Nexus of Labor, Capital and FDI: Boosting India's Manufacturing Sector

Parul Singh
Assistant professor, Department of Commerce
School of Management Sciences, Varanasi, India

Dr. Pradeep Kumar Singh
Assistant Professor, Department of Economics
University of Allahabad, Prayagraj, India

Abstract: This research examines how foreign direct investment (FDI) affects the manufacturing sector's output in India, with a particular emphasis on capital accumulation utilizing neoclassical and classical economic theories. It makes use of time-series analysis spanning from 2000 to 2022 and applies a Vector Error Correction Model (VECM) to assess the effects of labor, domestic capital, and foreign direct investment (FDI) on manufacturing growth both in the short and long terms, with and without the inclusion of labor quality as an exogenous variable. The results show that labor quality and capital inputs interact to enhance the impact of labor, domestic capital, and foreign direct investment (FDI) on industrial production.The creation of investment-friendly laws to encourage FDI inflows, a focus on skill development, and higher-quality labor are among the recommendations made to optimize the advantages of the manufacturing sector and quicken India's economic expansion.

Keywords: FDI, Labor Employment, Domestic Capital, Manufacturing Sector, Labor Quality Index, GVA, Productivity.

Introduction

It has long been understood that foreign direct investment (FDI), which provides much-needed cash, technology transfer, and managerial experience, is a major factor in economic growth, especially in emerging nations. When it comes to India, the manufacturing sector has been essential to industrialization, job creation, and general economic growth. Significantly more foreign direct investment (FDI) is coming into India, particularly in the manufacturing sector, since the country's economy was liberalized in the early 1990s and reforms were made to make doing business easier. The industry's Gross Value Added (GVA) is predicted to increase as a result of these inflows due to increased output and productivity. The effect of foreign direct investment (FDI) on the Indian manufacturing sector is still up for discussion,

especially in light of its potential short- and long-term consequences.India has established itself as a major global manufacturing hub during the last 20 years, drawing large FDI investments with the goal of modernizing industrial capabilities and raising production level. Despite uncertainty surrounding the global economy, foreign direct investment (FDI) inflows into India reached a record high of over USD 85 billion in 2021–2022, according to the Department for Promotion of Industry and Internal Trade (DPIIT). A significant portion of this expansion has come from the manufacturing sector, which received FDI totaling around USD 21.34 billion during the same time, or 25% of all inflows. The government's "Make in India" plan, which aims to increase the manufacturing sector's GDP contribution from the current 16–17% to 25% by 2025, depends on these investments.

Although it is well acknowledged that foreign direct investment (FDI) promotes technology transfer, generates employment, and strengthens capital formation, it is unclear how much of these advantages translate into higher gross value added (GVA). Driven by FDI and domestic capital investment, India's manufacturing GVA increased at an average annual rate of 6.7% between 2001 and 2023. However, the caliber of the labor force has a significant impact on how well FDI boosts productivity. For example, the India KLEMS database indicates that between 2000 and 2020, labor productivity in manufacturing grew by 2.8% yearly; however, this growth has been inconsistent between sectors and regions, primarily because of differences in the quality of labor.Given this, it becomes crucial to include a Labor Quality Index (LQI) in order to comprehend how education and skill levels within the workforce affect how much foreign direct investment (FDI) has an impact on manufacturing output. Using a Vector Error Correction Model (VECM) to capture both short-run and long-run dynamics, this study aims to close the gap in the literature by analyzing the link between FDI, investment in physical infrastructure, labor employment, and labor quality in the manufacturing sector. A unique window of opportunity to examine this link is provided by the years 2001 to 2023, which cover multiple stages of economic reforms, changes in labor laws, and significant fluctuations in foreign direct investment inflows.With labor quality being a significant exogenous element, the primary goal of this study is to evaluate the direct and indirect effects of FDI on the manufacturing sector's GVA. This research will offer empirical evidence on how labor quality interacts with FDI and domestic investment to effect manufacturing production in both the short and long term by using data from sources including the RBI, DPIIT, and KLEMS Report. Policymakers must comprehend these processes in order to design strategies that will optimize foreign direct investment (FDI) gains and promote sustainable industrial growth.

India's future economic roadmap heavily relies on manufacturing, especially with programs like "Atmanirbhar Bharat" and "Production Linked Incentive (PLI)" schemes. Based on this, this study attempts to offer practical insights on how human capital development plays a crucial role in helping the sector reach its full potential. The

results will provide useful policy recommendations for enhancing labor quality, bolstering domestic capital, and fostering an environment more favorable to foreign investment by identifying the elements that increase or limit FDI's impact.

Literature Review

A number of studies show the central role played by technology diffusion in the process of economic growth **(Barro & Sala-i-Martin, 1995)**, **(Nelson & Phelps, 1966).** Endogenous growth model looks at FDI as an important vehicle for the transfer of technology and knowledge **(Balasubramanyam, Salisu, & Sapsford, 1996)**and show that FDI can have long-run effects on growth by generating increasing returns in production via externalities and productivity spillovers. Moreover, FDI can contribute more to growth than domestic investment when there is sufficient absorptive capacity available in the host country **(Borensztein, Gregorio, & Lee, 1998)**. This is because FDI flows today are not confined to the primary sectors of developing countries but to modern manufacturing.

By incorporating technology with them, MNCs can make operations more productive and efficient. **(Kathuria, 1998),** found that technology spillover from India in Indian manufacturing have significant benefits. **(Wei, 1996),**used urban data to show that FDI produces technological spillovers in China and explains growth differentials among Chinese urban areas. FDI also augment human capital and increase productivity by making work force specialize in specific work by providing training and skill to them through knowledge transfers. **(De, 1999)**, showed that FDI can promote knowledge transfer even without significant capital accumulation as in the case of licensing and start-up arrangements, management contracts and joint ventures in capital.

Two empirical studies- **(Karikari, 1992)**and **(Saltz, 1992)**, however find support for a positive relationship between FDI and economic growth. **(Karikari, 1992),** tests for causality using data for Ghana and finds that FDI does not affect output, in a cross-sectional study of developed and less developed countries**. (Saltz, 1992),** found a negative correlation between FDI and economic growth. However, most studies assessed FDI influence on economic growth is cross – country studies, industry specific and firm specific. Very few studies have examined the sectoral composition of FDI inflows and its impact on sectoral output growth recently, in contrast to the past. A few of these studies found that the positive impact of FDI inflow is greater on the manufacturing sector than on the service sector, which has a lower absorption capacity **(Alfaro, 2003)(Aykut & Sayek, 2007)(Chakraborty & Nunnenkamp, 2008)(Dash & Parida, 2012)**.

(Dua & Rashid, 1998), examine the direction of relationship between FDI and economic activity (Output) in India in post-liberalization period in the framework of a vector autoregressive model using Granger causality test, impulse response, and variance decomposition. The study used monthly data from January 1992 through

March 1998 for FDI approvals and from January 1994 for actual FDI flows. The level of economic activity measured by Index of Industrial Production. This study found inconclusive evidence regarding the response of IIP to FDI flows. The Granger Causality test and innovation accounting suggest that IIP has yet to respond to actual flows while FDI approvals do affect output.

