Unveiling the Impact of Manufacturing Growth on Productivity Dynamics in India

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Abstract

The manufacturing sector plays a crucial role in driving economic growth and productivity in a country by creating jobs, advancing technology, and significantly contributing to GDP. Its prowess not only bolsters domestic industries but also underpins international competitiveness, cementing its pivotal role in sustaining economic dynamism.The present study examines the role played by manufacturing sector in productivity dynamics of India by examining relevance of Kaldor's growth laws from 1981–82 to 2019–20, affirming their empirical validity. To achieve this objective, ARDL bounds testing approach has been used for estimation. The results of the study reveal that first and third law does hold for the country during the study period. The findings reveal a substantial and positive contribution of manufacturing growth to overall economic and productivity growth in India. Based on the findings of the study it is advised for policymaker need to prioritize manufacturing sector growth through incentives like, improved infrastructure and a favourable business environment.

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Manufacturing sector, productivity growth, ARDL, Kaldor's Growth laws, India	*https://doi.org/10.54694/stat.2024.59*	*C01, D20, E10*

INTRODUCTION

Economic growth is crucial in any economy of the world as it fosters increased living standards, job creation, and technological advancements, ultimately enhancing overall societal well-being, if it occurs in a desired manner. Because of this reason, any policy framework naturally gravitates towards making economic growth its focal point. It is the economic growth with the aid of which developing countries have

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a hope to converge with the developed ones. There are two important and distinct opinions on the issue of addressing the growth concerns of developing economies. The neoclassical paradigm which emphasizes that nations should specialize in those sectors where they have a comparative cost advantage over rivals and the post-Keynesian development paradigm which follows Kaldor's engine of growth' hypothesis. The hypothesis suggests a focus on boosting the manufacturing sector, even if it lacks a comparative advantage in the initial stages of development (Cantore et al, 2014).

Manufacturing industry holds immense importance in any economy which aims to achieve the heights of development and prosperity. It boosts all aspects of the economy, from traditional to more moderate, through the spread of technology to accelerate economic growth by increasing production growth and productive efficiency (Amirapu and Arvind, 2015). The manufacturing sector serves as means for stimulating innovation, advancement, and competitiveness, with the goal of amplifying production, improving exports, and meeting the fundamental needs and desires of a nation. Moreover, the manufacturing sector undergoes both opportunities and challenges, contingent on conventional manufacturing methods (Banister, 2005). Having large forward and backward linkages, the growth of this sector holds crucial place and thereby lies at the centre of every economic planning. The unique qualities of the manufacturing sector can raise the competitiveness of economy over time and disseminate favourable externalities to other significant economic sectors (Cantore, Clara and Soare, 2014).

Depending on stage of development, the relative size and importance of the manufacturing sector varies among economies. In context of India, it's important to note that the country has lagged behind in the manufacturing sector compared to some other countries like China with similar levels of development and per capita income. Despite its historical roots in manufacturing, the post-independence era saw a shift towards an agrarian-focused economy. The subsequent policy of import substitution industrialization, although aimed at self-reliance, resulted in a highly regulated and less competitive manufacturing sector.

The 'Make in India' initiative, launched in 2014, aimed to reverse this trend by promoting a more business-friendly environment, attracting foreign investment, and fostering innovation. However, challenges such as inadequate infrastructure, complex regulations, and a rigid labour market persist. The sector's diversity, spanning automobiles, textiles, pharmaceuticals, electronics and chemicals offer potential, but there is a need for increased productivity and technology adoption. The push towards Industry 4.0 and integration into global supply chains, along with a focus on sustainability and green manufacturing, are critical aspects of India's ongoing efforts to strengthen its manufacturing sector.

Economic theories have stressed that economic development depends on the efficiency of using available resources, their productivity respectively (Stiglitz, 2005). Manufacturing growth plays a pivotal role in driving overall economic growth and productivity, a concept elucidated by Kaldor's law. P. J. Verdoorn, a Dutch economist, initially presented this idea in his research on productivity and output growth. He highlighted the statistical relationship between long-term growth rate of labor productivity and output, specifically within the manufacturing sector. Verdoorn's premise posited that output growth fosters productivity growth by facilitating increased labour division and specialization.

