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Impact of Foreign Direct Investment on Manufacturing Sector: Evidence from Indian Economy

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ABSTRACT

There is need for an additional source of finance in form of foreign direct investment (FDI) in the Indian manufacturing sector due to its long-term engagement between the investors and the host country. Further FDI in the manufacturing sector is gaining importance because of the benefits the manufacturing sector reaps as a result of technology spillover brought through FDI. Therefore the **objective** of the study is to assess the impact of Foreign Direct Investment on the manufacturing sector output of the Indian economy for the period of 1991–2020. **Methods** such as bounds test, Autoregressive Distributed Lag Model (ARDL) and Granger causality are used to study the impact of FDI and the interaction of FDI and human capital as two different variables on the output of the manufacturing sector in the Indian economy. Also, the technology-enhancing effect of FDI is addressed in the current study. The **results** of the study reveal that the inflow of FDI leads to an increase in manufacturing sector output. Further, it **concludes** that the higher the level of education (human capital) and the greater the technology gap between host and home country, the more is the technology spillover, and hence more prominent is the impact of FDI on the output of the manufacturing sector.

Keywords: Foreign Direct Investment; manufacturing sector productivity; ARDL model; India; absorption capacity; human capital; spillover; technology gap

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INTRODUCTION

Foreign direct investment (FDI) refers to investment made by one country in another with the purpose of controlling ownership in the host country [1]. It is also considered as an amalgamation of capital, technology, marketing skills, and managerial know-how [2]. Further, FDI is that it not only bridges the gap between domestic investment and the required investment, but also enhances economic growth, employment opportunity, exports, and positive balance of payment, production, and competitive practices [3]. Therefore, this kind of investment is essential for the manufacturing sector to meet the demand for capital and enhance the productivity of workers.

The inflow of FDI acts as an agent in developing less developed economies by promoting industrialisation and eventually improving the production of the manufacturing sector through bringing required capital, improved knowledge, skills, and innovative technology [4–7] since the manufacturing sector is primarily concerned with the conversion of raw material into usable finished goods or intermediate products [8].

FDI creates technology spillover in the manufacturing sector. However, the amount of benefit depends on the absorption capacity, which, in turn, depends upon educated or skilled employees, or human capital [9, 10]. Also, FDI leads to technology diffusion from the home to the host country, improves skills, reduces prices, and creates a competitive national structure [11, 12].

India has become an attractive destination for FDI because of its large consumer base, availability of cheap labour, and low cost of production [12]. India is also producing 2.2% of global manufacturing output, which is equivalent to the output produced by the UK [13]. According to the Global Manufacturing Competitive [14], "India held the second position in terms of its manufacturing capabilities in the entire world". India is becoming a desired destination for manufacturing, for numerous companies, and others are willing to move their manufacturing base to India, as the country ranks second in terms of excellence for quality after Japan.[1]

Thus, this paper is a modest attempt to study the impact of FDI on the manufacturing sector's output in India. The next section lays down the need for the study, followed by objectives in section 3. Section 4 focuses on a review of past studies and section 5 enumerates the methodology used in the study. Section 6 discusses the results obtained, followed by section 7, which contains the conclusion and policy implications.

NEED FOR THE STUDY

While there are numerous studies on FDI and manufacturing sector output/production links, little work has been done on the impact of FDI, and the linkage of FDI and human capital as two different variables on the output of the manufacturing sector. Besides, the technology-enhancing effect of FDI is still an unresolved issue, which the current study addresses. Thus, the study will be more useful, as a single country examination is able to analyse the detailed scenario of a developing economy like India to derive better policy implications.

OBJECTIVES

1. To determine the direct impact of FDI on manufacturing sector output in India.

2. To investigate the indirect effect of FDI through its interaction with human capital on the manufacturing sector output of India.

3. To study the impact of the technology gap on the manufacturing sector output of India.

REVIEW OF LITERATURE

Past studies related to the impact of FDI on the manufacturing sector and the technology spillover effect have shown mixed results. On one hand researchers state that an increased inflow of foreign investment is useful to meet the demand for required funds thus leading to economic growth and improved productivity of the host country [14–18]. Some other studies supported the positive impact of FDI on the manufacturing sector [3, 7–10, 19–23].

