parameters are almost entirely within the 5% boundaries in both instances.

Causal Inference Using Granger Causality

The Granger causality test helps to understand if a time series helps predict or influence another series. Under this technique, we regress a variable Y on a lagged value of itself and other variable X. If X turns out to be statistically significant, it explains (Granger-causes) some of the variance of Y, which is not explained by lagged values of Y. The test was conducted using log transformations of the variables, with mixed results. The results are shown in Table 10.

Figure 5. ***Results of CUSUM and CUSUM Squares Test***

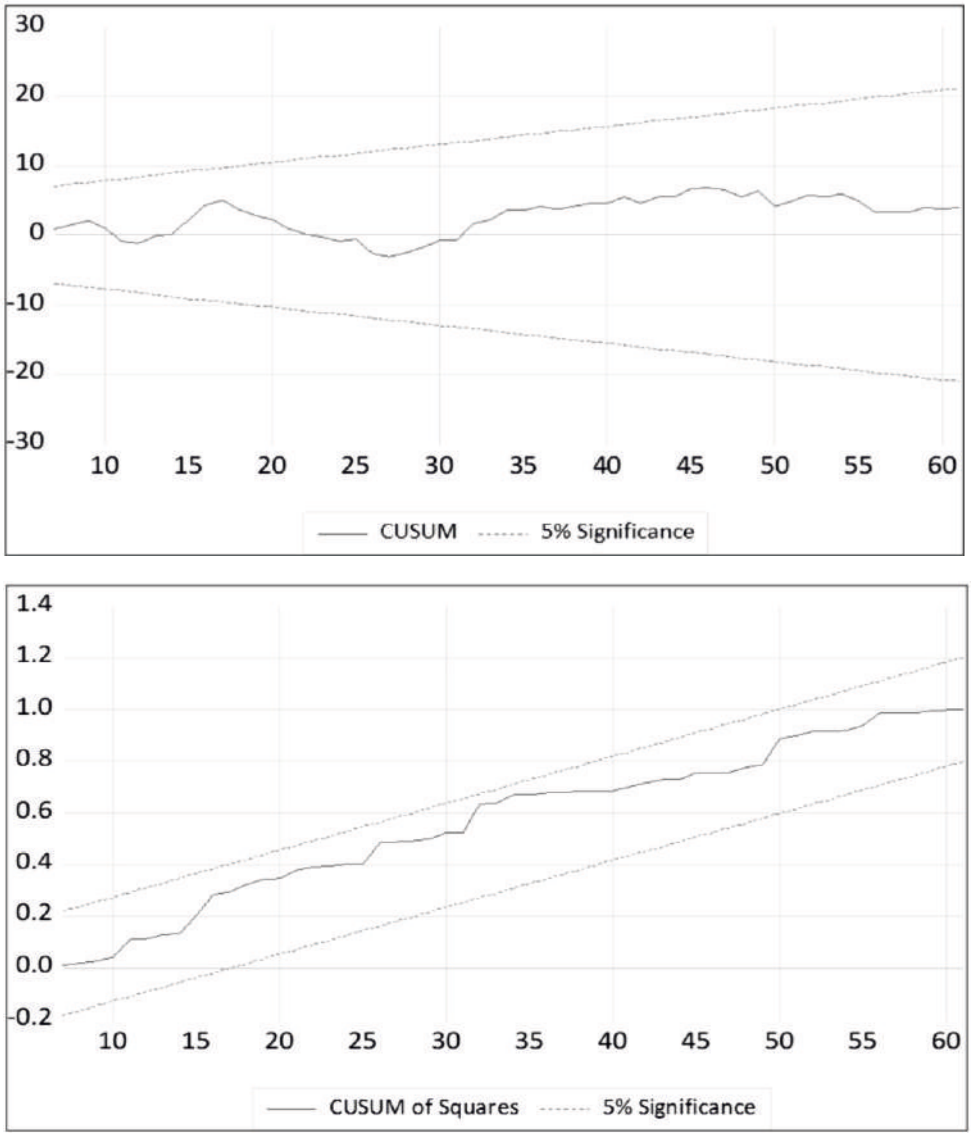


Table 10. ***Results of Granger Causality Test (with 2 lags)***

Hypothesis	Observations	*F*-Statistic	Prob.
LINV does not Granger cause *LEXP01**.	59	5.60782	0.0061
LEXP01 does not Granger cause *LINV***.		0.79599	0.4564
LMANUF does not Granger cause *LEXP01**.	59	0.09772	0.9071
LEXP01 does not Granger cause *LMANUF***.		0.43537	0.6493
LMANUF does not Granger cause *LINV**.	59	4.16059	0.0209
LINV does not Granger cause *LMANUF* **.		0.09329	0.9111

Note. * implies null hypothesis (H0) ; ** indicates alternate hypothesis (H1).

