Ramanujan International Journal of Business and Research, 2022, 7(2), 26-35

doi: https://doi.org/10.51245/rijbr.v7i2.2022.920
P-ISSN: 2455-5959
E-ISSN: 2583-0171

ARTICLE

Growth of India's High-tech Exports: Do the Import of Intermediate Goods and Inward FDI Promote India's High-tech Exports?

Ashwani Mahajan[1, *], Phool Chand[2, †] and Tausheef Alam[3, ‡]

[1]Department of Economics, PGDAV College, University of Delhi, Delhi, India and [2]Department of Commerce, PGDAV College, University of Delhi, Delhi, India and [3]Department of Commerce, University of Delhi, Delhi, India

[*] ashwanimahajan@rediffmail.com
[†] phool.chand@pgdav.du.ac.in
[‡] tauseefg90@gmail.com

Abstract

Exports across the globe have gone through structural change which has also led to the diversification of the export basket of the economies around the world. At present, the world is witnessing a shift towards medium and high-technology exports as compared to low-technology and natural resource-based exports. High competency in the production of technology-intensive goods and their exports can be a very important key factor in the growth and development of an economy. As high-technology exports play a very crucial role in the growth and development of an economy, the present study attempts to study the growth of India's high-tech exports and secondly to find out the impact of import of intermediate goods and inward FDI on India's high-tech export performance. Two control variables, namely R&D expenditure as a percentage of GDP and economic freedom level, represented by the index of economic freedom are also taken into the study to take up the empirical analysis. This study uses a simple and multivariate regression model for empirical analysis. In this study, the value of high-tech exports has been taken as the dependent variable, and on the other hand, import of intermediate goods, inward FDI, R&D expenditure, and index of economic freedom are the four independent variables. Results in the study show that, Firstly, high-tech exports performance has improved over the last two decades, and secondly, both import of intermediate goods and inward FDI has a significant positive impact on the growth of India's high-tech exports.

JEL Codes: F21, F23, O30 and O33
Keywords: FDI, High-tech exports, R&D Expenditure, and Index of Economic Freedom.

1 Introduction

1.1 The backdrop of the Study

Current economic trends around the globe are related to structural changes in exports and the expansion of export diversification (Samen, 2010). At present in the international competitive environment, economies are focusing more

on medium and high-technology product exports as compared to low-technology and natural resource-based product exports. As per (Mani, 2000), the share of developing countries in manufacturing exports and high-tech exports is growing, suggesting that developing countries' export systems are gradually shifting toward technology-intensive goods. High-tech exports have positive associations with economic growth (Eaton and Kortum, 2001); and significantly contribute to economic output by affecting the GDP positively (Yoo, 2008). One of the essential drivers of economic development is high technology competency, especially in countries that follow export-led growth strategies (Hobday, 2001). To compete in technology-intensive sectors, today's fast-growing countries must increase their share of high-tech products in their overall product mix and increase productivity (Sara et al., 2012).

In 1991, India began the economic reform process and continuous integration with the global economy to place its economy on a growth and development path. The primary aim of launching economic reforms is to assist in the production of modern and advanced technologies (Pohit and Basu, 2012). India has entered a new phase of growth that aims to make it globally more competitive by enabling trade, foreign investment, and technology inflows. Economic reforms seem to have been well-received. At present, the Indian economy is now one of the world's fastest-growing economies. Despite progress on the development path, India's export shares in the global market remain weak, with only a marginal rise in exports of medium and high-technology goods. According to the World Bank's World Development Indicators 2019, India's high technology exports accounted for only 10.3 percent of its manufactured exports, compared to 13.28 percent in Brazil, 30.79 percent in China, 23.09 percent in Israel, and 17.02 percent in Japan. In Figure 1 given below, high-tech exports as the percentage of manufactured exports are shown for select advanced and emerging economies for the year 2019.