(Banga, 2004), analyzed the impact of FDI from Japan and the US on the Total Factor Productivity Growth (TFPG) of a firm in the Indian manufacturing sector. It also examined the reasons why firms affiliated with different source countries may have differential productivity growth. A firm level analysis has been undertaken for the period 1993-94 to 1999-2000 for three industries- automobiles, electrical and chemicals. The study estimates both parametric and non-parametric techniques to estimate production frontiers to arrive at conclusion with respect to impact of FDI from different sources on the TFPG. The results of the 'time varying firm specific' technical efficiency approach (introduced by Cormwell, 1990) show that Japanese affiliated firms have higher average productivity growth than domestic and U.S affiliated firms. This study further showed that productivity growth in Japanese affiliated firms comes from efficiency improvement and US- affiliated firms rely mainly on technological improvement for productivity growth. In the post-reform period domestic firms have experienced both technological progress and efficiency growth in some industries such as electrical and chemical industries.

(Goldar & Sharma, 2015), assess the impact of FDI in Indian manufacturing firms on their performance. The analysis is carried out using panel-data set (unbalanced panel) on 775 manufacturing firms in India for the period 2000-01 to 2011-12. Growth, profitability and export intensity are considered as performance indicators for the analysis. The estimates obtained by using difference-in-difference estimator coupled with propensity score matching do not show a significant effect of FDI on growth and export performance. However, there is some evidence, though not strong, that FDI tends to raise the profitability of Indian manufacturing firms after two or three years which is probably a manifestation of the productivity enhancing effect of FDI.

(Mandol & Pant, 2014), in their research work on article "FDI and Firm competitiveness: Evidence from Indian manufacturing sector" had concentrated on Indian manufacturing firms, for which there is a dearth of empirical studies probably because of the insignificant volume of FDI prior to 2002. For the measure of competitiveness of firms, they measured relative inefficiency of the firms relative to the highest productive firms in the industry. This study had used semi-parametric Levinshon and Petrin (2003) method to measure the productivity of the firms in the industry as it provides unbiased and consistent estimates of firm productivity by taking into account the problem of endogeneity from unobserved shocks. "The result of this study supports the view that foreign presence and associated demonstration effects are more likely to lead to higher competitiveness than attempts to buy foreign technology. The result thus indicates that the abandoning of foreign technology

collaboration policy in 1990 was the right move. Second, they also supported the view that firm competitiveness is highly dependent on the absorptive capacity of the firms".
(Rath & Bal, 2014), this study looks at the changing dynamics between public investment (PU), private domestic investment (PDI), and foreign direct investment (FDI) in India from 1978–1979 to 2009–2010. To determine the structural break points in the data set, the Andrews and Zivot test has been employed. The structural VAR model's empirical results show that FDI has crowding-in effects on PDI, but PU neither "crowds out" nor "crowds in" PDI. Additionally, we discovered evidence that PU and PDI shocks have improved the FDI inflows.
(Fauzel, Seetanath, & Sannasee, 2015), investigated the dynamic relationship between FDI flowing in the manufacturing sector and productivity in the manufacturing sector for the case of Mauritius over the period 1980 to 2010 using a Vector Error Correction model (VECM) approach. The study estimated two models. First model showed the relation or effect of FDI on the total factor productivity (TFP) of manufacturing sector, by taking domestic investment, human capital (primary education), inflation and tariffs as control variables. Second model estimated the effect of FDI on the labor productivity (LP) of manufacturing sector by controlling other variables (domestic investment, human capital, inflation and tariffs). The finding of the paper showed that FDI has long-run impact on both, TFP and LP. In short-run, the impact of FDI on TFP is positive and significant but very small in magnitude. Additionally, the study demonstrated the bi-directional causality between FDI and TFP. Moreover, the paper also confirmed the crowd-in effect of FDI on the domestic investment. Even FDI and DI both reinforce each other, implied that DI was found to be crucial for the country to attract FDI in manufacturing sector. Results also demonstrated bi-causal relationship between TFP and DI.
(Bhattarai & Negi, 2020), concluded that from 2004 to 2018, FDI had a favorable impact on Indian companies' sales, profits, employment, and wages. The technologies and ideas that are needed for domestic enterprises to expand are embodied by foreign capital, which is a valuable complement to domestic capital. In India's manufacturing industry, foreign promoters have had a notable economic impact on businesses operating in several production areas. Analyses of the Prowess database for the years 2004, 2008, 2012, and 2014 show that, in addition to sales, total expenses, managerial compensation, corporation taxes, and employment, the involvement of foreign promoters is a statistically significant determinant of profits, employment, and wages among firms across all seven sectors of the manufacturing industry.The consequences of the Made in India program in 2014 were amplified in every Modi-I year from 2015 to 2019. The implementation of reforms, such as the automatic route that grants 100% ownership in most industrial sectors, has yielded positive results. Not only has FDI per capita increased from approximately 16 dollars in 2000 to 285 dollars in 2018, but India's ranking on the ease of doing business has improved as well, moving it up to 63 out of 190 economies in 2019. This puts India 79 places higher than in 2014. Theoretical

and empirical study leads to the conclusion that positive FDI mood in India during the Modi–II years, which began in 2019, will avert declining capital returns and support sustainable growth in the years to come.

Research Gap

Few studies have examined the sectoral composition of FDI inflows and their particular implications on the expansion of the manufacturing sector in India, despite the fact that a sizable body of literature has examined the influence of FDI on economic growth and productivity, particularly in the context of developing countries. While FDI has a different effect on the manufacturing versus service sectors, as noted by a number of researchers (**(Alfaro, 2003); (Aykut & Sayek, 2007); (Chakraborty & Nunnenkamp, 2008)),** a thorough analysis that takes into account labor quality as an exogenous factor in addition to FDI and domestic investment in infrastructure is still lacking. Furthermore, dynamic interactions between these factors are frequently ignored in empirical studies on India's manufacturing sector, especially when long- and short-term effects are taken into account using Vector Error Correction Models (VECM).Furthermore, the majority of research that has been done so far has concentrated on cross-national or firm-specific analysis, and there are very few time-series sectoral studies that look at Gross Value Added (GVA) as a productionindicator.Therefore, using the VECM technique, this study fills these gaps by examining the short- and long-term linkages between FDI, domestic investment, labor employment, and labor quality in India's manufacturing sector from 2000 to 2022.

The desire to comprehend how foreign direct investment (FDI) and domestic capital affect production in India's manufacturing sector—a vital engine of economic expansion and job creation in the post-liberalization era—motivates this study. As FDI inflows to manufacturing increase, it is critical to evaluate FDI's qualitative effects as well as its quantitative ones, including the implications of improved worker quality on overall productivity. Policymakers and industry stakeholders need to understand the synergistic effects of labor quality, FDI, and domestic capital as labor quality continues to evolve as a result of the inflow of new technology and management methods linked with FDI. The study is especially pertinent in light of India's "Make in India" policy push and initiatives to raise the nation's manufacturing competitiveness internationally. This study offers a more comprehensive understanding of how capital (both domestic and foreign) interacts with human resources to influence manufacturing sector productivity—a topic that is still understudied in the current literature—by including labor quality as an exogenous variable in the analysis.

There are three main ways in which this study adds to the corpus of current knowledge:

Sectoral Focus: Unlike the more general, cross-sectoral studies frequently found in FDI literature, this study focuses exclusively on the manufacturing sector. This makes it possible to comprehend the understudied relationship between FDI and production in India's manufacturing sector.

Integration of Labor Quality: By capturing the indirect benefits of advances in human capital brought about by FDI spillovers, the labor quality index is introduced as an exogenous variable, thereby addressing an important gap. This is significant because labor quality is becoming more widely acknowledged as a major factor influencing production level; nevertheless, in the context of India's manufacturing industry, its significance in FDI and physical infrastructure models is still understudied.