Building upon Verdoorn's foundation, Nicholas Kaldor incorporated Verdoorn's law into his exploration of alternative distribution theories, aiming to elucidate the sluggish economic growth in the United Kingdom. In subsequent works (1966, 1968, 1975), Kaldor expanded on Verdoorn's ideas and formulated three laws. The first law asserts a positive relation between a country's GDP growth and growth in manufacturing output. The second law posits a positive relation between a country's growth in manufacturing productivity and its manufacturing output growth. The third law asserts that a country's growth in non-manufacturing productivity is positively correlated with the growth in manufacturing output.

First law having a straight forward explanation as manufacturing growth forms a part of overall growth and can be expected to have a positive impact on overall growth of the economy. Second law is based on economies of scale, where increase in manufacturing sets in economies of scale in this sector by increasing productivity. According to Kaldor's third law, productivity in non-manufacturing sectors experiences an upswing with an increase in manufacturing sector output. This phenomenon is attributed to the substantial spillover effects that the manufacturing sector exerts on other segments of the economy. The present study aims to delve into and assess the assertion put forth by Kaldor's three growth laws, positing that the manufacturing sector plays a pivotal role as an engine of growth. The focus will be to empirically examine Kaldor's three growth laws within Indian context.

A significant research gap emerges in the context of India, as there is a conspicuous absence of recent studies investigating the applicability and implications of Kaldor's Laws, and highlights the need for a comprehensive examination of this phenomenon. By shedding light on the extent to which manufacturing growth positively influences the productivity of the entire Indian economy, this research aims to provide actionable insights for policymakers, economists, and industry stakeholders. The findings of this study have the potential to inform strategies for fostering sustainable economic development, job creation, and technological progress in India, which are crucial for achieving long-term economic prosperity and improving the standard of living in the country.

1 REVIEW OF LITERATURE

1.1 Theoretical literature

Kaldor's first growth law establishes a positive relationship between manufacturing growth and overall economic growth in the economy. Kaldor's first law is estimated in the following form:

$$G_{nm} = \Upsilon_1 + \Upsilon_2 G_m + \varepsilon, \qquad \text{where } \Upsilon_2 > 0, \qquad (1)$$

where G_{nm} represents the rate of GDP growth in the economy, G_m is growth of manufacturing output and ε is error term. Υ_2 represents the impact of manufacturing growth on overall economic growth of the economy, Kaldor's first law posits that this impact should be positive.

Kaldor's Second law posits that as manufacturing sector grows, economies of scale tend to occur which pushes productivity in this sector to higher levels. The law can be estimated in the following form:

$$P_m = \Upsilon_1 + \Upsilon_2 G_m + \Upsilon_3 Em + \varepsilon, \qquad \text{where } \Upsilon_2 > 0, \qquad (2)$$

where P_m is the productivity in manufacturing sector, G_m is growth of manufacturing output, Em is the employment growth in manufacturing sector and ε is error term. Υ_2 represents the impact of manufacturing growth on productivity in the manufacturing sector, Kaldor's second law posits that this impact should be positive, pointing towards occurrence of economies of scale in the manufacturing sector as the sector grows overtime.

Kaldor's third law posits the transmission of productivity increases in the non-manufacturing sector as manufacturing sector grows. According to this law, as manufacturing output increases, surplus labor employed in other sectors of the economy is drawn out, which lowers the rate of disguised unemployment and therefore raises productivity in other sectors of the economy. The law is based on Lewis (1954) premise of transferring labor from agriculture sector to non-agriculture sectors, manufacturing being one among them:

$$P_{nm} = \Upsilon_1 + \Upsilon_2 G_m + \varepsilon, \qquad \text{where } \Upsilon_2 > 0, \qquad (3)$$

where P_{nm} is the rate of productivity growth in non-manufacturing sector, Υ_1 is intercept, $\Upsilon_2 G_m$ is rate of growth in manufacturing sector, and ε is the error term or white noise. Cripps and Tarling (1973) propose an alternative formulation of this law, stating that the aggregate productivity growth exhibits a positive correlation with the growth rate of output in the manufacturing sector and a negative correlation with the growth rate of employment in non-manufacturing sectors:

$$P_{nm} = \Upsilon_3 + \Upsilon_4 G_m + \Upsilon_5 E_{nm} + \varepsilon, \qquad \text{where } \Upsilon_4 > 0 \ \& \ \Upsilon_5 < 0, \tag{4}$$

where P_{nm} refers to productivity in non-manufacturing sector, Υ_3 refers to some constant, $\Upsilon_4 G_m$ refers to rate of growth of manufacturing output, $\Upsilon_5 E_{nm}$ refers to rate of growth of employment in non-manufacturing sector and ε refers to error term.

