The Relationship between Foreign Direct Investment and Exports in India:

An Empirical Study

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Submitted to

Central European University

Department of Economics and Business

In Partial Fulfilment of The Requirements for the Degree of

Master of Arts in Economics

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Vienna, Austria

Abstract

This thesis aims to comprehensively investigate the multifaceted impact of Foreign Direct Investments (FDI) on exports in India, specific to certain sectors that acquire the most stock of FDI. Through the utilization of the panel Auto Regressive Distributed Lag model and an extensive but unbalanced panel of data from multiple sectors spanning from 2000-2021, this study investigates the relationship between FDI and exports, while considering various controls. The short-run and long-run relationship between FDI and exports are analyzed using 3 different estimation methods, which lead to interesting and significant results. GDP is found to have no short-run significant effect on exports, thus motivating us to investigate how the other controls react in the short term when you remove GDP from the model.

The relationship between FDI and exports is found statistically significant and positive in the DFE estimator, and the existence of a long-run relationship was established. However, in the long run, the significant effect tends to diminish suggesting the presence of other factors that affect export performance over time. Furthermore, it uncovers substantial heterogeneity in the impact of FDI on different industries, with some sectors depicting a strong relationship between FDI and exports while others don't. This promotes the importance of implementing different policies for different industries so that they can all benefit in the best way possible.

Overall, this thesis provides some insight into the complex relationship between FDI and exports within each sector in India, provoking more thought into the importance of industry composition and tailor-made policies enabling best suit outcomes for each. The findings provide more updated literature on this relationship in the Indian context, while also looking into the sector-specific dynamics, which give room for practical implications for not only policymakers but also for aspiring entrepreneurs and companies.

Keywords: Foreign Direct Investment (FDI), GDP, Exports, India, ARDL approach, Sensitivity analysis.

Acknowledgements

My sincerest gratitude goes towards all the individuals who played a major role during the 2 years of my master's at CEU. Although it is a bit late for me to say a wishful thank you, I believe that going through those two challenging, but amazing years would not have been possible without the support and care of the people around us.

First, I would like to thank my current supervisor, Professor Soomin Lee for being so considerate and understanding, helping me with insights and ideas, and making time in odd situations while I was trying to juggle a busy work life and working on this thesis together. Thanks a lot for your understanding and support and for the interesting courses I was able to take under you.

A big thanks to Professor Atilla Ratfai for being a positive support till the end of our course not only as the Head of Department but also as a professor and mentor. Even though coming from a non-analytical background made me face some tough situations and unfavorable outcomes, your support and encouragement helped me grow as a person in my two years of master's.

It wouldn't do justice if I don't go share my gratitude towards our Econ program coordinators at our time, Zsuzsanna, as well as Kriszta who has been understanding and supportive at every moment not only during the masters but also in the last couple years ensuring that I got all the necessary information and help needed to complete this thesis on time.

A huge thank you to all the amazing professors whom I had the opportunity to meet and learn from at CEU, this was an experience of its kind for me that I don't think will be replaced or replicated again.

I cannot share enough gratitude towards my classmates and friends, who were there with me through thick and thin, and without whom things wouldn't have been so interesting and memorable. Special thanks to Rafael, Geri, Ali Asad, Ekaterine, Juan, and Flora for making those years worthwhile and amazing. Whether it be helping with assignments till late in the night, trying to learn new things together, or just having a good time and being there for each other. CEU gave me people I will be in touch with for life.

Finally, I would also like to thank my family, especially my sister, who is the constant pillar of support and goodwill in my life, from being the reason I came to CEU to helping and supporting me every step of the way ahead, thank you for being an amazing supporter in everything I do and having more belief in me than I do myself.

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1 Introduction

Foreign Direct Investment has in the last 50 years become an important and influential factor in economic growth, particularly for countries in the developing regions of the world. Characterized by scarce amounts of capital, foreign investments play a major role in not only increasing economic activities through an increase in industrialization but also through the transfer of new technologies, knowledge, and capital. Export-led growth is generally considered a more reasonable alternative to import substitution and inward economic growth-oriented strategies. It helps increase output growth through investments in new capital and technology, boosting productivity and output, increase in employment, as well as promotes capital formation domestically (Mohammed and Ruslee (2015)). Fisher and Gelb (1991) theorize that with foreign investment of MNCs in developing regions and local firms, there is the transfer of technology which not only helps the resultant local firm with improved R&D but also other local firms as a result of spillover. This transfer of technology, know-how, and managerial practices from the investing foreign firms to the host country benefits local firms by improving their production processes, product quality, and efficiency, making them more competitive in international markets and increasing their export capacity.

FDI is often regarded as a stable source of funding that is less vulnerable to financial crises, offering increased investment opportunities without the burden of additional external debt for the receiving country. It is also considered the preferred mechanism for the transfer of technology, especially in the cases of MNCs[1] to their local subsidiaries, which in turn improved the total factor productivity of the local firms and helps in the overall output. The change in

[1] Multinational Corporations

liberalization policies in India in 1991 has paved the path for sustainable economic growth as well as increased the amount of foreign investment in the form of FDI and FII[2].

Previous studies have established a positive link between foreign direct investment (FDI) and trade on economic growth. However, the magnitude of this effect varies across countries, influenced by various factors including human capital, financial market regulations, domestic investment, infrastructure, macroeconomic stability, and trade policies. Ongoing scholarly discussions revolve around understanding the impact of FDI and trade on economic growth, as well as recognizing the importance of economic and institutional advancements in promoting FDI and trade.