Methodological Advancement: The study examines the short- and long-term equilibrium linkages between FDI, domestic capital stock, labor employment, and GVA using a Vector Error Correction Model (VECM). This dynamic time-series approach offers a more sophisticated view of the interdependencies between these crucial variables by illuminating how shocks to one variable, such as FDI, can affect the others both instantly and over time.
All things considered, this study adds to the body of knowledge by providing a thorough, industry-specific, and methodologically sound analysis of the interactions among FDI, domestic capital, labor employment, and labor quality. This analysis will help shape future studies and policies in emerging nations such as India.

Theoretical Framework

Many economic theories have been used to study the effects of foreign direct investment (FDI) on the manufacturing sector. These theories provide different insights into the direct and indirect ways that FDI affects manufacturing productivity. Particularly in emerging nations like India, these theoretical frameworks aid in explaining how FDI fosters capital accumulation, knowledge transfer, and economic progress. Key theories including the OLI paradigm, endogenous growth theory, neoclassical growth theory, spillover theory, and dependency theory are examined in this literature review in order to show how important they are for comprehending the connections between FDI, labor quality, domestic capital, and productivity in the manufacturing sector.
Using a variety of economic theories as a guide, this study investigates how foreign direct investment (FDI) affects productivity in India's manufacturing sector. Neoclassical growth theory holds that FDI increases capital accumulation, which is how the **(Solow, 1956)** growth model suggests FDI increases industrial productivity. Human capital was added to this model by **(Mankiw, Romer, & Weil, 1992)**, emphasizing the significance of trained workers in maximizing the impact of FDI.

According to the endogenous growth theory, FDI acts as a conduit for technology transfer and promotes competition, which boosts productivity for local businesses. It also highlights the importance of technology and innovation in productivity growth. The influence of foreign direct investment (FDI) on the host economy is explained by John Dunning's OLI paradigm(**Dunning & Lundan, 2008**), which highlights how ownership, location, and internalization advantages boost industrial productivity in India.According to the spillover theory, foreign direct investment (FDI) creates positive externalities that enable domestic enterprises to embrace cutting-edge technology and processes. Dependency theory, on the other hand, offers a more critical viewpoint, arguing that FDI may lead to exploitation and dependency, which would limit the host economy's long-term gains. In India's case, programs such as the "Make in India" campaign seek to mitigate the dangers associated with an excessive reliance on foreign direct investment (FDI) while striking a balance between FDI and the country's growing manufacturing sector.

A number of important economic theories that explain the direct and indirect effects of foreign direct investment (FDI), local capital, and labor quality on manufacturing sector productivity provide the theoretical framework for this study. The underlying framework for comprehending the interactions between capital, labor, and output in the manufacturing sector—which is the focus of this study—is provided by the neoclassical growth theory, specifically the Solow-Swan model. The neoclassical viewpoint holds that labor and physical capital accumulation drive economic growth, while technology is an exogenous component that gradually raises productivity. The main sources of capital accumulation in the context of this study are FDI and domestic capital stock, both of which help to raise the manufacturing sector's gross value added (GVA). According to the hypothesis, a growth in capital, whether from domestic or foreign direct investment, raises the economy's potential for production over time, resulting in higher levels of output.The neoclassical model also highlights the importance of labor as a necessary input in the manufacturing process. The production function, which establishes an economy's output, is based primarily on the interaction between capital and labor. Labor employment is a significant independent variable in this study that affects the manufacturing sector's GVA. Neoclassical theory, on the other hand, views labor quality, as measured by the labor quality index, as an exogenous element. This means that gains in labor quality have a substantial effect on productivity even if they are not defined by the model itself. Improved labor quality brings the economy closer to its potential production by increasing the efficiency of both labor and capital.

The Solow-Swan model suggests that economies tend toward steady-state equilibrium where the contributions of labor and capital to growth become constant, which further supports the long-term relationship between the variables in this study. While labor employment and capital accumulation (including foreign direct investment) have a stabilizing effect on output levels in this steady state, continuous

improvements in labor quality (an external factor) may cause changes in the production function that raise output above the steady-state level.Neoclassical theory presupposes declining returns to labor and capital in the short run. This suggests that unless technical advancements or improvements in worker quality are made, the influence of capital accumulation, particularly foreign direct investment (FDI), on productivity will eventually decrease. Under this approach, labor quality acts as an exogenous factor influencing the total efficiency of the manufacturing sector, and the use of the Vector Error Correction Model (VECM) to capture the short- and long-term dynamics between GVA, FDI, domestic capital stock, and labor employment is justified.Overall, the study's main structure is supported by the neoclassical framework, which emphasizes the significance of labor and capital in generating output and acknowledges the vital role that labor quality plays as an exogenous determinant of productivity development in the manufacturing sector. More contemporary growth models are better able to account for the spillover effects and dynamic interactions between FDI, domestic capital, and labor quality; they are best captured by the theory's view of labor quality as exogenous.Based on theoretical framework, this study proposed two hypotheses to be tested:

H1: There is no significant positive relationship between FDI inflows and GVA of manufacturing sector in India.

H2: There is no long-run relationship between FDI, labor employment, domestic capital stock and labor quality and GVA of manufacturing sector in India.

Data Descriptions and Sources:

A thorough understanding of the changing dynamics of India's manufacturing industry may be gained from the study's data, which spans the years 2000 to 2023. The information was gathered from reputable and trustworthy sources, such as the Department for Promotion of Industry and Internal Trade's (DPIIT) FDI factsheets and the Reserve Bank of India's (RBI) KLEMS report. Because these data sources provide annual observations, time series analysis may be carried out with a strong temporal dataset.

Variable Name	Symbol	Type	Data Sources	Description
Gross Value Added	LnGVA	Dependent Variable	KLEMS Report, RBI	The logarithm of Gross Value Added (GVA), representing the value of goods and services produced in the manufacturing sector. GVA is used as a measure of economic output.GVA is measured in constant prices to account for inflationary effects and to provide a real measure of productivity over time.
Labor	LnLE	Independe	KLEMS	The logarithm of the number of people

Employment		nt Variable	Report, RBI	employed in the manufacturing sector. It reflects the quantity of labor input in production.This variable includes both skilled and unskilled labor engaged in various activities within the manufacturing sector. It is crucial to analyze labor employment trends in the context of evolving technology, FDI inflows, and other factors influencing the manufacturing sector's growth.
Domestic Capital Stock	LnDC	Independent Variable	KLEMS Report, RBI	The logarithm of the domestic capital stock, representing the value of fixed assets like machinery, equipment, and buildings used in production. It is reflecting the extent of investment in productive capacity. Capital accumulation is a vital driver of long-term growth and productivity improvements in the manufacturing sector. This study taken as proxy to measure domestic investment in manufacturing sector.
Foreign Direct Investment	LnFDI	Independent Variable	FDI Factsheets, DPIIT	The logarithm of the amount of Foreign Direct Investment (FDI) inflows in the manufacturing sector. This variable indicates the inflow of foreign capital and technology into the sector.FDI is measured in Indian Rupees (INR) to maintain consistency with the other variables.
Labor Quality Index	LnLQI	Exogenous Variable	KLEMS Report, RBI	The logarithm of the labor quality index, representing the skills and education level of labor employed in the manufacturing sector. Used to capture the qualitative aspect of labor input.A skilled and knowledgeable workforce enhances the efficiency of labor and capital, leading to higher levels of Gross Value Added.