1.2 Empirical literature

Many scholars have examined role played by manufacturing sector in promoting economic growth and productivity under the shades of Kaldor's growth laws. In 1999, Necmi conducted an evaluation to determine the continued relevance and importance of Kaldor's growth models in light of the rapid growth and expansion of the industrial sector. The results strongly substantiated Kaldor's assertions in the development model, emphasizing the pivotal role of the manufacturing sector as an "engine of growth" for a significant number of emerging economies. Similarly, Tybout's (2000) findings and conclusions echoed this sentiment, highlighting the manufacturing sector's crucial function as a growth engine for developing economies. A broader examination by Szirmai and Verspagen (2015) encompassing 92 low and middle-income countries affirmed that the manufacturing sector performs a driving role in economic growth, particularly when there is a presence of sufficient and efficient human resources. In their assessment of the Kaldor growth model's hypotheses, Chakravarty and Mitra (2009) found that the manufacturing sector has a significant influence on the expansion and development of the Indian economy. Furthermore, in the designated timeframe from 1994–1995 to 2005–2006, Kathuria and Natrajan (2013) scrutinized the role of the manufacturing sector as a growth engine across 15 states in India. They concluded that this supported Kaldor's theory that the industrial sector serves as a growth engine.

Drakopoulos and Theodossiou (1991) tested Kaldor's law for the Greek period 1967–1988, found that there was a positive link between worker productivity and manufacturing. Andrew (1996) discovered evidence for the Kaldorian approach in several countries. Additionally, Noval and Marsal (1998) also supported the validity of Kaldor's first and second laws in the European region. Meliha and Feyza (2011) looked at 23 high-income OECD nations to determine the viability of Kaldor's hypothesis and discovered evidence in support of Kaldor's KEG hypothesis. In some OECD nations between 1980 and 2008, Feyza (2013) also found a long-term correlation between industrial development and economic growth. Thirlwall (1983) examined the Kaldor's first rule for the 1990–2011 period in 89 developing nations and discovered a strong correlation between manufacturing output and GDP.

By combining regional and panel data in China, Hansen and Zhang (1996) and Jeon (2007) discovered that Kaldor's laws were supported by the findings. By applying Kaldor's rule to the South-East Asian nations of Indonesia, Malaysia, the Philippines, Singapore, and Thailand between 1980 and 2000, Hamri and Shazali (2004) came to the conclusion that the expansion of manufacturing production had a major impact on the rise of total output. Al-Awad (2010) examined the impact of industrial growth on the region of the Gulf Cooperation Council (GCC)'s overall GDP from 1997 to 2007. He came to the conclusion that, over time, the region's manufacturing boom had a significant positive impact on non-oil industries.

To our knowledge, there has been a dearth of studies conducted in the Indian context addressing this particular aspect. This study seeks to bridge this gap and enhance the current literature by evaluating Kaldor's growth laws in Indian context for recent period. The remainder of the paper is structured as follows: Section 2 elucidates the data and methodology employed in the study, while Section 3 presents the results and ensuing discussion. Finally, last section is the conclusion, along with some policy implications and potential avenues for future research in this field.

2 DATA AND METHODOLOGY

2.1 Data source and measurement of variables

The present study uses annual time series data from 1981–82 to 2019–20. We have intentionally used data for this period, to escape the distortion in economic data caused by Covid disruption. This is especially crucial since we are relying on the use of econometric methodology for the examination. The data has been taken for the non-manufacturing factor productivity (Productivity growth whole economy), non-manufacturing output (GDP growth whole economy), non-manufacturing employment (Employment growth whole economy), manufacturing productivity, and manufacturing output growth from KLEMS database of RBI. Data on Total factor productivity of whole economy has been used to represent non-manufacturing factor productivity. Although there are different approaches of measuring TFP, however, there is no consensus on which of the measure is best for all purposes (Mehadevan, 2003). For the present study, the data on non-manufacturing factor productivity estimated by KLEMS is directly used without making any changes. In the KLEMS approach, total factor productivity is measured by applying growth accounting. For measuring the total factor productivity of individual industries, the gross production function framework is used, taking capital, labor, energy, materials, and services as five inputs. Then aggregation of these individual measurements is done in order to reach the total factor productivity. Further information about data is presented in Table 1.