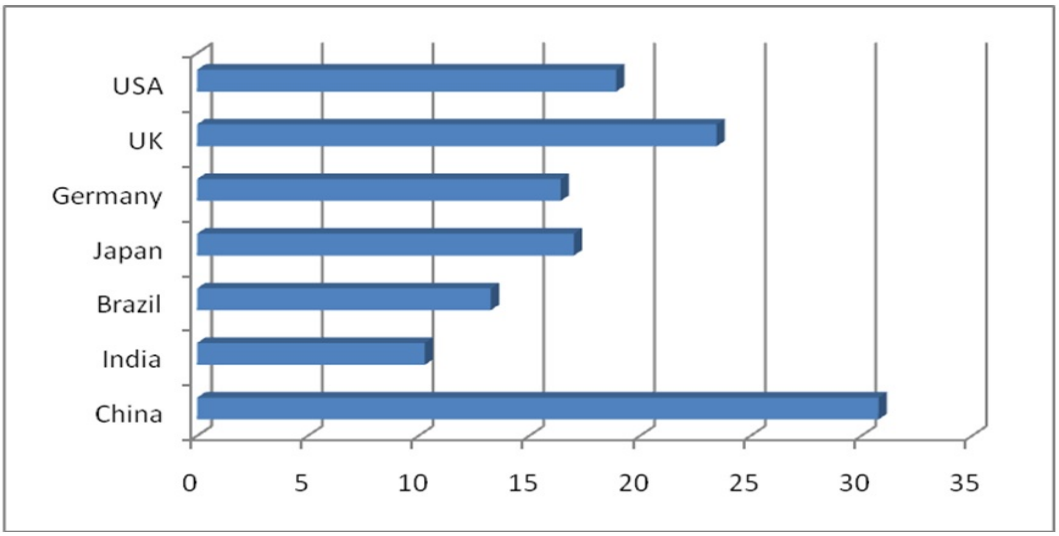

Figure 1. High-Tech Exports as a % of manufactured imports (2019)
Source: Authors' compilation using data from World Development Indicators, World Bank (2021)

India has huge potential to grow as one of the leading exporters of high-technology products. The Indian economy needs to diversify into innovation-intensive and high technology-based exports, which can result in higher export earnings and thereby fuelling India's faster GDP growth. Some of the areas where India is making an impact are pharmaceuticals, computer software, and aerospace. But still, the overall performance in High technology exports is not very impressive. India's sharesuperscript[1] of high-tech exports increased from 0.18% in 2000 to 0.81% in 2014, which (high-tech exports) in absolute value[2] rose from US$ 10659.48 in 2009 to US$ 18326 in 2014 and further rose to US$ 23471 in 2019. India's imports were only US$ 3.7 billion in 2000 which rose to US$ 35.9 billion in 2017. High-technology imports[3] from India increased by 40% during 2007-2011and the global imports of high-tech products increased by 20% in the same period. Rising imports and slowing exports in the high-tech sector are a matter of concern for the overall profile of India's trade. If India has to achieve its development goals, it needs to be technologically more sound and advanced.

1.2 High-Technology Exports

According to the United Nation WITS products that require a high degree of R&D including computers, scientific instruments, aerospace electrical machinery, and pharmaceuticals constitutes high-technology product exports. Hatzichronoglou (1997) has also defined high-technology products to include aerospace, consumer electronics computers, semiconductors, electrical machinery, pharmaceuticals, and scientific instruments as these products require a high level of R&D. International

Source[1]: CII Report
Source[2]: UN Database
Source[3]: As reported by EXIM Bank

trade of High-technology products including both exports and imports of such high-tech products is classified as per the Standard International Trade Classification (SITC-Rev. 4) as listed in Table 1. This list is based on the OECD definition given by Hatzichronoglou (1997) which contains high-tech products, the production of which requires a degree of R&D.

S. No.	Product Group	Sub-Product Codes
1	Chemistry Pharmacy	522.22; 522.23; 522.29; 522.69; 525; 531;574.33; 591 541.3; 541.5; 541.6; 542.1; 542.2
3	Non-Electrical Machinery	714.89; 714.99; 718.7; 728.47; 731.1; 731.31; 731.35; 731.42; 731.44; 731.51;731.53; 731.61; 731.63; 731.65; 733.12;733.14; 733.16; 735.9; 737.33; 737.35
4	Aerospace	(714-714.89-714.99); 792.1 (792.2+792.3+792.4); 792.5; 792.91; 792.93; 874.11
5	Electronics-telecommunications	763.31; 763.8; (764-764.93-764.99); 772.2; 772.61 773.18; 776.25; 776.27; 776.3; 776.4
6	Computers-Office Machines	776.8; 898.44; 898.46 751.94; 751.95; 752; 759.97 774; 871; 872.11;
7	Scientific Instruments	(874-874.11-874.2); 881.11; 881.21; 884.11; 884.19; (899.6-899.65-899.69)
8	Electrical Machinery	(778.6-778.61-778.66-778.69); 778.7; 778.84
9	Armament	891

Table 1. Classification of High-tech Products by SITC Rev. 4
Source: UN Trade Statistics http://unstats.un.org/unsd/trade/sitcrev4.htm

2 Literature Review

2.1 Existing Literature

Studies on the characteristics of high technology firms show that high technology firms tend to be R&D intensive, often involved with radical rather than incremental innovations, and are faced with challenges of exploiting technologies in markets that have international opportunities (Keeble and Wilkinson, 2000). To achieve growth, they underline the need to transfer technology to markets quickly and increase the firm's technological capabilities through interaction with others in the trade sector (Dowling and McGee, 1994; Boter and Holmquist., 1996). Many studies prove that inward FDI is an important determinant of high-tech exports. A study by Tebaldi (2011) based on panel data from 1980 to 2008, empirically proved that inward FDI is an important factor affecting a country's high-tech export performance.