Justification regarding variables and data sources used in this study

- **Dependent Variable: Gross value Added of Manufacturing Sector in india (LnGVA)**

  A thorough indicator of the manufacturing sector's economic output and its contribution to the economy as a whole is gross value added, or GVA. It accurately reflects the productivity and production growth of the industry, which are directly impacted by labor, domestic capital, and foreign direct investment (FDI). The KLEMS database, which provides sectoral disaggregation and consistent time-series data built following exacting standards, is a reliable source for GVA statistics. This guarantees its dependability and relevance for this analysis.
- **Independent Variables:**
- **Log of Foreign Direct Investment Inflows (LnFDI):**FDI is a crucial factor since it directly affects the manufacturing sector's productivity and output by bringing in capital, technology, and management experience. The most reliable source of sector-specific FDI data in India is the Department for Promotion of Industry and Internal Trade (DPIIT). It is an appropriate independent variable since its thorough reporting guarantees precise measurement of FDI inflows into manufacturing.
- **Log of Labor Employed in Manufacturing Sector (LnLE):**Labor is a fundamental input in manufacturing production, influencing GVA by contributing to output and productivity. Employment data from the KLEMS report is reliable as it provides consistent and sector-specific measures, aligning with the study's scope. It captures trends in labor force utilization, a key determinant of both short-term and long-term growth.
- **Log of Domestic capital stock in the manufacturing sector (LnDC):** The inherent link between investment and capital stock justifies the use of the logarithm of domestic capital stock in the manufacturing sector, as provided by the KLEMS database, as a stand-in for domestic investment in the sector. Capital stock is a reliable indicator of long-term investment patterns since it represents the total return of prior investments after depreciation. When interpreting elasticities and growth patterns in econometric models, taking the logarithm of capital stock helps to stabilize variance and capture proportional changes. Because it uses defined procedures to generate sector-specific estimates, including manufacturing, the KLEMS data is usually considered to be accurate and relevant. Utilizing capital stock data streamlines the study while preserving credibility because direct data on domestic investment in manufacturing is frequently dispersed. Furthermore, investments in assets that dominate manufacturing, such as infrastructure and machinery, are a major cause of changes in capital stock. Its validity as a proxy is supported by this assumption as well as the regular synchronization of KLEMS capital stock data

with independent indicators such as gross fixed capital creation. Therefore, a reliable and analytically beneficial alternative to domestic investment in India's manufacturing sector is the logarithmic transformation of domestic capital stock from the KLEMS report.

A complete set of explanatory variables that represent both internal and external factors influencing the manufacturing sector's GVA is provided by the combination of FDI, labor employment, and domestic capital stock. FDI attracts technological and financial infusions from outside sources. The human capital component is labor employment. The sector's asset base and domestic investments are reflected in the domestic capital stock.

- **Exogenous Variable in the Model**
- **Log of Labor Quality Index (LnLQI):** Given its crucial significance in capturing the qualitative features of labor that have a substantial impact on the industrial sector's productivity and output, the Labor Quality Index (LQI), which was derived from the KLEMS report, is a well-justified exogenous variable to include in the model. In contrast to simple employment figures, the LQI takes into account the workforce's skill mix, educational attainment, and work history, all of which have an effect on labor productivity and its contribution to GVA. Because of this, it is a crucial variable for examining the sector's long-term and short-term developments. Since the LQI is mostly influenced by outside variables—such as worker training initiatives, education regulations, and demographic changes—rather than by the industrial sector's direct performance, it functions as an exogenous variable. Its incorporation enables the model to take into consideration advancements in human capital, which are essential for both the efficient use of local capital stock and the successful absorption of FDI. While differences in LQI can mitigate the short-term effects of other factors on GVA, higher labor quality over the long term increases the sector's productivity and growth potential. The KLEMS report, which was created using strong and globally accepted methodologies, offers trustworthy and industry-specific data on the LQI. Its thorough technique guarantees that the data is appropriate for analyzing India's industrial industry. The analysis is strengthened by adding LQI to the model, which captures both the qualitative and quantitative aspects of labor as important factors influencing GVA. This addition improves the model's overall explanatory capacity and offers more profound understanding of the variables affecting the performance of the manufacturing sector.

This study's dataset, which spans a substantial 23 years, enables the examination of both long-term patterns and short-term swings in the manufacturing industry. Global financial crises, sectoral reforms, and various stages of economic policy changes have occurred over this time frame. These events can have a significant impact on FDI, labor employment, capital accumulation, and productivity growth. The variables are

consistent and comparable thanks to the data gathered from the KLEMS report and DPIIT's FDI factsheets. This makes the data a solid basis for empirical analysis employing methods like Granger causality tests, unit root tests, Johansen co-integration, and Vector Error Correction Model (VECM). Understanding the relationships between GVA, labor employment, domestic capital stock, foreign direct investment, and labor quality is the goal of this study. Moreover, the purpose of this research is to determine the direct and indirect effects of GVA, labor employment, domestic capital stock, foreign direct investment, and labor quality on productivity in the Indian manufacturing sector during the previous 23 years.

Research Methodology

The analytical framework and econometric techniques used to examine the relationship between labor employment, gross value added (GVA), domestic capital stock, foreign direct investment (FDI), and labor quality in the Indian manufacturing sector between 2000 and 2022 are described in the research methodology section of this study. Numerous econometric tests are part of the selected technique, which includes the Granger causality test, the Johansen co-integration test, the Vector Error Correction Model (VECM), and the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests for stationarity analysis. These methods provide a thorough examination of both the short-term dynamics and the long-term equilibrium relationships between the variables since each is specifically chosen to fit the study aims and the features of the data.

ADF and Phillips-Perron Unit Root Tests:

The stationarity of the time series variables is checked using the Augmented Dickey-Fuller (ADF) **(Gujarati, 2004)**and Phillips-Perron (PP) **(Phillips & Perron, 1988)**unit root tests before beginning the empirical analysis. Because non-stationary data might produce erroneous regression findings, stationarity is an essential need for trustworthy time series analysis. Lagged differences of the dependent variable are included in the ADF test to account for autocorrelation and assess whether the variables display unit roots. As a substitute for adding lag difference components, the Phillips-Perron test allows for heteroscedasticity and autocorrelation in the error terms when examining stationarity.In order to determine whether the data requires difference in order to reach stationarity, both tests are necessary. This will guarantee the validity and accuracy of subsequent econometric modeling.

Johansen Co-Integration Test

To ascertain whether a long-term equilibrium relationship exists among the variables, the study proceeds with the Johansen co-integration **(Johansen , 1988)** test after establishing the order of integration of each variable by unit root testing. Because of its reliability in detecting numerous co-integrating connections within a multivariate

framework, the Johansen test is the one that was selected. The Johansen technique, in contrast to single-equation methods, has the ability to find several co-integrating vectors, which is very helpful considering the numerous independent variables in this study. Finding co-integration indicates that, despite short-term variations, the variables move together over the long term due to a shared long-term trend. This is essential to comprehending the long-term relationships between labor, capital stock, FDI, and labor quality and GVA in the manufacturing sector.

Vector Error Correction Model (VECM)

The study uses the Vector Error Correction Model (VECM) to look at both the short- and long-term dynamics because the variables co-integrate. Because the variables have co-integrating relationships, VECM is favored over conventional Vector Autoregression (VAR). An error correction term in the VECM model represents the rate of return to the long-term equilibrium following a departure. This makes it possible to distinguish between the long-term pressures that bring the system back to equilibrium and the short-term dynamics, where variables may vary from one another.The study's goals are best served by the VECM framework, which captures the influence of independent variables on GVA in both the short and long term while preserving a stable connection.