Studies by C. Azolibe [7], S. Samal and D. Raju [13], and L. Mounde [20], and indicated that FDI acts as a catalyst in manufacturing sector growth by providing the required finances, knowledge, expertise, and technology. In line with this, E. Ekienabor et al. [4], M. Sinha et al. [5], Fujimori et al. [12], T. Masron and M. Hassan [19], and B. Ni et al. [24] stated that FDI triggers technology spillover through the development of human capital, leading to increase in output of the manufacturing sector.

A major factor through which FDI impacts manufacturing sector production is the absorption capacity of a firm. One way to measure the absorption capacity is through the availability of a skilled and educated labour force. Skilled workers are also required for complex technological progress and technology changes, as well as to adapt to information changes in the organisation [13, 25, 26]. Some researchers explained that firms with skilled labour and better human capital can benefit from spillover [27, 28]. FDI is identified as a major source of technology spillover. However, the amount of technology spillover depends on the learning capacity of employees (human capital) [9, 10]. In connection with these results, T. Kalu-Ulu [2] stated that FDI, in addition to human capital among other factors, helps the economy to achieve growth through the transfer of technology, improved productivity, skills, employee training and development, and international production network. N. Aggrey [29] similarly found that human capital is the essence for all economies that want to increase manufacturing growth by improving technology and skills brought through FDI. Likewise, C. Jude [30] asserted that spillover occurs due to heterogeneity in domestic firms and that human capital plays a major role in absorption and transfer of knowledge.

On the other hand, some researchers suggest that the greater the technology gap between host and foreign firms, the greater the probability of technology transfer [19]. Technology transfer occurs when local firms adopt foreign firms'

[1] Global manufacturing competitiveness Index. Dellolite. 2010. URL: https://www2.deloitte.com/content/dam/Deloitte/us/Documents/manufacturing/us-mfg-2010-global-manufacturing-competitiveness-index.pdf (accessed on 12.12.2022).

technology [7, 22]. C. Malikane & P. Chitambra [11] stated that FDI has a limited effect on the productivity of African countries due to the limited absorption of technology. Another study conducted by M. Azeroual [9] revealed FDI from France had a negative impact on the Moroccan manufacturing sector, whereas FDI coming from Spain had a positive influence on productivity. The reason for the negative impact of FDI originating from France was that all the inflow was directed towards medium and high technology sectors, thus reducing the technology gap. With minimal technology gap, there was very little scope for the transfer of technology.

However, some studies show the mixed impact of FDI. O. Timothy & A. Chigozie [31] stated that there is no short-run causality from FDI, human capital, and GDP towards manufacturing value-added, but since FDI impacts the performance of the manufacturing sector in the long run, it is required to maintain human capital to absorb the required skill brought through FDI. On the other hand, E. Akpan & G. Eweke [32] explained there is no long-run relationship between the variables; however, there was a bidirectional causal relationship between FDI and industrial development, and industrial development and GDP.

Other researchers are of the opinion that FDI negatively affects the production of the manufacturing sector in the host country [3, 23, 33]. These results were supported by A. Fujimori et al. [12], stating the negative productivity is due to the inability of domestic firms to fight international competition, thus driving domestic firms out of the market. Similarly, K. Marcin [28] found negative impact of foreign investment on manufacturing productivity; however, he stated that the magnitude of impact varies according to the absorptive capacity of the home country. This was further supported by N. Samantha & H. Liu [22] in their study on Sri Lanka's industrial sector.

RESEARCH METHODOLOGY

Data Collection and Definition of Variables Selected

The data chosen for the study is annual data for the period of 1991–2020 for the Indian economy. The data was collected after 1991, that is, after the liberalisation of the economy, which led to a tremendous inflow of foreign funds.

Manufacturing sector output/production is the dependent variable, while FDI, human capital, labour, capital, trade openness, and technology gap are the independent variables identified by theory; however, technology spillover, also referred to as absorption capacity, is measured by technology gap similar to [9, 11], and interactive variable (FDI*H) in line with [9, 34, 35]. Trade openness was identified as a control variable by [7, 9, 20, 22]. All the data was collected through secondary sources such as the Central Statistical Office, the Ministry of Statistics and Programme Implementation, the Government of India, the RBI Handbook of Statistics on the Indian Economy, and DIPP.

THEORETIC WORK

From the literature, the link between FDI and productivity has three branches. The first is the neoclassical growth model of R. Solow [36] and T. Swan [37]. In this model, production (Y) is a function of two variables, labour (L) and capital (K), where A measures the productivity component, Total Factor Productivity (TFP). TFP can be attained from various factors such as knowledge, technology spillover, human capital, and foreign investment [3, 8]. The equation as per the neoclassical growth model is given by:

$$Y = f(K, AL).$$

Later new growth theory suggests that, unlike land and capital, learning does not suffer from losses and emphasised on innovation and learning to drive returns.