Table 1 Data information

Variables	Symbol	Source
Growth economy (GDP)	Ge	KLEMS (RBI)
Employment growth economy	Ee	KLEMS (RBI)
Productivity growth economy	Pe	KLEMS (RBI)
Manufacturing growth	Gm	KLEMS (RBI)
Employment growth manufacturing	Em	KLEMS (RBI)
Productivity growth manufacturing	Pm	KLEMS (RBI)

Source: Authors

2.2 Model specification

Kaldor's growth laws have been examined using following three model specifications.

Kaldor's 1st Growth Law (Model-I):

$$log\mathrm{Ge}_t = \propto_0 + \propto_1 log\mathrm{Gm}_t + \propto_2 log\mathrm{Ee}_t + \varepsilon_t, \tag{5}$$

where Ge_t represents growth in the whole economy, Gm_t represents growth of manufacturing output and Ee_t represents employment growth in the economy.

Kaldor's 2nd Growth law (Model-II):

$$log\mathrm{Pm}_t = \propto_0 + \propto_1 log\mathrm{Gm}_t + \propto_2 log\mathrm{Em}_t + \varepsilon_t, \tag{6}$$

where Pm_t represents productivity in the manufacturing sector, Gm_t represents growth in the manufacturing sector and Em_t represents employment growth in the manufacturing sector.

Kaldor's 3[rd] Growth law (Model-III):

$$logPe_t = \propto_0 + \propto_1 logGm_t + \propto_2 logEe_t + \varepsilon_t, \tag{7}$$

where Pe_t represents productivity in economy at time t, Gm shows manufacturing growth, Ee rate of employment growth (Overall), and ε is the error term.

2.3 Autoregressive distributed lag approach of cointegration

A statistical method known as ARDL is suggested by Pesaran and Shin (1995) and Pesaran et al. (1996) for studying the long-run relationship between the variables that are either level stationary, stationary of first difference, or a combination of two. In economic analysis, Autoregressive distributed lag model (ARDL) (Pesaran and Shin 1999; Pesaran et al. 2001), and cointegration techniques by (Granger 1981; Engle and Granger 1987; Johansen and Juselius 1990) have become widely used for estimating long-run relationships between non-stationary variables. In contrast to other techniques, the ARDL cointegration technique does not call for pre-testing for unit roots (Emeka and Aham, 2016). Lagged variables can be included in the ARDL approach, which makes it possible to analyse equilibrium relationship over the long run as well as short-term dynamics. This is essential to conveying how these relationships change over time. The flexibility of the ARDL methodology in handling mixed-order integrated time series is especially useful. ARDL model is useful when the sample size is small and guarantees that the analysis will yield significant insights despite the limited data. Although ARDL allows estimation of variables which are combination of I(0) and I(1), however Unit root tests can be performed to prevent a model crash in the event that one or more of the variables turns out to be I(2). Finally, a dynamic error correction model (ECM) can be derived from ARDL through a simple linear transformation. The technique of cointegration (ARDL) for three respective models is specified as in Formulas (8), (9) and (10):

$$\Delta Ge_t = \propto_0 + \sum_{i=0}^{n} \propto_{1i} LnGe_{t-i} + \sum_{i=0}^{n} \propto_{2i} LnGm_{t-i} + \sum_{i=0}^{n} \propto_{3i} LnEe_{t-i} + \beta_1 LnGe_{t-1} + \beta_2 LnGm_{t-1} + \beta_3 LnEe_{t-1} + \epsilon_t, \tag{8}$$

$$\Delta Pm_t = \propto_0 + \sum_{i=0}^{n} \propto_{1i} LnPm_{t-i} + \sum_{i=0}^{n} \propto_{2i} LnGm_{t-i} + \sum_{i=0}^{n} \propto_{3i} LnEm_{t-i} + \beta_1 LnPm_{t-1} + \beta_2 LGm_{t-1} + \beta_3 LnEm_{t-1} + \epsilon_t, \tag{9}$$

$$\Delta Pe_t = \propto_0 + \sum_{i=0}^{n} \propto_{1i} LnPe_{t-i} + \sum_{i=0}^{n} \propto_{2i} LnGm_{t-i} + \sum_{i=0}^{n} \propto_{3i} LnEe_{t-i} + \beta_1 LnPe_{t-1} + \beta_2 LnGm_{t-1} + \beta_3 LnEe_{t-1} + \epsilon_t. \tag{10}$$