Gökmen (2013) studied the association between FDI, human capital, and economic freedom level using data on EU-15 countries, they proved that all three factors aggregately have a statistically significant positive impact on high technology exports by conducting panel co-integration method. Another study by (Ismail, 2013, Feb. 20-21) based on select Asian countries empirically proved that FDI is one of the significant factors affecting high-tech exports positively. Similarly, Garces and Adriatico (2019) in their study came up with the conclusion that foreign direct investments have a significant contribution to high-tech exports. Seyoum (2005) in his study developed a model of high-technology export determinants. His findings revealed that high-tech export performance is dependent on a variety of factors, including inbound FDI in sophisticated industries, demanding local buyers, and a well-developed technical infrastructure. Another study suggested that an FDI-assisted export strategy provides rapid entry into complex activities, along with continuous access to new technologies and close integration into global markets and networks (Zhang, 2007).

Some studies advocate and empirically proved that R&D expenditure has a significant positive impact on high-technology exports. Alagoz et al. (2016) and Topcu (2018) in their studies found that R&D expenditure and high technology exports

R&D intensity is generally defined as expenditures by a firm on its research and development divided by the firm's sales. Measures of R&D intensity are used for a variety of purposes-cross-country comparisons; allocation of industries to high, medium or low technology groups; as a proxy for innovation intensity and so forth (Hughes 1988).

are closely associated. Ismail (2013, Feb. 20-21) also empirically proved that R&D activities along with Inward FDI are key drivers of high-tech product exports in Asian countries. In a similar attempt, Kizilkaya et al. (2016) in their study based on BRICS countries found that R&D expenditure has a positive impact on high-technology exports. Another study on 16 OECD countries by Dumrul and Kilicarslan (2018) empirically proved that R&D expenditures and exports have a close association and also there exists a long-term relationship between them. Kabaklarli and Duran (2018) conducted a study on 14 OECD countries that empirically proved that patent applications and foreign direct investments play a positive role in upgrading high-tech exports.

Some studies show the impact of input tariffs and imports on the export performance of the firms. Bas (1999, 2012) investigated the effect of liberalizing input tariffs on a firm's export status and found that industries facing lower input tariffs became exporters of larger volumes. In another study, Bas and Strauss-Kahn (2013) found that imported inputs from developed countries have a significant impact on a firm's TFP and exports. Kasahara and Lapham (2006) in their study based on Chilean plant-level data showed that restricting imports by using regressive import policies adversely affects the industry's aggregate productivity along with export performance.

3 Research Gap and Rationale of the Study

Contributions of different authors mentioned in the literature review are crucial initial steps to have a clear understanding of the factors that enhance and maintain the competitiveness of technology-driven firms. However, there is very limited empirical research on developing countries including India, as the empirical research has been hampered due to the lack of reliable data and trustworthy statistics. There is a need for an in-depth examination of important factors that influence high-technology exports to address any policy prescriptions.

As past research work is more focused on aggregate exports, studies on high-tech exports have been limited, especially the empirical analysis of high-tech exports highlighting its determinants for recent data. Existing studies relating to high-technology exports tend to focus exclusively on developed countries. Largely the focus of the researchers has been on the OECD countries as a major part of high-technology export comes from these developed nations. On the other hand, there are only a few studies that showcase the development of high-technology exports in developing nations including India. Therefore, there is a clear-cut gap in the extant literature that is to be studied in the Indian context. So, the present study aims to focus on the factors that affect Indian high-tech exports. There is a lot of scope to study the factors that affect the exports of high-tech products. So, it would be interesting to study Indian high-tech exports.

3.1 Independent/Explanatory Variables

Four independent/explanatory variables are chosen based upon analysis of the literature review consisting of Inward FDI, Imports, R&D Expenditure, and Economic Freedom Level. Many authors have tested the impact of inward FDI on high-tech exports, and most of them have found that it encourages and affects high-tech exports positively. Similarly, imported inputs and R&D expenditure tend to affect the high-tech export positively as established from the extant literature. The fourth variable/factor economic freedom level, represented by the index of economic freedom also tends to affect high-tech exports positively. Therefore, the potential of all these four variables to affect high-tech exports is positive. These variables are shown in Table 2 which is given below.