Subsequently, the development of endogenous growth theory emphasised the importance of human capital to absorb knowledge and skills. This theory took into consideration the importance of FDI and human capital [6]. The endogenous model focuses on the impact of FDI on economic growth through spillover [8, 10, 22]. Also, from theory and literature, FDI has an impact on the host economy in various ways. The studies focused on the importance of human capital and skilled labour to take advantage of technology spillover from FDI inflow. Thus, the human element interacting with FDI and the technology gap act as two technology spillover (absorption capacity) measures.

Thus, the production function is

$$Y_t = L_t^{a1} K_t^{a2} FDI_t^{a3} H_t^{a4} TG_t^{a5} FDI * H_t^{a6} TO_t^{a7}$$

where *Y* stands for manufacturing sector output, *L* is labour measured by the number of people employed, *K* is capital (measured using gross fixed capital formation), *FDI* is foreign direct investment inflow, *H* is human capital (measured by the population that has completed senior secondary education), TG refers to technology gap (measured by total value added) as it is used to measure the absorption capacity in order to determine the spillover, *FDI * H* is the interactive term to assess the indirect impact of *FDI* with human capital (spillover), and *TO* is trade openness (measured by the sum of imports and exports as a ratio of *GDP*), where *TO* is a control variable.

Log-Log transformation is used to smoothen the data and reduce the problem of heterogeneity.

$$lnY_t = a_0 + a_1 ln\, L_t + a_2 lnK_t + a_3 lnFDI_t + a_4 lnH_{t0} + a_5 lnTG_t + a_6 lnFDI * H_t + a_7 lnTO_t + et.$$

Model Specification

To estimate the impact of FDI, along with capital, labour, and human capital, on manufacturing sector production, we applied autoregressive distributed lag (ARDL) model proposed by M. Pearson et al. [38] rather than conventional cointegration techniques proposed by R. Engle and C. Granger [39] and S. Johansen [40] as ARDL model is that it has numerous advantages over these methods.

The estimated ARDL equation is given as

$$lnY_t = a_1 + \sum_{i=1}^{p} \lambda 1 \ln Y_{t-1} + \sum_{j=1}^{q} \lambda 2 \Delta \ln FDI_{t-1} + \sum_{k=1}^{q} \lambda 3 \Delta \ln K_{t-1} + \sum_{l=1}^{q} \lambda 4 \Delta \ln L_{t-1} + \sum_{m=1}^{q} \lambda 5 \ln H_{t-1} + \sum_{n=1}^{q} \lambda 6 \ln FDI * H_{t-1} + \sum_{o=1}^{q} \lambda 7 \ln TO_{t-1} + \sum_{p=1}^{q} \lambda 8 \ln \Delta TG_{t-i} + \lambda ECT_{t-1} + e_t$$

where a is the drift, t is the time period measured quarterly, p and q are the lag of the dependent variable and independent variables, $\lambda_1,\ldots\lambda_7$ are long-run multipliers, e_t is the error term related to the normal distribution, λ is the speed of adjustment parameter, and ECT_{t-1} is the error correction term, the lagged value of the residual obtained from the cointegrating regression of the dependent variables on the repressors, containing long-run information from the long-run cointegration equation.

RESULTS AND DISCUSSION

Unit Root Test

We used the Phillips-Perron test [41] to assess the presence of unit root. As variables are integrated at the combination of I (1) and I (0), thus it is preferable to adopt the ARDL method. The results are summarised in *Table 1*.

Multicollinearity

Multicollinearity test results (*shown in Table 2*) show that capital (K) has a very high centered VIF, that is, a value of 13.98, as a result of which it had to be removed from the list of the independent variables for further analysis.

Cointegration and Causality

Bound test results (shown in *Table 3*) depict that the calculated F-statistics (7.4936) is higher than the upper critical bound (4.088), indicating the existence of cointegration among the variables at 5% level of significance. Further, the ARDL model was applied to determine short-as well as long-run coefficients, along with ECT. The appropriate lag length has been selected based on Akaike Information Criteria (AIC).