The parameters $(\propto_0 - \propto_3)$ gauge short-term relationships, while $(\beta_1 - \beta_3)$ capture long-term relationship among variables and ϵ_t represents error term. Formulas (5), (6) and (7) to be estimated using the ARDL framework. Subsequent to verifying cointegration, the next step involves estimating the ECM for primarily two objectives. Firstly, it facilitates an examination of short-term dynamics. Secondly, it furnishes insights into the speed of adjustment within the model. Given these advantages, the following ECM models have been explicitly defined:

$$\Delta Ge_t = \propto_0 + \sum_{i=0}^{n} \propto_{1i} \; LnGe_{t-i} + \sum_{i=0}^{n} \propto_{2i} \; LnGm_{t-i} + \sum_{i=0}^{n} \propto_{3i} \; LnEe_{t-i} + \lambda_1 ECM_{t-1} + \epsilon_t \;, \tag{11}$$

$$\Delta Pm_t = \propto_0 + \sum_{i=0}^{n} \propto_{1i} \; LnPm_{t-i} + \sum_{i=0}^{n} \propto_{2i} \; LnGm_{t-i} + \sum_{i=0}^{n} \propto_{3i} \; LnEm_{t-i} + \lambda_1 ECM_{t-1} + \epsilon_t \;, \tag{12}$$

$$\Delta Pe_t = \propto_0 + \sum_{i=0}^{n} \propto_{1i} \; LnPe_{t-i} + \sum_{i=0}^{n} \propto_{2i} \; LnGm_{t-i} + \sum_{i=0}^{n} \propto_{3i} \; LnEe_{t-i} + \lambda_1 ECM_{t-1} + \epsilon_t \;. \tag{13}$$

In Formulas (11), (12) and (13) the term ECM denotes the error correction term in three growth laws, which shows the speed of adjustment, whereas other variables have already been defined.

3 RESULTS AND DISCUSSION

Within the overall framework, descriptive analysis is the first step towards understanding the fundamental properties of the data. Similarly, descriptive analysis is carried for the current study. This preliminary investigation helps to understand data normality and provides information for later decision about model specification in addition to identify potential anomalies within the dataset. The result of Jarque-Bera test indicates that all the variables follow a normal distribution, making them suitable for further econometric analysis. Furthermore, it is observed that the mean value of the variables is greater than the standard deviation, implying stability in the variables over the study period.

3.1 Unit root results

Testing the unit root is a preliminary exercise in any econometric analysis for examining the stationarity nature of time series data. The presence of unit root can lead to spurious regression results and misleading conclusions in empirical analyses. To check the presence of unit root, Augmented Dickey-Fuller (1981) (ADF) test and Philip-Perron (1988) (PP) are used. Results presented in Table 2 conclude that employment growth, manufacturing and other variables are non-stationary at level except productivity growth in economy for Phillip-Perron with intercept and trend. However, all the variables are found to be stationary at first difference. Concluding the results reveal that variables are combination of I(0) and I(1).

Table 2 Unit root test results

	Intercept		Intercept & trend	
Variables	**ADF test-stat.**	**PP test-stat.**	**ADF test-stat.**	**PP test-stat.**
Level				
Ge	−5.54(0.000)	−5.52(0.000)	−5.66(0.000)	−7.11(0.000)
Pe	−3.75(0.008)	−3.35(0.021)	−3.64(0.042)	−3.18(0.107)
Ee	−2.73(0.077)	−1.81(0.365)	−2.44(0.351)	−1.36(0.856)
Gm	−4.15(0.002)	−3.49(0.013)	−4.04(0.015)	−3.31(0.079)
Pm	−4.53(0.000)	−3.65(0.009)	−5.06(0.001)	−4.12(0.012)
Em	−2.07(0.255)	−2.07(0.255)	−2.20(0.471)	−2.40(0.371)