S. No.	Independent Variables	Expected impact/sign	Reason
1	FDI inflow/Inward FDI	Positive (+)	Extant literature
2	Imports/Imported Inputs	Positive (+)	Extant literature
3	R&D Expenditure	Positive (+)	Extant literature
4	Economic Freedom Level	Positive (+)	Extant literature

Table 2. List of Independent Variables taken up for the study based on the literature review
Source: Authors' compilation based on literature review

3.2 Objectives and Hypotheses

After going through the extant literature following objectives have been framed to take up this study: The study has the following objectives:

- To analyze the trend of Indian high-tech exports.
- To measure and analyze the impact of FDI on Indian high-tech exports.
- To measure and analyze the impact of the import of intermediate goods on Indian high-tech exports.
- To measure and analyze the impact of R&D expenditure on Indian high-tech exports.
- To measure and analyze the impact of economic freedom level on Indian high-tech exports.

Based on the objectives of the study following null hypotheses have been formulated:

i. H_{01}: There is no growth in high-tech exports.
ii. H_{02}: There is no impact of FDI on high-tech exports.
iii. H_{03}: There is no impact of imports on high-tech exports.
iv. H_{04}: There is no impact of R&D expenditure on high-tech exports.
v. H_{05}: There is no impact of economic freedom level on high-tech exports.

4 Materials and Methods

4.1 Data

In this study, the aggregate of high-technology product exports is the dependent variable. There are three independent variables taken into the study including inward FDI, imports of intermediate goods, R&D expenditure as a percentage of GDP, and the index of economic freedom which represents the economic freedom level. Data is collected through secondary and tertiary sources. Data in this study starts from the year 1995 and extends to the year 2019.

S. No.	Variable	Source of Data
1	High-tech Exports	UN COMTRADE Database
2	Imports of Intermediate Goods	UN COMTRADE Database
3	Inward FDI	World Development Indicators, World Bank
4	R&D Expenditure as % of GDP	World Development Indicators, World Bank
5	Index of Economic Freedom	Annual Guide of Heritage Foundation

Table 3. Data Sources
Source: Authors' compilation based on data collection

4.2 Methodology

Simple and multivariate regression is used for the analysis of the variables under the study. The entire methodology here is laid out in three steps:

i. Linear trend
ii. Simple Regression
iii. Multivariate Regression

(i) **Linear Trend:** This would show the linear trend of high-tech exports from 1995 to 2019.
(ii) **Simple Regression:** This model is like any other model in which the parameters β_1 and β_2 are linear, it is used to measure the growth rate of different variables and is also referred to as the log-lin model.

$$\ln Y_t = \beta_1 + \beta_2 t + U_t. \tag{1}$$

The regression equations in this study would be:

$$\ln HTX_t = \beta_1 + \beta_2 t + U_t. \tag{2}$$

(iii) Multivariate Regression: This model is used to measure the elasticity of the dependent variable say 'Y' to the independent variable say 'X'. Therefore, we can measure the degree and direction change in the dependent variable if the independent variables change say by 1 percent. General regression equation based on variables in the study: High-tech exports =f(FDI,Imports, R&D Ex. and Index of Economic Freedom)

5 Results and Analysis

5.1 Trend Analysis of High-tech Exports (US$ million)

In the year 1995, the high-tech exports stood at US$ 1489.83 million which increased to US$ 1816.6 million in the following year (1996) then it fell to US$ 1309 million in 1998 after which the high-tech export started to increase again and went up to US$ 11611.8 million in 2009 after which it saw a downfall in the following year (2010) to US$ 9847.45 million. The high-tech export figures rose to US$ 14587 in 2011 with a marginal dip in 2012 where the figure stood at US$ 13860 million. It saw a more than 30% rise as the exports rose to US$ 18231 million in 2013. High-tech export saw a fall of around 20%

in 2015 as the figure came down to US$ 14870 million, this can be due to three reasons, first, there was a fall in crude oil prices, second the appreciation of the rupee against the dollar, and other currencies including euro, rouble and thirdly the slower growth of world trade. There was a marginal dip in 2016, where the export figure was only US$ 14455.47 million. After 2016 during the new Foreign Trade Policy (FTP) 2015-20 which aimed to boost India's exports, the high-tech export kept increasing to reach their peak in 2019 which is the final year of study where the high-tech export figure stood at US$ 23808.22 million.