In your empirical model analyzing the effects of labor employment, domestic capital stock, and foreign direct investment (FDI) on manufacturing productivity (also known as gross value added, or GVA), you can treat the labor quality index (LQ) as an exogenous variable. The model can be described as follows:

$$\boldsymbol{LnGVA = \beta_0 + \beta_1 LnLE + \beta_2 LnDC + \beta_3 LnFDI + \beta_4 LnLQI + \varepsilon_t}$$

Where,

LnGVA: Natural Logarithm of Gross Value Added (Productivity measure)

LnLE: Natural Logarithm of labor employment

LnDC: Natural Logarithm of domestic capital

LnFDI: Natural logarithm of Foreign Direct Investment

LnLQI: Natural logarithm of labor quality index (treated as exogenous)

$\beta_0: Constantterm$

$\beta_1, \beta_2, \beta_3, \beta_4: coefficientsoftherespectivevariables$

$\varepsilon_t: errorterm.$

Short-run model for short-run dynamics:

$$\Delta LnGVA_t = \alpha + \sum_{i=1}^{\rho} \emptyset_i \Delta LnGVA_{t-i} + \sum_{j=1}^{q} \theta_j \Delta LnLE_{t-j} + \sum_{k=1}^{r} \varphi_k \Delta LnDC_{t-k} + \sum_{m=1}^{s} \gamma_m \Delta LnFDI_{t-m} + \lambda ECT_{t-1} + \mu_t$$

Where,

$\Delta = first difference operators$

$\rho, q, r, s = lag length of each respective variables$

$\alpha = constant term$

$\emptyset_i, \theta_j, \varphi_k, \gamma_m = coefficients for the lagged changes$ inrespectivevariables.

$\lambda =$ coefficientfortheECT

$\mu_t =$ errortermfortheshort − rundynamics

$$\mathbf{ECT_{t-1} = LnGVA_{t-1} - (\beta_0 + \beta_1 LnLE_{t-1} + \beta_2 LnDC_{t-1} + \beta_3 LnFDI_{t-1} + \beta_4 LnLQI)}$$

The labor quality index is considered an exogenous variable in this model, which means that other variables are not expected to alter it. Instead, it is presumed to be predefined. This method makes it possible to evaluate precisely how labor quality, employment, and foreign direct investment (FDI) interact to affect the manufacturing sector's productivity in India.

Granger Causality Test

The Granger causality test is used to look at the directional relationships between the variables in more detail. By evaluating the predictability of one time series against another, this test sheds light on the relationships that cause GVA, labor, capital stock, FDI, and labor quality. Determining the elements that actively affect GVA and whether feedback linkages exist between the variables need establishing causality. The Granger causality test facilitates the investigation of the dynamic relationships among FDI, labor employment, capital accumulation, and GVA; it provides insight into the variables that function as catalysts for productivity and growth in the manufacturing sector.

The aforementioned approaches were chosen in accordance with the goals of the research and the type of data. Despite being a popular method for evaluating time series data with multiple integration orders (I(0) and I(1)), the Autoregressive Distributed Lag (ARDL) model is not appropriate for this study because all the variables were determined to be non-stationary and integrated of the same order (I(1)). Since all of the variables in this scenario are integrated to the same extent, the Johansen co-integration approach is a better fit for identifying co-integration relationships in a multivariate environment. The ARDL model is especially helpful when variables have mixed integration orders.

The Johansen approach also has the benefit of simultaneously capturing several co-integrating relationships, which is crucial in a model that includes several independent variables like labor, capital stock, and foreign direct investment. Then, it makes sense to extend Johansen co-integration to the VECM in order to study short-run dynamics while taking long-term equilibrium circumstances into account. When paired with VECM, Johansen co-integration allows for a more thorough examination of the data than would be possible with the ARDL method, which would not give specific details on several long-term equilibrium relationships.

Analysis and Findings

Table 2: Result for Unit Root Test

Variables	At level	Augmented Dickey Fuller Test (ADF)			Phillips-Perron Test (PP Test)		
		t-statistics	Critical value	p-value	t-statistics	Critical value	p-value
LnGVA	I(1)	-3.36	-3.01	0.02	-3.19	-3.01	0.03
LnLE	I(1)	-4.93	-3.01	0.00	-5.20	-3.01	0.00
LnDC	I(1)	-4.66	-3.01	0.00	-4.68	-3.01	0.00
LnFDI	I(1)	-5.20	-3.01	0.00	-5.25	-3.01	0.00
LnLQI	I(1)	-5.29	-3.02	0.00	-9.44	-3.01	0.00

Note: Critical values are calculated at 5 per cent level of significance.

The findings of the unit root tests for the following five major variables are shown in the table 2 Labor Quality Index (LQI), Domestic Capital (DC), Foreign Direct Investment (FDI), Labor Employment (LE), and Gross Value Added (GVA). To evaluate the stationarity of these variables, the Phillips-Perron (PP) and Augmented Dickey-Fuller (ADF) tests were used. It was discovered that each of the five variables was non-stationary at level one (I (1)). Using LnGVA as an example, the ADF test statistic of -3.36 and a p-value of 0.02 indicated non-stationarity, whilst p-values of 0.00 for LnLE, LnDC, and LnFDI indicated even stronger evidence against the null hypothesis. In both experiments, LnLQI also demonstrated significance, suggesting that differencing is necessary for all variables to reach stationarity.

To sum up, the results of the unit root tests indicate that the variables do not display trends over time and do not stabilize around a mean. Due to this feature, differencing must be used to achieve stationarity before performing additional studies, such co-integration testing and VECM (Vector Error Correction Model) estimate. The fact that all variables were confirmed to be integrated of order one emphasizes how crucial it is to guarantee reliable statistical conclusions in further modeling endeavors.

Table 3: Results for Johansen's Co-integration Test

Hypothesized no. of CE (s)	Trace Test			Max Eigen Test		
	Trace statistics	Critical value	p-value	Eigen value	Critical value	p-value
None	93.16	47.85	0.00	47.01	27.58	0.00
At most 1	46.15	29.79	0.00	26.88	21.73	0.00
At most 2	19.26	15.49	0.01	14.09	14.26	0.05
At most 3	5.17	3.84	0.02	5.17	3.84	0.02

Note: p-value calculated at 5 per cent level of significance.

Significant conclusions about the long-term linkages between the study's variables—gross value added (GVA), labor employment (LE), domestic capital (DC), and foreign direct investment (FDI)—are revealed by the results of the Johansen co-integration test in table 3.

At the 0.05 significance level, the trace test shows the existence of four co-integrating equations. With a p-value of 0.0000 and a trace statistic of 93.16940, which is more than the crucial value of 47.85613, the null hypothesis of no co-integration (None) is rejected. Up to the third equation, there is substantial evidence to refute the null hypothesis, supporting this strong result for the remaining hypotheses. Specifically, the trace statistic of 5.172999 vs. critical value of 3.841466, p-value of 0.0229, rejects the hypothesis that there can only be three co-integrating links.

The existence of substantial co-integration is further supported by the max-eigenvalue test. There is a strong long-term association between the variables, but the nature of these relationships is more constrained than suggested by the trace test findings, as shown by the identification of two co-integrating equations at the 0.05 level. With a p-value of 0.0001, the first equation is validated with a max-eigenvalue statistic of 47.01734, exceeding the crucial value of 27.58434. The test, however, produces a p-value of 0.0532 for a maximum of two equations, indicating a marginal significance that might call for more investigation.

All things considered, the results of the two tests show that there are substantial long-term correlations between the model's variables—that is, between GVA, LE, DC, and FDI. Multiple co-integrating relationships imply that these variables adjust in concert with one another towards long-term equilibrium. These findings offer a strong basis for more investigation, which can involve defining a Vector Error Correction Model (VECM) to investigate error correction processes and short-run dynamics.