Table 2 (continuation)

	Intercept		Intercept & trend	
Variables	**ADF test-stat.**	**PP test-stat.**	**ADF test-stat.**	**PP test-stat.**
First diff.				
Ge	−9.67(0.000)	−20.79(0.000)	−9.59(0.000)	−27.13(0.000)
ΔPe	−6.95(0.000)	−7.25(0.000)	−7.04(0.000)	−7.31(0.000)
ΔEe	−3.81(0.009)	−3.69(0.008)	−3.81(0.026)	−3.84(0.025)
ΔGm	−8.81(0.000)	−4.58(0.001)	−6.44(0.000)	−4.79(0.000)
ΔPm	−6.16(0.000)	−11.02(0.000)	−6.22(0.000)	−11.91(0.000)
ΔEm	−4.69(0.000)	−4.59(0.000)	−4.63(0.003)	−4.53(0.004)

Note: The corresponding P-values are given in parenthesis.
Source: Authors

Keeping in view that the variables under consideration are combination of I(0) and I(1), ARDL modelling and Bounds testing are found to be optimal choice for estimation. The first step for ARDL is to check whether the long run relationship does exist or not, for which ARDL Bounds test is applied. In the bound testing approach, the null hypothesis positing no Cointegration among variables is assessed against the alternative hypothesis suggesting Cointegration. The results of the bounds test in Table 3 offer compelling evidence for the presence of long-run relationship, given that the F-Statistic exceeds the upper bound values at a 5% level of significance for all the three growth laws.

Table 3 ARDL bounds test results

Model-I				
		10%	3.17	4.14
3	12.96	5%	3.79	4.85
		1%	5.15	6.36
Model-II				
		10%	3.17	4.14
3	6.241	5%	3.79	4.85
		1%	5.15	6.36
Model-III				
		10%	2.17	3.19
3	8.241	5%	2.72	3.83
		1%	3.88	5.30

Source: Authors

3.2 Long run results

Long run results presented in Table 4 reveal strong positive correlation between the manufacturing growth (Gm) and economic growth. It shows that 1% increase in manufacturing output is associated with a 0.24% increase in economic growth. The coefficient for employment growth (Enm), is negative (−0.36), but insignificant. Panel-B, examines the second law. The coefficient for manufacturing growth

(Gm) and employment growth (Em), are insignificant which shows lack of relationship. The result of third law in Panel-C reveals that manufacturing growth has positive and significant impact on productivity of the economy. A look at results indicates that 1% increase in manufacturing output leads to increase in productivity by 0.23%. Further, the coefficient from impact of employment growth on productivity is found to be negative and significant. These findings support Kaldor's third growth law (Model-III) prepositions in India.

However, results also revealed that Kaldor's second law (Model-II) does not hold in India for the study period, meaning economies of scale doesn't occur in manufacturing sector in the long run. The results of this study affirm the validity of Kaldor's first and third growth law and are in line with available literature of (Kathuria and Natrajan 2013; Chakravarty and Mitra, 2009; Cantore, Lennon and Clara 2016; Romero and Mccombie, 2016; Pacheco-Lopez and Thirlwall, 2014; Necmi, 1999; Roodman, 2009; Sukti Dasgupta and Ajit Singh, 2005; Marconi et al., 2016).

Table 4 Long run results

Variable	Coefficient	Std. error	T-statistic	Prob.
Panel-A: Model-I				
Gm	0.24	0.04	5.25	0.000
Enm	–0.36	0.24	–1.49	0.143
Panel-B: Model-II				
Gm	4.29	7.25	0.59	0.551
Em	–0.89	6.75	0.70	0.423
Panel-C: Model-III				
Gm	0.23	0.039	5.94	0.000
Enm	–0.32	0.11	2.91	0.006

Source: Authors

3.3 Short run results

Short run ECM results are presented in Table 5. These results reveal that in line with long run results manufacturing growth has positive impact on overall economic growth, although the effect is bit stronger than the long run. Results of Model-II reveal that in short run economies of scale actually sets in, as manufacturing growth has positive impact on manufacturing productivity in the short run at 5% level of significance, where 1% increase in manufacturing growth increase productivity in this sector by 0.63%. In line with the long run results, findings of Model-III reveal that manufacturing growth has positive and significant impact on productivity growth in the economy in short run as well, where 1% increase in manufacturing growth increases productivity growth by 0.26 percent. Similarly, employment growth has negative impact on the productivity growth in Indian economy in short run, where 1% increase in employment growth decreases productivity growth by 0.35 percent. The results also reveal that short run impact of independent variables on dependent variable is stronger as compared to long run.