The first test was to check if the rate of investment influenced the rate of exports. The initial hypothesis was that investment does not Granger-cause exports. The statistic's p-value is less than 0.05, indicating a unidirectional causal relationship in which the rate of investments affected the rate of exports but not the other way around (the p-value was more than 0.05). The second test was to see if India's share of manufacturing influenced its rate of exports. The results showed that there was no causality running in both directions. The null hypotheses could not be rejected since the estimations' probability was not statistically significant. This suggested that exports have no effect on the proportion of manufacturing or are impacted by it.

The third causality experiment was run between the share of manufacturing and the rate of investment. It was found that the rate of investment did not grow because of the share of manufacturing. However, the share of manufacturing tended to grow because of the rate of investment, implying that investment priorities were linked to the contribution of the manufacturing sector.

Managerial and Theoretical Implications

There are currently few management implications from this study effort. Given India's poor manufacturing base (13% of GDP as of 2022, according to the World Bank), one effect is the recognition of the importance of significantly expanding the breadth and scale of manufacturing-oriented exports for the country. The statement also emphasizes the necessity for the business to explore alternative investment opportunities and increase manufacturing in India, both of which can lead to a rise in productive employment.

The research offers a different approach to examining India's exports and potential factors when it comes to theoretical ramifications. It aims to make new ground in delivering the empirically researched result to build a potential macro-level transmission mechanism by demonstrating the presence of a long-run relationship between India's rate of exports, rate of investments, and share of manufacturing. Additionally, it advances the field by offering a macroeconomic viewpoint on the benefits of increasing manufacturing investments and altering the value of the export basket to lessen the current reliance on services, especially ITES [2].

Conclusion

Numerous economists have extensively researched the significance of savings and additional investment for economic growth. Roy F. Harrod and Evsey Domar made significant progress in this area with their seminal Harrod–Domar model. The amount of research that is currently available demonstrates how extensively and using a variety of econometric methodologies, the role of exports, industrialization, and capital formation in determining growth in different contexts (India and BRICS) has been explored.

This paper distinguished itself from previous research by employing log-transformations, ARDL cointegration, as proposed by Pesaran et al. (2001) and Granger causality tests to examine the relationship between the rate of investment and the percentage of manufacturing on India's rate of exports. It concludes that investment and the percentage of manufacturing in export rate exhibit long-term cointegration. The Granger causality test yields inconsistent results, though: exports and manufacturing do not cause one another, but the percentage of manufacturing affects the rate of investment. Investments have an impact on exports but not the other way around. The study concludes that increasing the manufacturing share and investment rate is essential to increasing the rate of exports and that policies should be focused on building a strong manufacturing foundation to pave the way for future ELG.

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[2] IT and Enabled Services.

Limitations of the Study and Scope for Further Research

The present study is restricted to using a macro-level methodology to comprehend how India might achieve export-led growth by gradually increasing its export rate (as a percentage of GDP). This leads to a loss of opportunities regarding the competitiveness of the Indian export basket, the relative cost of Indian exports, and the demand for Indian exports throughout the world market.

Additional study opportunities may lie in examining how different sectors behave when it comes to exports in relation to interest rates, labor market circumstances, labor productivity, and capital used. Furthermore, more research is needed to understand how macroeconomic policies are affecting overall export trends and how the general engines of the economy can help drive Indian exports to be globally competitive in terms of both price and quality, even though efforts are being made to conduct state-by-state sector-specific export competitiveness analyses.

Author's Contribution

The concept was created by Mr. Pavan Kumar Thimmavajjala in 2021 following his graduation from the University of Hyderabad with an MA in Economics. After earning an MA in August 2021, the quantitative design was created in the interval when he was employed as an Economic Research Analyst at Nikore Associates following graduation. This was prior to his current position as a Research Associate at the University of Hyderabad. While working as a freelance contributor to ISPP Policy analysis and Econfinity, as well as an independent economic researcher, additional research and a literature analysis were conducted. Using E-Views software, the required econometric analysis was completed in its entirety. The author will always be thankful to Dr. Krishanu Pradhan, Assistant Professor at the Madras Institute of Development Studies in Chennai, for his early remarks and inputs on the study.

Conflict of Interest

The author certifies that he has no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

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