Table 4: Long – Run Vector Error Correction Models

Variables	Model Estimation I Dependent Variable: (LnGVA			Model Estimation II (with an exogenous variable: Labor quality index) Dependent Variable: LnGVA		
	Coefficients	**Standard errors**	**t-Statistics**	**Coefficients**	**Standard errors**	**t-statistics**
LnLE	0.02	0.07	-0.41	0.10*	0.08	-3.56
LnDC	0.11*	0.02	-5.55	0.38*	0.05	-7.53
LnFDI	0.48*	0.10	-4.65	0.57*	0.25	-2.20
C	2.66			0.18		
Co-integrating Equation	**LnGVA=2.66+0.02LnLE+0.11LnDC+ 0.48LnFDI**			**LnGVA=0.18+0.10LnLE+0.38LnDC +0.57LnFDI**		

Note; *denotes level of significance.

Understanding the connections between Gross Value Added (GVA) and its determinants—Labor Employment (LE), Domestic Capital (DC), and Foreign Direct Investment (FDI)—is made possible by the model estimation findings in table 4. The results of Model Estimation I, in which GVA is regressed only on these independent variables, show that, although Labor Employment's effect (0.02) is statistically insignificant (t-statistic of -0.41), Foreign Direct Investment (0.48) and Domestic Capital (0.11) show significant positive relationships with GVA (t-statistics of -4.65 and -5.55), according to the coefficients. As a result, it can be shown that rising levels of foreign direct investment and domestic capital are linked to rising GVAs, highlighting their crucial roles in raising GDP.

The importance of Domestic Capital and Foreign Direct Investment is further highlighted by the fact that their coefficients remain positively significant in Model Estimation II, which also includes the Labor Quality Index as an exogenous variable. With a t-statistic of -3.56, the coefficient for LnLE rises to 0.10, indicating that labor quality now significantly positively affects GVA. This finding is consistent with the theory that more skilled labor increases efficiency by suggesting that improved labor quality may lead to higher productivity and economic output. In this model, the coefficients for domestic capital and foreign direct investment are 0.38 and 0.57, respectively, and the t-statistics for these variables show substantial significance (-7.53 and -2.20).While not changing the overall meaning, the constant term in this model, which is 0.18, indicates a baseline level of GVA that is impacted by the other factors taken into account. Thus, while labor employment may not be the only factor driving

GVA, the quality of labor and the amount of both domestic and foreign investment are critical for promoting economic growth. These results collectively point to a more complex view of the linkages at work. To learn more about these dynamics and investigate any possible causal relationships between the variables, more investigation may be required.

Table 5: Short-Run Model Estimation of VECM

Variables	Model Estimation I Dependent Variable: LnGVA		Model Estimation II (with exogenous variable: Labor quality index) Dependent variable: LnGVA	
	Coefficients	**t-statistics**	**coefficients**	**t-statistics**
D(LnGVA)$_{-1}$	0.37*	1.34	0.39*	1.42
D(LnGVA)$_{-2}$	-0.42	-0.17	-0.41*	-1.49
D(LnLE)$_{-1}$	-0.003	-0.04	0.001	0.19
D(LnLE)$_{-2}$	0.002	0.24	0.012*	2.21
D(LnDC)$_{-1}$	0.002*	1.06	0.002	0.87
D(LnDC)$_{-2}$	0.005*	2.08	0.005*	1.92
D(LnFDI)$_{-1}$	-0.01	-0.74	-0.01	-0.53
D(LnFDI)$_{-2}$	0.02*	3.23	0.04*	3.30
ECT(-1)	-0.11*	-4.43	-0.08*	-4.07
R^2	0.84		0.87	

Note: * denotes level of significance.

Insights into the short-term variables influencing labor quality index (LnGVA) and the effects of the labor quality index as an exogenous variable in Model II are offered by the outcomes of Model Estimation I and II as shown in table 5. A positive correlation between current GVA and the first lag of GVA (D (LnGVA)-1) is seen in both models, with coefficients of 0.37 and 0.39; however, the t-statistics (1.34 and 1.42) indicate that these effects are not statistically significant, suggesting that the GVA of the recent past has little bearing on the GVA of the present. A minor impact of earlier GVA values on the current value is suggested by the second lag of GVA (D (LnGVA)-2) in both models, which has a negative effect that is likewise not statistically significant.

With respect to labor employment (LnLE), Model II is the only one where the second lag (D (LnLE)-2) with a coefficient of 0.012 and a t-statistic of 2.21 is statistically significant. In the other model, Model I has no meaningful effect on GVA at all. This implies that increases in labor employment have a delayed beneficial impact on GVA, and that this effect is more pronounced when labor quality is taken into account. With t-statistics of 2.08 in Model I and 1.92 in Model II, domestic capital (LnDC) at the second lag (D (LnDC)-2) in both models has a positive and significant effect on GVA, suggesting that prior investments in domestic capital contribute positively to current

GVA.With coefficients of 0.02 and 0.04 and t-statistics of 3.23 and 3.30, respectively, foreign direct investment (LnFDI) also has a substantial positive effect at the second lag in both models, emphasizing the delayed but beneficial influence of FDI on economic output.

With t-statistics of -4.43 in Model I and -4.07 in Model II, the error correction term (ECT) is negative and statistically significant in both models. This suggests that deviations from the equilibrium are corrected over time and indicates a considerable adjustment process towards the long-run equilibrium. The labor quality index in Model II gives it a little stronger explanatory power than Model I, although both models have good fits, as indicated by their respective R-squared values of 0.87 and 0.84. This improvement raises the possibility that worker quality influences GDP in the economy.

Table 6: Results for Granger Causality/Block Exogeneity Wald Test

Dependent Variables	Independent Variables	Model I			Model II (with Labor quality Index)		
		Chi-square	**Degree of Freedom**	**p-value**	**Chi-square**	**Degree of Freedom**	**p-value**
D(LnGVA)	D(LnLE)	0.09	1	0.12	4.28*	1	0.03
	D(LnDC)	6.01*	1	0.01	5.06*	1	0.02
	D(LnFDI)	5.06*	1	0.09	4.01*	1	0.03
	All	4.97*	3	0.04	10.63*	3	0.02
D(LnLE)	D(LnGVA)	1.58	1	0.20	1.23	1	0.26
	D(LnDC)	1.01	1	0.31	0.41	1	0.51
	D(LnFDI)	0.04	1	0.83	0.07	1	0.95
	All	2.14	3	0.54	1.62	3	0.65
D(LnDC)	D(LnGVA)	6.84*	1	0.00	4.43*	1	0.03
	D(LnLE)	2.73*	1	0.09	3.28*	1	0.07
	D(LnFDI)	2.90*	1	0.08	1.22	1	0.26
	All	10.51*	3	0.01	8.86*	3	0.03
D(LnFDI)	D(LnGVA)	0.25	1	0.61	0.002	1	0.95
	D(LnLE)	1.58	1	0.20	2.30	1	0.12
	D(LnDC)	4.01*	1	0.04	3.41	1	0.64
	All	6.50*	3	0.08	5.38	3	0.14

The findings from the two estimated models—the second of which included the Labor Quality Index as an exogenous variable—offer important new insights into the Granger causality relationships between Gross Value Added (GVA), Labor

Employment (LE), Domestic Capital (DC), and Foreign Direct Investment (FDI) as presented in table 6.