Error correction results show statistically significant association between the selected variables and lagged error correction representation (ECM_{t-1}). Similarly, rate of transition from short-run disequilibrium to long-run equilibrium is shown by the coefficient of –1.12 and –1.10 for first and third growth law respectively. Accordingly, adjustments are rectified by 112% and 110% annually. This shows that in case of any disequilibrium, it may take less than a year to revert back to equilibrium position in both the cases. While for the second law, no evidence of such stable long run association was revealed, as ECM_{t-1} was found to be statistically insignificant.

Table 5 Short run results

Variable	Coefficient	Std. error	T-statistic	Prob.
Panel-A: Model-I				
Gm	0.28	0.049	6.65	0.000
Enm	–0.20	0.264	–0.76	0.449
CointEq.(–1)	–1.12	0.124	–8.82	0.000
R-square		Adjusted R-square		
0.61		0.57		
Panel-B: Model-II				
Pm-1	0.10	0.065	2.62	0.015
Gm	0.63	0.100	6.29	0.000
Em	–0.75	0.344	–0.83	0.449
CointEq.(–1)	0.10	0.234	0.45	0.643
R-square		Adjusted R-square		
0.52		0.48		
Panel-C: Model-III				
Pnm-1	0.10	0.065	2.62	0.015
Gm	0.26	0.043	6.03	0.000
Enm	–0.35	0.11	–3.10	0.003
CointEq.(–1)	–1.10	0.116	–9.46	0.000
R-square		Adjusted R-square		
0.68		0.65		

Source: Authors

3.4 Sensitivity estimates

Sensitivity estimates for the model are shown in Table 6. The independence of error components (serial correlation) is confirmed by the Breusch-Godfrey serial correlation LM test, which finds no indication of serial correlation in all the three models. Additionally, the absence of heteroscedasticity is supported by tests for autoregressive conditional heteroscedasticity (ARCH) using the Breusch-Pagan-Godfrey and Glejser tests. The F-statistics values and accompanying probability values are above 5% level of significance, which shows that the models used are most appropriate given data set. These results give reason to believe that the model performance is reliable and that it is appropriate for the study under investigation in all the three cases.

Table 6 Sensitivity estimates

	Obs. R-square	F-statistic	Prob.
(Model-I)			
Breusch-Godfrey serial	0.74	0.32	0.68
Correlation LM test			
Heteroskedasticity test	4.338	1.46	0.22
Breusch-Pagan-Godfrey			
Heteroskedasticity test Glejser	6.55	1.24	0.24
(Model-II)			
Breusch-Godfrey serial	2.31	0.97	0.31
Correlation LM test			
Heteroskedasticity test	2.61	1.28	0.30
Breusch-Pagan-Godfrey			
Heteroskedasticity test Glejser	6.43	1.30	0.15

Table 6 (contunuation)

	Obs. R-square	F-statistic	Prob.
(Model-III)			
Breusch-Godfrey serial	0.61	0.27	0.73
Correlation LM test			
Heteroskedasticity test	3.661	1.20	0.30
Breusch-Pagan-Godfrey			
Heteroskedasticity test Glejser	3.651	1.140	0.34

Source: Authors

3.5 Stability estimates

Moreover, the CUSUM and CUSUM Square tests have been applied in order to test for model stability. The results of CUSUM square (shown in Figures 1, 2 and 3) provide a dynamic perspective on the model stability for all the three growth laws, by analysing cumulative sums of the estimated coefficients and their squares. The results of these tests add further confidence to the robustness and reliability of the findings obtained from the econometric analysis. By employing these advanced stability tests, the study ensures that the relationship between variables remains consistent and reliable throughout. Lastly it is pertinent to mention that models are selected using AIC (Akaike Information Criteria) among top 20 models in three respective cases.