ARDL results (*summarised in Table 4*) show a higher value of Durbin-Watson than R-squared, indicating the absence of serial correlation. In the long run, human capital, labour, technology gap, and FDI*H have a significant and positive influence on manufacturing sector output, indicating the

Table 1

Phillips-Perron Test Results for Unit Root

Variables	At level	At first difference
	With constant With constant and trend	With constant With constant and trend
L(IP)	−5.0287−5.0623	−10.0784−10.0915
	(0.0001***) (0.000***)	(0.0000***) (0.0000***)
L(FDI)	−0.7142−0.9872	−11.8475−11.6247
	(0.8293) (0.5674)	(0.0000***) (0.0000***)
L(K)	−0.6875−2.6578	−13.7843−13.7217
	(0.9171) (0.0006*)	(0.0000***) (0.0000***)
L(L)	−1.2652 0.7853	−18.1784−18.0678
	(0.4823) (0.6147)	(0.0001***) (0.0000***)
L(H)	−3.0482−3.8745	−9.7847−9.1472
	(0.0232**) (0.0213**)	(0.0000***) (0.0000***)
L(FDI*H)	−5.5478−6.1498	−8.1245−8.0784
	(0.0003***) (0.0001**)	(0.0000***) (0.0000***)
L(TO)	−2.1475−4.4154	−9.1784−9.0072
	(0.0486**) (0.0021**)	(0.0000***) (0.0000***)

Source: Authors computation.

Notes: (*), (**), and (***) significant at 10%, 5%, 1% respectively.

t-stats (P-value).

Table 2

Results of Multicollinearity

Variable	Coefficient variance	Uncentered VIF	Centered VIF
C	10978.48	278.94750	NA
L	0.0845754	376.4515	1.9762
K	1.75E-09	298.1456	13.9846
H	0.008755	37.8455	1.6795
TG	0.000476	33.1487	5.7843
FDI	0.000784	16.4193	3.7164
FDI*H	0.000875	16.3216	6.3379
TO	87.289E-09	17.9541	6.1283
Y	1.29E-13	13.8734	1.3796

Source: Authors computation.

importance of absorptive capacity measured via technology gap and interactive variable (FDI*H). Human capital, along with its interaction with FDI, is significant in explaining the variation more than FDI alone in the long run, indicating the importance of human capital in the absorption of technology and know-how brought to the nation through FDI. Further, the technology gap (measuring absorption capacity) is found to be a major determinant affecting manufacturing sector output. Apart

Table 3

Bound Test Results

Computed F statistics 7.4936		
Critical value	Lower bound value	Upper bound value
1%	4.093	5.532
5%	2.947	4.088
10%	2.46	3.46

Source: Authors computation.

Table 4

ARDL Short and Long Run Results

Short run coefficients					Long run coefficients				
Variables	Coff	SE	t-stats	Prob	Variables	Coff	SE	t-stats	Prob
LnY(−1)	0.70614	.01562	4.5194	0.0001	LnY(−1)	−0.7847	0.3909	−2.007	0.0511
LnY(−2)	−0.1414	0.1718	−0.827	0.4127	LnL	1.1660	0.3689	3.161	0.0029
LnL	0.0299	0.1750	0.1714	0.8651	Lnfdi	0.3227	0.3988	0.808	0.4235
LnL(−1)	0.0144	0.1658	0.0872	0.9309	Lnh	0.4426	0.1139	3.885	0.0003
Lnh	1.3180	0.5085	2.5917	0.0133	Lnh(−1)	0.5175	0.6448	0.802	0.4265
Lnh(−1)	1.4356	0.4900	2.9297	0.0056	Lnh(−2)	1.278	1.4785	0.864	0.3918
Lnh(−2)	0.0901	0.0749	1.2024	0.2362	Lnfdi*h	0.6317	2.2152	2.851	0.0066
Lnfdi	0.1423	0.0571	2.4944	0.0165	Lnfdi*h(−1)	0.8850	0.3498	2.530	0.0151
Lnfdi(−1)	−0.1691	0.1801	−0.938	0.3530	Lnfdi*(−2)	0.1423	0.0393	3.619	0.0008
Lnfdi(−2)	−0.1841	0.4204	−0.448	0.6563	LnTO	−2.4135	2.4247	0.995	0.3249
Lnfdi*h	0.6555	0.1421	4.6117	0.000	LnTG	0.4663	0.0876	5.3189	0.0000
Lnfdi*h(−1)	1.1664	0.4352	2.6788	0.0104	cointEq(−1)	−0.5340	0.1160	−4.601	0.0000
Lnfdi*h(−2)	0.8850	0.4001	2.2117	0.0323					
Lnfdi*h(−3)	0.0195	0.5742	0.0341	0.9730					
LnTO	1.2754	1.4785	0.8646	0.3918					
LnTO(−1)	−2.4196	1.7108	−1.414	0.6877					
LnTG	0.3619	0.1266	2.8587	0.0072					
LnTG(−1)	0.2874	0.1165	2.4667	0.0188					
LnTG(−2)	0.2869	0.1093	2.6249	0.0129					

Source: Authors computation.