When looking at GVA as the dependent variable in Model I, the research shows that FDI (Chi-square = 5.06, p-value = 0.09) and domestic capital (Chi-square = 6.01, p-value = 0.01) have a significant impact. But labor employment has no discernible effect (p-value = 0.12, Chi-square = 0.09). The joint significance test reveals significance (p-value = 0.04) for all omitted variables, indicating that the combined impacts of FDI and DC are important in determining GVA.

By contrast, the outcomes of Model II show that the linkages are substantially changed when the Labor Quality Index is included. While the effects of FDI (Chi-square = 4.01, p-value = 0.03) and domestic capital (Chi-square = 5.06, p-value = 0.02) are still substantial, labor employment now has a noticeable impact on GVA (Chi-square = 4.28, p-value = 0.03). This change indicates that labor quality is a significant factor in explaining GVA, suggesting that higher labor quality is essential for economic performance. The importance of taking labor quality into account in understanding GVA dynamics is confirmed by the overall significance of all excluded factors increasing (p-value = 0.02).

Using labor employment as the dependent variable, both models show that FDI, domestic capital, and GVA have no statistically significant effects, with p-values showing this. The findings imply that, even with labor quality included in Model II, labor employment is still largely unaffected by these economic factors.

Model I shows that, when concentrating on domestic capital, GVA has a high Granger causality (Chi-square = 6.84, p-value = 0.00), meaning that changes in GVA have a major effect on domestic capital. A borderline significance is shown by FDI (Chi-square = 2.90, p-value = 0.08), while labor employment approaches significance (Chi-square = 2.73, p-value = 0.09) but does not quite reach it. With a p-value of 0.01, all eliminated variables have strong joint significance.

When labor quality is taken into account in Model II, the impact of GVA on domestic capital is still significant (Chi-square = 4.43, p-value = 0.03), but the effects of labor employment and FDI are now slightly different. The impact of FDI is not significant (p-value = 0.26), while the impact of labor employment shows a p-value of 0.07, which is closer to significance. The overall joint test continues to support the relationships between these variables by indicating significance (p-value = 0.03).

Model I shows that while domestic capital is significant (p-value = 0.04), there is no significant impact from GVA for FDI, the dependent variable (p-value = 0.61). Additionally, labor employment is not influenced (p-value = 0.20). With a p-value of 0.08, the total combined significance is only slightly significant. GVA retains no significant effect on FDI (p-value = 0.95) in Model II with the addition of the Labor Quality Index, whereas labor employment and domestic capital produce p-values of 0.12 and 0.64, respectively, indicating no significant connections. The combined

importance of all the variables that were eliminated points to no discernible impact on FDI (p-value = 0.14).

In contrast, the Labor Quality Index does not much alter FDI's association with the other variables, but it does seem to improve our knowledge of the links between GVA, DC, and labor employment. The findings demonstrate that whereas domestic capital in the first model had some effect on FDI, this was lessened when labor quality was included. As a result, FDI appears to be less sensitive to changes in labor quality and GVA than domestic capital, despite GVA's significant impact on economic dynamics. All things considered, the results highlight how crucial labor quality is to comprehending economic interactions and show how FDI may have different dynamics from domestic capital and GVA.

Table 7: Results of Models Residuals Diagnostic Test

Models residual Diagnostic Test	Normality Test			LM-Serial Correlation Test			Heteroskedasticity Test		
	Jarque-Bera Test	**Degree of Freedom**	**p-value**	**LM-Stat**	**Degree of freedom**	**p-value**	**Chi-square**	**Degree of freedom**	**p-value**
Model I	5.09	8	0.74	10.63	16	0.83	107.09	100	0.29
Model II (with an exogenous variable)	6.76	8	0.56	11.05	16	0.80	136.82	120	0.139

Model I and Model II (which incorporates an exogenous variable) are the two models whose statistical qualities are assessed by the residual diagnostic tests shown in the table 7. The LM-Serial Correlation test, which looks for serial correlation, the Jarque-Bera test for normalcy, and the Heteroskedasticity test are some of these diagnostic tests.

First, let's look at the results of the normality test. For Model I, the Jarque-Bera statistic is 5.09 with a p-value of 0.74, and for Model II, it is 6.76 with a p-value of 0.56. We are unable to reject the null hypothesis of normality because the p-values for both models are much higher than the typical significance thresholds (such as 0.05 or 0.01). This implies that both models' residuals have a normal distribution, which is advantageous for statistical inference.

To find out if there is serial correlation in the residuals; apply the LM-Serial Correlation test. The LM statistics for Model I and Model II are 10.63 and 11.05, respectively, with a p-value of 0.83 and 0.80. We are unable to rule out the null

hypothesis that there is no serial association because the p-values for both models are higher than 0.05. This suggests that neither model's residuals exhibit any substantial serial correlation, indicating that the residuals are independently distributed—a crucial premise for the model's dependability.

Model I has a chi-square value of 107.09 with a p-value of 0.29 for the Heteroskedasticity test, whereas Model II has a chi-square value of 136.82 with a p-value of 0.139. Since the p-values in both situations are higher than 0.05, the homoskedasticity null hypothesis cannot be rejected. This suggests that there is no heteroskedasticity in the residuals, supporting the assumption of homoskedasticity for both models, and that the residuals from both models show constant variance.

Overall, both models' diagnostic tests yield satisfactory findings. The models are well-specified and appropriate for additional study because they both show homoskedasticity, normally distributed residuals, and no serial correlation. The results of Model II remain mostly unchanged with the exogenous variable included, suggesting that the diagnostic features of the model are not negatively impacted by its addition.

Conclusion:

With gross value added (GVA) acting as the dependent variable, the study examines the effects of labor employment (LE), domestic capital (DC), and foreign direct investment (FDI) on manufacturing production in India. Two models were used: Model II adds labor quality as an exogenous factor while Model I contains LE, DC, and FDI as independent variables. The objective was to evaluate the short- and long-term effects of these independent factors on manufacturing production while investigating the ways in which labor quality affects these connections.

The findings show that all three of the independent variables—LE, DC, and FDI—have a major and favorable effect on GVA over the long term. The inclusion of labor quality (Model II) increased the coefficients of these variables, particularly DC (from 0.11 to 0.38) and FDI (from 0.48 to 0.57), suggesting that higher labor quality amplifies the effects of both domestic and foreign investments on manufacturing production. However, the impact of DC and FDI on GVA remained strong in both models. Additionally, LE displayed a higher coefficient in Model II (from 0.02 to 0.10), suggesting that higher-quality labor can boost the labor employment's contribution to industrial production.

There was some fluctuation in the independent variables' impact on manufacturing production, according to the short-run analysis. With the coefficients rising in Model II, DC and FDI demonstrated significant short-run effects on GVA in both models, underscoring the significance of labor quality in boosting the immediate impact of capital expenditures. However, LE's short-term performance was inconsistent, and Model II was the only model in which its impact became noticeable. This implies that

the efficacy of labor employment in increasing productivity in the short term is highly dependent on the caliber of labor.

All things considered, the results show that FDI, DC, and LE are crucial factors influencing industrial output in India. Furthermore, adding labor quality greatly amplifies their effect, indicating that human capital investments are critical to optimizing the returns on both local and foreign investments. To guarantee a complete boost to manufacturing output, policymakers should thus concentrate not only on luring FDI and promoting domestic capital formation but also on enhancing worker quality through skill development programs.

The study's conclusions, which emphasize the major effects of labor employment (LE), domestic capital (DC), and foreign direct investment (FDI) on India's manufacturing output—especially when labor quality is raised—lead to the following policy recommendations:

Improve Labor Quality through Skill Development Programs: The research shows that FDI, domestic capital, and labor employment all have a major positive impact on manufacturing production when labor quality is high. To raise the caliber of the labor force, the government should fund programs for skill development. To guarantee that workers have the skills required by the industrial sector, this could involve partnerships between educational institutions and businesses, technical training, and vocational programs.