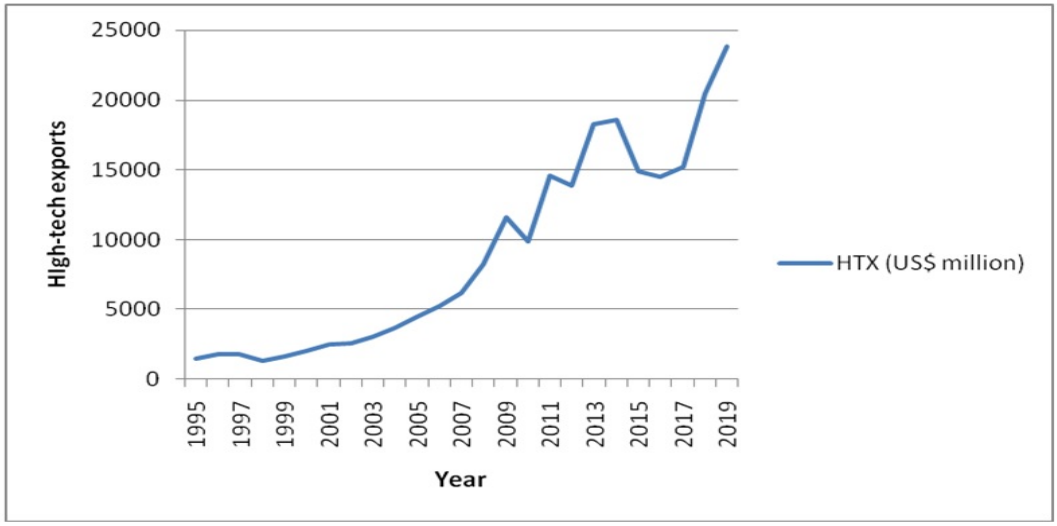

Figure 2. The trend of High-tech Exports
Source: Authors' compilation using data from the UN COMTRADE database

5.2 Simple Regression

Estimating equation: $\ln HTX_t = \beta_1 + \beta_2 t + U_t$.
Estimated equation: $\ln HTX_t = -250.99 + 0.1294t$
P-values: (9.76E-16) (4.65E-16)
r (CAGR) = 0.1381 i.e. 13.81%
The annual compound growth rate, 'r' is coming out to be 13.81%. It implies that the high-tech exports in India grew quite handsomely at an average rate of 13.81% annually which is highly significant over the past 25 years that is from 1995 to 2019 (Figure 3).

5.3 ADF Unit Root Test

ADF Unit root test is applied to check whether the data on different variables is stationary or not. If the data is non-stationary then there exists a unit root, and it violates the times series property because only in stationary data series statistical properties of time series do not change over time. Table 4 shows the ADF unit root test results for all the variables under the study. Panel-A shows the result of the unit root test based on the level series and Panel B shows the result of the unit root test at the first difference series. It is evident from Table 4 that the ADF unit root test shows that at level series (Panel-A), data of all the variables are found to be having the presence of unit root which makes it non-stationary at 1%, 5%, and 10% significant levels. But when the first difference of price was calculated (Panel-B) then the return series showed the absence of unit root which implies that the data series has become stationary, meaning that the mean and variance are constant over time which makes it fit for econometric testing. These results are significant at 1%, 5%, and 10% significant levels for the entire series of data.

5.4 Philips-Perron Test

The Philip-Perron test is another type of unit root test to check whether the data in a time series is stationary or not. This test in a time series analysis tests the null hypothesis that a given time series is integrated of order 1. This test has been applied here in addition to the ADF test as it is more robust than autocorrelation and heteroscedasticity, which can be present in the test equation. Table 5 shows the Philips-Perron test results for all the variables under the study.

Source: As reported by "The Diplomat"