Notes: R^2 = 0.22, Adjusted R^2 = 0.18, F-statistics: 7.76 (0.000***), AIC: −2.134, Durbin-Watson (DW): 2.01L is the log value.

from FDI, labour and trade openness are found insignificant in explaining any variation in the long run. ECT is negative and significant, inferring the conversion of short-run shocks to long-run equilibrium at an adjustment speed of 53.4%.

Short-run dynamics of variables given by ARDL results (shown in *Table 4*) show that the first lag of manufacturing sector production, human capital and its first lag, FDI, the interactive variable of FDI and its first and second lag, as well as technology gap and its lags, have a positive and significant impact on the production of the manufacturing sector. Trade openness is found to have an insignificant impact in both the short as well as long run. However, it can be seen that in the short run, the impact of FDI is significant. The positive impact of FDI on the manufacturing sector indicates that FDI brings the required capital to expand manufacturing output [1, 4–8, 11, 20, 23, 32, 42]. Further, with an increase in foreign firms, demand for raw materials increases, which is met by increased production of domestic manufacturers. Further, the ARDL results reveal, the interactive term (FDI*H) has better power in explaining the variation of manufacturing productivity due to the presence of human capital, as higher human capital explains a better ability to absorb and adapt to improved technology and managerial know-how. This is in line with [9, 10, 35]. The impact of the technology gap and its lags are also positive and significant, similar to [9, 11], signifying that the economy is able to benefit through technology spillover.

Diagnostic Testing

The results of LM test of serial correlation and the Breusch-Pagan-Godfrey test of heteroskedasticity (summarised in *Table 5*) reveal the absence of serial correlation and heteroskedasticity respectively. Further, the results of the CUSUM of square test indicate the stability of the model as the model line does not cross either of the bounds (*Fig. 1*). Thus, indicating the model is fit for inference.

Table 5

Diagnostic Test Results

Test	Hypothesis		Results
Breusch-Godfrey serial correlation LM Test	Null= No serial Correlation	0.6623	No serial correlation
Breusch-Pagan -Godfrey	Null=no heteroskedasticity	0.6175	No heteroskedasticity
CUSUM of square test for stability	If the coefficient of the estimated model is in two bounds it is stable		Stable

Source: Authors computation.

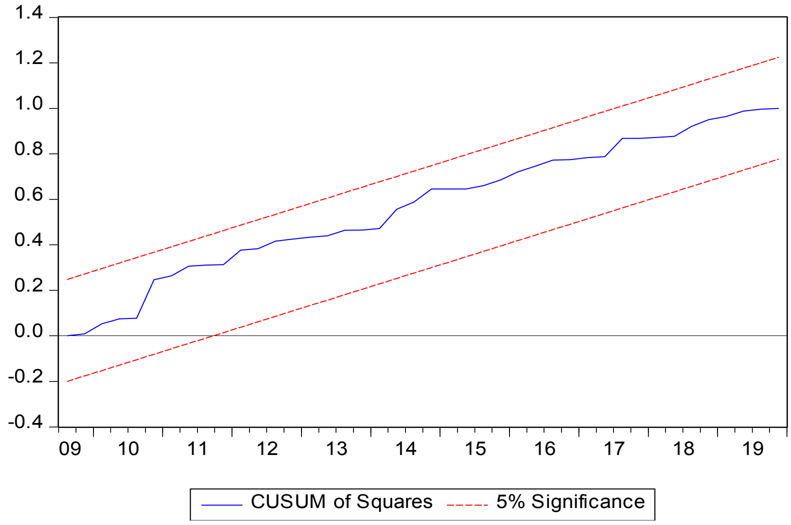

Fig. 1. **CUSUM of Squares Plot**

Source: Authors computation.

Short-Run Causality

The Granger causality test given by C. Granger [43] is used to examine the short-run causality among the variables in the given multivariate framework. Results of the Granger causality test at lag length 3 (shown in *Table 6*) indicate that the results are in line with those of ARDL, indicating short-run causality running from FDI, human capital, technology gap, and the interactive term (FDI*H) to the manufacturing sector production. However, Granger test results also show causality running from manufacturing sector output to FDI, showing bidirectional causality between FDI and production/manufacturing sector output.