Encourage and facilitate FDI inflows: Research has shown that FDI has a favorable short- and long-term impact on manufacturing output. To take advantage of this, the government should simplify approval procedures, cut bureaucratic red tape, and provide incentives to international investors in the form of tax rebates. Maintaining investor trust and drawing more foreign investments into the manufacturing sector also depends on political and economic stability.

Encourage the Formation of Domestic Capital: The benefits of domestic capital on manufacturing output point to the necessity of assisting domestic companies and investors. The main goals of policymakers should be to lower borrowing costs, support capital-intensive companies with subsidies, and give attractive credit facilities. The availability of local capital can be increased by initiatives like promoting domestic savings and offering rewards for investments in the manufacturing sector.

Public-Private Partnerships (PPPs): The government ought to support PPPs in order to improve the efficacy of FDI as well as domestic capital. By fusing the effectiveness of the private sector with government backing, these alliances can promote cooperation between the public and private sectors. By introducing cutting-edge technology and international investors' best practices to home businesses, this strategy can help increase productivity even more.

Boost Infrastructure and Make Doing Business Easier: Developing infrastructure is essential to encouraging both domestic and foreign investment. The development of energy supplies, digital infrastructure, transportation networks, and industrial parks

should be given top priority by the government. Additionally, the manufacturing environment would be more favorable for both domestic and foreign investors if rules were made simpler and commercial transactions were made easier.

Emphasis on Sector-Specific Policies: According to the study, FDI may have varying effects on various industrial sectors. Thus, to draw foreign direct investment (FDI) into high-potential sectors such as automotive, electronics, and pharmaceuticals, sector-specific regulations had to be put in place. The overall effect of investments on the manufacturing sector can be maximized by identifying critical sectors and providing tailored incentives.

Foster Innovation and Technology Transfer: Foreign Direct Investment (FDI) not only provides finance but also skills and technology. Policy makers should support technology transfer from overseas companies to domestic businesses in order to increase manufacturing productivity. Incentives for R&D and innovation promotion in the manufacturing sector would also contribute to increased productivity and competitiveness in the global market.

The creation of jobs and labor market reforms: Considering the advantages that labor employment has for industrial output, efforts have to be directed toward creating additional job opportunities. Labor laws must be made more flexible through labor market changes in order for businesses to hire and retain people with ease while maintaining the protection of their rights. This adaptability may draw in additional capital for the manufacturing industry.

The objective of these policy recommendations is to develop a comprehensive strategy for augmenting the influence of LE, DC, and FDI on manufacturing output in India. The recommendations specifically center on enhancing the quality of labor and guaranteeing that investments, both foreign and domestic, are efficiently employed to foster growth and productivity.

References

1. Alfaro, L. (2003). FDI and Growth: does the sector matter? Boston: Harvard Business School.
2. Aykut, D., & Sayek, S. (2007). The role of sectoral composition of FDI on growth. Elsevier, Amsterdam: In: piscitello L, Santangelo GO (eds) .
3. Balasubramanyam, V., Salisu, M., & Sapsford, D. (1996). FDI and Growth in EP ans IS Countries. The Economic Journal, 106, 92-105.
4. Banga, R. (2004). Impact of Japenese and US FDI on Productivity Growth: A Firm-Level Analysis. Economic and Political Weekly, vol.39, no.5, pp. 453-460.
5. Barro, R., & Sala-i-Martin, X. (1995). Technological Diffusion, Convergence, and Growth (NBER Working paper No. 5151). Cambridge: Cambridge Maisachusetts: National Bureau of Economic Research.
6. Bhattarai, K., & Negi, V. (2020). FDI and Economic Performance of Firms in India. Applied and Economic Research: Studies in Microeconomics, 8(1); 44-74.

7. Borensztein, E., Gregorio, J., & Lee, J. (1998). How does foreign direct investment affect economic growth? International Journal of Economics, 115-135.
8. Chakraborty, C., & Nunnenkamp, P. (2008). Economic reforms, FDI, and Economic growth in India: a sector level analysis. World Development, vol.7, issue no. 36, PP- 1192-1212.
9. Dash, R., & Parida, P. (2012). Services trade and economic growth in India: an analysis in the post-reform period. International Journal of Economics Business Research, vol.4, issue no. 3, pp- 326-345.
10. De, M. L. (1999). Foreign Direct Investment-led Growth: Evidence from Time Series and Panle Data. Oxford Economic Papers, 51(1): 133-151.
11. Dua, P., & Rashid, A. I. (1998). Foreign Direct Investment and Economic Activity in India. Indian Economic Review, 153-68.
12. Dunning, J., & Lundan, S. (2008). Institutions and the OLI Paradigm of the Multinational Enterprise. Asia Pacific Journal of Management, 25(4), 573-593.
13. Fauzel, S., Seetanath, B., & Sannasee, R. (2015). Productivity Spillovers of Foreign Direct Invetsment in the Mnaufacturing Sector of Mauritius: Evidence from a dynamic framework. The Journal of Dveloping Areas, 49(2):295-316.
14. Goldar, B., & Sharma, A. K. (2015). Foreign Investment in Indian Industrial Firms and its impact on Firms Performance. The Journal of Industrial Statistics, 4 (1), 1-18.
15. Gujarati, D. (2004). Basic Econometrics (5th edition). McGraw Hill.
16. Johansen , S. (1988). Statistical Analysis of Cointegration Vectors. Journal of Economic Dynamics and Control, 12(2-3), 231-254.
17. Karikari, J. (1992). Causality between Direct Foreign Investment and Economy Output in Ghana. Journal of Economic Development, vol.17, pp: 7-17.
18. Kathuria, V. (1998). Technology transfer and Spillover for Indian Manufacturing firms. Development Policy Review, vol.16, pp: 73-91.
19. Mandol, S., & Pant, M. (2014). FDI and Firms Competitiveness: Evidence from Indian Mnaufacturing. Economic and Political Weekly, 49(38): 56-64.
20. Mankiw, N. G., Romer, D., & Weil, D. N. (1992). A Contribution to the Empirics of Economic Growth. Quarterly Journal of Economics, 107:407-437.
21. Nagraj, R. (2011). Industrial Performance 1991-2008: A Review. India Development Report, 2009-10. New Delhi, New Delhi, India: Oxford University Press.
22. Nelson, R., & Phelps, E. (1966). Invetsment in Humans, Technological Diffusion, and Economic Growth. American Economic Review, 61, 69-75.
23. Phillips, P., & Perron, P. (1988). Testing for a Unit Root in Time Series Regression. Biometrika, 75(2);335-346.

24. Rath, B. N., & Bal, D. P. (2014). Do FDI AND Public Investment Crowds in or Crowds out Private Domestic Investment in India. The Journal of Developing Areas, 48(3); 269-284.
25. Saltz, I. (1992). The negative correlation between Foreign Direct Invetsment and Economic Growth in the Third World: Theory and Evidence. Rivista Internazionale di Scienze Econmiche e Commerciali, vol.39, pp: 317-633.
26. Solow, R. (1956). A Contribution to the theory of Economic Growth. The Quarterly Journal of Economics, 70(1).
27. Wei, S.-j. (1996). FDI in China: Sources and consequences. In I. Takatoshi, & O. Anne, Financial Deregulation and Integration in East Asia . Chicago, IL: University of Chicago Press.