Figure 1 CUSUM of Squares (Model-I)

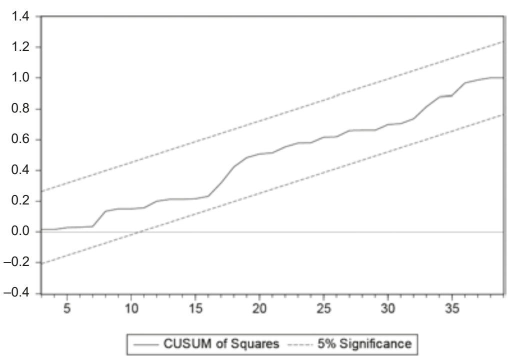


Figure 2 CUSUM of Squares (Model-II)

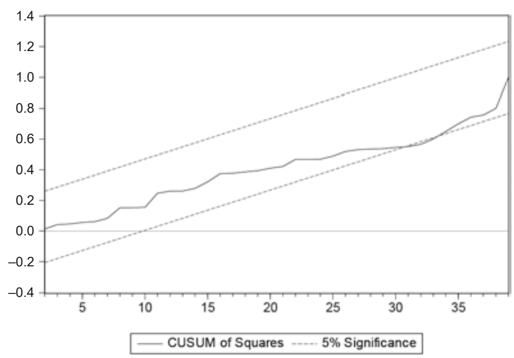
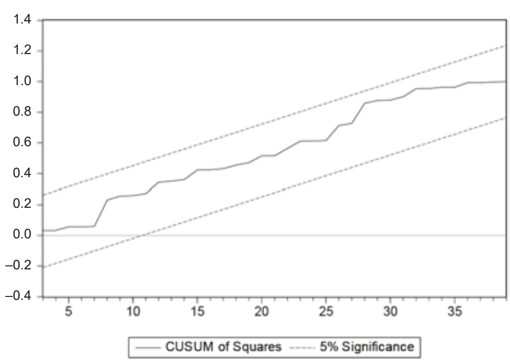


Figure 2 CUSUM of Squares (Model-III)



Source: Authors

CONCLUSION AND RECOMMENDATIONS

This paper highlights the significance of Kaldor's growth law in explaining the crucial role manufacturing plays in the expansion of economies, both empirically and theoretically. The findings offer valuable insights for policymakers and businesses aiming to foster sustainable economic growth through productivity enhancement. The empirical findings indicate that the relationship proposed by Kaldor's first and third law does hold for India for the period 1981–82 to2019–20. In other words, it follows from the findings that manufacturing growth has a significant contribution in the overall economic growth of the country during the study period. The results reveal that productivity of the entire economy is impacted by manufacturing sector, owing its large backward and forward linkages and large spill-over. Thus, it follows that the expansion of the manufacturing sector may cause a positive variation in the rate of productivity growth across the entire economy. Further, according to Kaldor's analysis, an economy's productivity growth should change in opposite direction from the expansion of employment opportunities in the economy. Due to the fact that for a particular unit of economic growth, there is a trade-off between employment growth and productivity growth and one can be higher at the cost of other. Consistent with the findings of (Kaldor 1966; Thirlwall and Vines 1982; Cripps and Tarling 1973; Drakopoulos and Theodossiou 1991; Hansen and Zhang 1996), there exists a notably robust relationship between productivity and industrial growth. The findings in the present study are in line with results of (Chakravarty and Mitra, 2009; McCausland and Theodossiou 2012; Sukti Dasgupta and Ajit Singh2005) in application of Kaldor's growth laws for India.

Certain useful policy implications can be deduced about the importance of Kaldor's growth laws in explaining the contribution of manufacturing to growth and productivity dynamics. It is crucial that decision-makers keep an eye on and assess the success of initiatives meant to boost productivity and encourage manufacturing expansion. This might entail setting up systems for monitoring important metrics like manufacturing output, productivity growth, employment patterns, and sectoral contributions to economic growth, then modifying policy in response to the results.

Thus, the present study highlights how important the manufacturing sector is to economic growth and productivity improvement, giving policymakers important information to develop focused interventions meant to promote sustainable economic development. Policymakers can effectively harness the potential of the manufacturing sector to propel India's economic growth trajectory in the coming years by aligning measures with the principles outlined by Kaldor's growth laws.

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