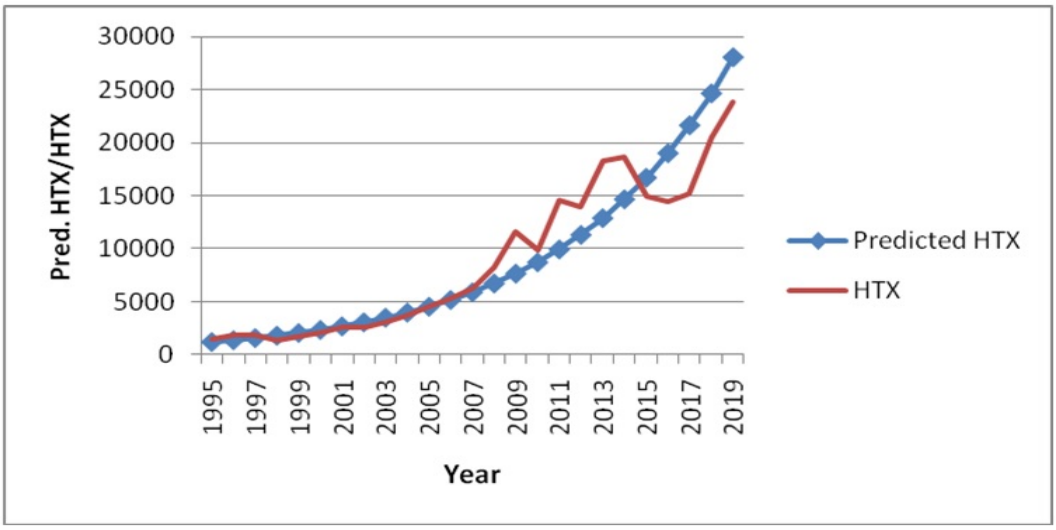

Figure 3. High-tech Exports (Prediction of Growth)
Source: Authors' calculation

PANEL - A (At Level)			
Variable	ADF Statistic	p-value	Remarks
HTX	-0.42628	0.8894	Non-Stationary
FDI	-1.03866	0.7222	Non-Stationary
Imports	-1.182573	0.6646	Non-Stationary
RDEX	-2.11809	0.2397	Non-Stationary
IEF	2.28508	0.1847	Non-Stationary
PANEL - B (At First Difference)			
Variable	ADF Statistic	p-value	Remarks
HTX	-5.10968	0.0004	Stationary
FDI	-4.43577	0.0021	Stationary
Imports	-3.66467	0.0122	Stationary
RDEX	-3.26721	0.0287	Stationary
IEF	-6.97707	0.000	Stationary

Table 4. ADF Unit Test Results (Source: Authors' calculation)

Note: Critical Value at 10% = -2.6355, 5% = -2.9919 and 1% = -3.73785 *Found significant at p-values 1%, 5%, and 10% levels

PANEL - A (At Level)			
Variable	t- Statistic	p-value	Remarks
HTX	-0.42628	0.8894	Non-Stationary
FDI	-1.03866	0.7222	Non-Stationary
Imports	-1.18257	0.6646	Non-Stationary
RDEX	-2.16040	0.2247	Non-Stationary
IEF	-2.2873	0.0634	Non-Stationary
PANEL - B (At First Difference)			
Variable	t-Statistic	p-value	Remarks
HTX	-5.10647	0.0004	Stationary
FDI	-4.43577	0.0021	Stationary
Imports	-3.65102	0.0125	Stationary
RDEX	-3.18502	0.0341	Stationary
IEF	-8.23579	0.000	Stationary

Table 5. Philips-Perron Test Results(Source: Authors' calculation)

Note: Critical Value at 10% = -2.6355, 5% = -2.9919 and 1% = -3.73785 *Found significant at p-values 1%, 5%, and 10% levels

Panel-A shows the results of the unit root test based on the level series and Panel B shows the result of the unit root test at the first difference series. It is evident from Table 5, which shows the Philip-Perron test result that at level series(Panel A), data of all the variables are found to have the presence of unit root which makes it non-stationary at 1%, 5%, and 10% significant levels. But when the first difference of price was calculated (Panel-B), then the return series showed the absence

of a unit root which implies that the data series has become stationary now, meaning that the mean and variance are constant over time which makes it fit for econometric testing. These results are significant at 1%, 5%, and 10% significant levels for the entire data series.

5.5 Autocorrelation Check

An Autocorrelation check has been performed to check whether there exists autocorrelation among the independent variables in the given time series.
Included observations: 24
Q-statistic probabilities adjusted for 3 dynamic regressors.

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
.**| . |	.**| . |	1	-0.313	-0.313	2.6528	0.103
. | . |	. *| . |	2	-0.021	-0.131	2.6651	0.264
.**| . |	***| . |	3	-0.295	-0.388	5.2551	0.154
. |* . |	. *| . |	4	0.145	-0.134	5.9109	0.206
. | . |	. *| . |	5	0.004	-0.096	5.9115	0.315
. | . |	.**| . |	6	-0.035	-0.212	5.9545	0.428
. *| . |	.**| . |	7	-0.078	-0.222	6.1776	0.519
. | . |	.**| . |	8	0.021	-0.207	6.1943	0.625
. |* . |	. *| . |	9	0.101	-0.128	6.6161	0.677
. |* . |	. |* . |	10	0.180	0.141	8.0653	0.622
.**| . |	. *| . |	11	-0.241	-0.149	10.846	0.456
. | . |	. | . |	12	0.046	-0.010	10.955	0.533

Table 6. Autocorrelation Check (Source: Authors' calculation)

Results after running the autocorrelation check from Table 6 imply that there is no autocorrelation among the independent variables under the study, as all the probability values are more than 0.05. Therefore, no autocorrelation exists among the independent variables.