CONCLUSION AND IMPLICATIONS

This paper analysed the impact of FDI on the output of the manufacturing sector. Further, the absorption capacity (technology spillover) of the host country was assessed by the interaction of FDI and human capital (H) and the technology gap. The ARDL model has been used in the dynamic framework for a period ranging from 1991 to 2020.

The results reveal that the Indian manufacturing sector has registered a significant gain from the inflow of FDI. However, the percentage gains are not as high as reported in other countries. Out of the six explanatory variables, trade openness had no significant impact on manufacturing sector production similar to N. Samantha & H. Liu [22], indicating low exports of Indian manufacturing.

Even labour does not influence productivity in the short run but has a positive and significant impact in the long run. Further, FDI has a positive impact on production in the short run but has no influence in the long run.

Human capital and its interactive variables, along with the technology gap, have a positive and

Table 6

Results of Granger Causality Test

Variables From	Y	FDI	TG	L	H	FDI*H	TO	Direction of causality
Y	–	0.011*	0.7817	0.004*	0.0512	0.0873	1.0645	Y→L Y→FDI
FDI	0.023**	–	1.6241	0.1264	0.7814	0.041**	0.7435	FDI→Y FDI→FDI*H
TG	0.0092	0.4851	–	0.1247	0.3114	0.8475	0.9146	TG→Y
L	0.1875	0.9824	0.9134	–	0.0054**	0.0975	0.1428	L→H
H	0.001*	0.014**	0.4864	0.4173	–	0.004**	0.4318	H→Y H→FDI H→FDI*H
FDI*H	0.000*	0.1476	0.6425	0.9724	0.1746	–	0.6357	FDI*H→Y
TO	1.345	0.003*	0.9751	0.1784	0.9173	0.0036*	–	TO→FDI TO→FDI*H

Source: Authors computation.

Note: (*) and (**) indicate rejection of no causality at 1% and 5% level of significance respectively.

significant impact both in the short as well as long run. The positive impact of FDI indicates the inflow of foreign capital by bringing the required finance to raise manufacturing output. Similar results indicating the positive impact of human capital and technology gap were given by various researchers such as C. Idoko & U. Taiga [1], E. Ekienabor et al. [4], M. Sinha et al. [5], C. Azolibe [7], M. Oluwatoyin et al. [8], C. Malikane & P. Chitambra [11], L. Mounde [20], A. Afolabi et al. [23], E. Akpan & G. Eweke [32], and O. Nwosu et al. [42].

Also, human capital and the interactive variable (FDI*H) have a positive and significant impact both in the short as well as long run. This is in line with [9, 10, 35]. The result explains that an increase in FDI directly leads to an increase in the production of the manufacturing sector by providing the required capital. Also, FDI*H indirectly has a positive influence over the manufacturing sector growth, indicating the ability of skilled manpower to adapt to technological advancements and new ideas. Further, this study suggests that the greater the technology gap between a foreign firm and the host country's firm, the greater the amount of absorption or technology spillover. This view is supported by [9, 11].

With the growing importance of FDI and technology spillover in the manufacturing sector, it is essential to formulate policies to attract FDI. Thus, the study recommends that it is essential to develop human skills and increase research and development activities of the host country so they can gain the maximum by absorbing and adopting improved technology and managerial know-how. Government policies should aim at attracting a higher proportion of FDI, which could contribute to industrial production. For this, the government should focus on other push and pull factors affecting the FDI, related to the host as well as the home country. FDI brings the latest technology, capital, machinery, knowledge, and skill required for the development of the manufacturing sector, in turn, to the economy. Therefore, emphasis should be given to the policymakers to invest in infrastructural development, political and macroeconomic stability, and framing pro-FDI policies.

In addition, the government should encourage foreign investors to prioritise their investment in the manufacturing sector, as technology spillover is likely to benefit the entire economy. The government should also clearly lay down their policies related to tax cuts, rebates, etc. with regard to the manufacturing sector for increasing the import of machinery and new technology and to enhance productivity in the manufacturing sector.

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N. Mehta — identified the gap, collected data, performed analysis, reviewed literature, performed analyses and wrote the conclusion.
S. Gupta — designed tables and graphs, discussed variables, techniques and interpreted the results.
Sh. Maitra — contributed to the conclusion and reviewed the paper.

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