5.6 Multivariate Regression

Since all the variables happened to be non-stationary at level series. Therefore multivariate regression model is being used in the first difference series. The results of multivariate regression are shown in Table 7A and Table 7B. From the results given in Table 7A and Table 7B it is found that is coming out to be negative which indicates that to start with, high-tech exports were very low. F-statistic is also coming out to be statistically significant indicating that the equation is well specified containing a sufficient number of variables. The p-value for FDI is 0.0016, for R&D expenditure it is 0.00019, for imports it is almost zero, and for the index of economic freedom, it is 0.2916, implying that all the independent variables under this study are statistically significant except the index of economic freedom. One can find the elasticity by looking at the coefficients which are coming out to be 0.195 in the case of FDI,-1.51 in the case of R&D expenditure, 0.6987 in the case of imported inputs, and 1.155 in the case of the index of economic freedom. The degree of elasticity here implies that an increase in FDI by 1% leads to a 0.195% increase in high-tech exports. Therefore, the degree of elasticity is low between FDI inflow and high-tech exports. On the other hand, if imported inputs increase by 1%, then will increase high-tech exports by 0.698%. So, the degree of elasticity is higher as compared to FDI. But in the case of R&D expenditure, the elasticity is coming out to be negative, which implies that if there is an increase in R&D expenditure by 1%, it will lead to a reduction in high-tech exports by 1.51% showing a high degree of inverse relationship.

5.7 Testing Hypotheses

Test Criterion: If $Calt_{(\alpha,n-k)} > Tabt_{(\alpha,n-k)}$, then reject the null hypothesis
1. H_{01}: There is no growth in high-tech exports. Here, the computed t-value is 20.036, which exceeds the critical t-value (1.725) at a 5% level of significance with 20 degrees of freedom. Therefore, the null hypothesis is rejected, suggesting that there is a growth in high-tech exports.
2. H_{02}: There is no impact of FDI on high-tech exports. The computed t-value is 2.653, which exceeds the critical t-value at 1.725, which leads to the rejection of the null hypothesis. It implies that FDI does have an impact on high-tech exports. As per the regression results, FDI has a significant and positive effect on high-tech exports.
3. H_{03}: There is no impact of imports on high-tech exports.

Multiple R	0.993124133
R Square	0.986295544
Adjusted R Square	0.983554652
Standard Error	0.125569391
Observations	25

Table 7A. Regression Results (Source: Authors' calculation)

	Df	F	Significance F	
Regression	4	359.8448	2.54E-18	
Residual	20			
Total	24			
	Coefficients	Standard Error	t Stat	P-value
Intercept	-6.45257996	3.672944942	-1.75679	0.094255
Imports	0.698713116	0.100155996	6.976249	9.03E-07
FDI	0.195447468	0.074448197	2.625281	0.016214
RDEx	-1.509819978	0.331226909	-4.55826	0.000191
IEF	1.154963024	1.066330668	1.083119	0.291641

Table 7B. Results of Multivariate Regression (Source: Authors' calculation)

6 Discussion, Conclusion, and Implications

This study has been conducted to find the impact of inward FDI and the import of intermediate goods on Indian high-tech exports. The empirical results of this study proved that both FDI and imported inputs are significant factors affecting high-tech exports positively. Therefore, suggesting that more inward FDI would improve high-tech competitiveness leading to more exports of high-tech products. And more import of intermediate goods will increase the high-tech exports. Therefore, the government should bring in some new measures to attract more FDI to increase high-tech exports. The other explanatory variable, the import of intermediate goods is also a significant factor that affects high-tech exports positively. This indicates that if the Indian economy imports more intermediate goods, it will promote high-tech exports in the country. Therefore, the Indian government should encourage the import of intermediate goods, which will benefit the high-tech export basket of the country to grow. R&D expenditure is also a significant factor, and it is found to affect high-tech exports negatively with a high degree of elasticity. Thereby the notion that R&D expenditure would lead to an increase in the volume of high-tech exports does not hold good, which is contrary to the expectations at the beginning of the study. The reason for the negative impact of R&D expenditure on high-tech exports can be the possibility that a major portion of R&D expenditure could be reflected in the import of technologies from abroad in high-tech areas and that is why it would form royalties paid from the home country and not directed towards development the of domestic technology. The fourth explanatory variable, economic freedom level as per empirical results, is an insignificant factor as per the empirical results of this study, implying that economic freedom level does not affect high-tech exports. There is a possibility that the impact of economic freedom level might get reflected in economic growth, which in a way, can lead to the promotion of high-tech exports, suggesting an indirect relation between economic freedom level and high-tech exports. So, another empirical study can be conducted to cater to the indirect effect of economic freedom level on Indian high-tech exports.

7 Policy Recommendations

- Inward FDI encourages India's high-tech export, so there is a need to make further changes in the existing FDI policy to make India a more attractive destination for foreign direct investors.
- Import of intermediate goods is crucial for the growth of high-tech export. Therefore, the government can bring in some measures which can be beneficial to increase the import of such intermediate goods.
- Government can also increase the import of intermediate goods by making changes in the existing import duty structure related to the import of intermediate goods from abroad.
- R&D expenditure is affecting high-tech exports negatively, which is contrary to expectations. So, there is a need to bring in measures to focus on result-oriented R&D expenditure rather than spending on the import of technologies which leads to the payment of royalties abroad.

Declaration of Interest Statement

The authors declare that no financial interest has been derived from this empirical research.

References

Alagoz, M., Akar, G., Akar, T., 2016. High technology export and r&d expenditures: A study for e7 countries. International Journal of Economics, Commerce and Management 4, 219–230.

Bas, M., 1999. Trade, foreign inputs and firm's decisions: Theory and evidence.

Bas, M., 2012. Input-trade liberalization and firm export decisions: Evidence from argentina. Journal of Development Economics 97, 481–493.

Bas, M., Strauss-Kahn, V., 2013. Does importing more inputs raise exports? firm level evidence from france. Review of World Economics 150, 241–275.

Boter, H., Holmquist., C., 1996. Industry characteristics and internationalization process in small firms. Journal of Business Venturing 11, 471–487.

Dowling, J., McGee, J., 1994. Business and technology strategies and new venture performance: A study of the telecommunications equipment industry. Management Science 40, 1663–1677.

Dumrul, Y., Kilicarslan, Z., 2018. The effect of r&d expenditures on export: Evidence from a panel of selected oecd countries. Journal of Economics, Finance and Accounting 5, 234–241.

Eaton, J., Kortum, S., 2001. Technology, trade, and growth: a unified framework. European Economic Review 45, 742–755.

Garces, E., Adriatico, C., 2019. Correlates of high-technology exports performance in the philippines. Open Journal of Social Sciences 7, 215–226.

Gökmen, Y & Turen, U., 2013. The determinants of high technology exports volume: A panel data analysis of eu-15 countries. International Journal of Management, Economics and Social Sciences 2, 217–232.

Hatzichronoglou, T., 1997. Revision of the high-technology sector and product classification.

Hobday, M., 2001. The electronics industries of the asia- pacific: exploiting international production networks for economic development. Asian-Pacific Economic Literture 15, 13–29.

Ismail, M., 2013, Feb. 20-21. Innovation and high-tech trade in asian countries.

Kabaklarli, E., Duran, MS andÜcler, Y., 2018. High-technology exports and economic growth: Panel data analysis for selected oecd countries. Forum Scientiae Oeconomia 6, 47–60.

Kasahara, H., Lapham, B., 2006. Import protection as export destruction.

Keeble, D., Wilkinson, F., 2000. High Technology Clusters, Networking and Collective Learning in Europe. Routledge.

Kizilkaya, O., Ay, A., Sofuolu, E., 2016. The determinants of high technology product export in brics countries: An econometric approach. Global Journal on Humanities & Social Sciences 4, 112–120.

Mani, S., 2000. Exports of high technology products from developing countries: Is it real or a statistical artifact.

Pohit, S., Basu, S., 2012. High technology merchandise exports: Where does india stand? South Asia Economic Journal 13, 183–206.

Samen, S., 2010. A primer on export diversification: Key concepts, theoretical underpinnings and empirical evidence.

Sara, T., Jackson, F., Upchurch, L., 2012. Role of innovation in hi-tech-exports of a nation. International Journal of Business and Management 7, 85–93.

Seyoum, B., 2005. Determinants of levels of high technology export an empirical investigation. Advances in Competitiveness Research 13, 64–79.

Tebaldi, E., 2011. The determinants of high-technology exports: A panel data analysis. International Atlantic Economic Society 39, 343–353.

Topcu, B., 2018. The effect of r&d expenditures on high-tech manufacturing industry export: The case of oecd countries. Social Sciences Studies Journal 4, 1177–1183.

Yoo, S., 2008. High-technology exports and economic output: an empirical investigation. Applied Economic Letters 15, 523–525.

Zhang, K., 2007. Determinants of complex exports: Evidence from cross-country data for 1985-1998. International Economics 60, 111–122.