The effect of FDI on the growth of a country is highly dependent on the capacity of domestic firms to absorb technology transfers as well as spillovers because of FDI inflow. Many researchers support the idea of positive spillover as a result of increased productivity of domestic firms due to FDI. At the same time, it also promotes the development of skilled labor and talent locally. However, there is still a lot of ambiguity on the overall causality and significance of FDI growth on the growth of exports and GDP and vice versa. This can be accounted to variations in the data, countries, control variables, and methodologies applied.

Although there is a lot of research to determine the causality and relationship between FDI and economic growth, only a limited number of them shed light on the effects of FDI on exports. In the case of India, researchers argue that economic growth leads to foreign direct investment (FDI)[3]. On the other hand, it is also suggested that the relationship between economic growth and FDI is independent[4]. When it comes to exports and economic growth, Bhat (1995)

[2] Foreign Institutional Investment
[3] Chakraborthy & Basu (2002)
[4] Kumar and Pradhan (2002), and Bhat et al. (2005)

demonstrates a two-way causal relationship, whereas Nidugala (2000) shows an independent relationship between exports and economic growth in India.

Most of the research on the causality of FDI and growth in the context of India has been done based on novel panel methods. Another point is that studies, even the ones that incorporated ARDL cointegration techniques, focus on a simple two-variable model. A paper from Nunnenkamp and Chakraborty (2008) also does a sector-level analysis, but it also sticks to a bivariate analysis, considering only the FDI and output and relies on data before 2000. Durairaj (2010) analyses the relationship between aggregate FDI, exports, and economic growth, but it relies on data only till 2008 and only considers FDI, Exports, and Industrial production.

Considering all the above factors, my notable contributions to existing literature apart from creating more updated and relevant findings for India as compared to the above papers would be:

i. To conduct an aggregate sectoral level analysis using the ARDL approach while considering multiple controls for the short term and analyzing the long term.
ii. Do a sensitivity analysis among various sectors to see which ones are most responsive to changes in FDI in the respective sectors. I believe it will help give some insights not only into the current situation of the causal relationship but also show as to which sectors are more responsive to FDI and which aren't.

This paper would aim to investigate the question of whether FDI and exports have a significant relationship in the context of India by taking sector-specific data for FDI and Exports. The study relies on unbalanced panel data collected for multiple sectors from 1996 through 2021. The autoregressive distributed lag (ARDL) method will be used to test our time series model on account of the small sample size and to determine both the short and long-run relationship in the model. The stationarity conditions would be examined using the Fisher Type unit root

test based on Augmented Dickey-Fuller Test. Then we would use different estimation methods like the PMG, MG, and DFE and use Hausman tests to determine which method of estimation leads fares better. The model will then be tested for normality and independence of the variables.

The rest of the paper is divided into the following starting with an extensive review of existing literature, followed by the description of methodology and data, followed by the results where we would investigate the results of each of the above-mentioned tests as well as the long and short run coefficients that we get after running the model. The final part would summarize the whole paper and provide a short conclusion and implication of the findings.

2 Literature reviews:

FDI's growth effect is influenced by capital accumulation and technological progress, leading to efficiency gains. Spill-over effects of FDI encompass capital and knowledge spillovers, involving the introduction of new techniques, improved skills, and organizational capabilities (Crespo and Fontoura, 2007). Five channels of spillovers are identified: demonstration/imitation, lab or mobility, exports, competition, and linkages between domestic firms.

Over the course of the next literature, we will try to investigate the determining factors of FDI. Human capital is deemed to be an important factor in a country's ability to take advantage of FDI spillovers. The positive effect of FDI can be significant only after a minimum level of human capital is achieved. Nelson and Phelps (1966) also note the significance of human capital in absorbing FDI spillovers and stipulate that FDI boosts growth only if there is an

adequate level of education/skill and human capital in the host country [5] [6]. All the above imply that human capital is quite important, albeit a prerequisite to ensure FDI led growth.

The macroeconomic situation/environment of the host country affects the absorptive capacity of FDI, thus affecting economic growth. The institutional system also plays an important role in determining FDI, which is supported by many studies proving that improvement in institutional systems promotes economic growth[7]. Spill overs can also be improved as a result of stable institutional systems as they ensure the steady and uninterrupted operation for firms specially MNCs (Prüfer and Tondl, 2008).

In a more recent study by Hayat (2018), which was conducted for 104 countries over 20 years, it is found that although there is positive relationship between FDI and growth, an increase in the natural resource sector to a point decreases FDI's impact on growth, and beyond a point it causes a negative effect of FDI. Empirical studies[8] also support the idea that FDI led economic growth can be a result of factors such as technological development, human capital investment, trade policies and absorptive capacity of the economy[9].

Countries endowed with robust financial systems have a greater capacity to attract and accommodate foreign direct investment (FDI), and conversely, well-developed financial systems foster the inflow of FDI. The influx of FDI contributes to reducing transaction costs for a country while facilitating the expansion of the domestic market and boosting exports. In a separate study conducted by Lee and Chang (2009), panel cointegration and panel error correction models were employed to uncover a substantial long-term relationship between FDI, financial development, and economic growth, whereas no evidence of a short-term relationship

5. Gregorio, and Lee (1998)
[6] . Blomström, Globerman, and Kokko (2001)
[7] Rodrik, Subramanian, and Trebbi (2004); Acemoglu and Johnson (2005).
[8] Gonel and Aksoy(2016) and Katircioglu (2009)
[9] LE and Suruga (2005)

was found. In a paper by Shan et al. (1997) causality between FDI and growth of China (1985-1996) is found to be robust and bidirectional, using VAR Model and Toda Yamamoto Causality tests (1995). Reichert and Weinhold (2001) use Gross Domestic Investment and control for trade openness and inflation to test causal relationship of FDI and growth for 24 developing countries over the time period of 1971-1995. They made the use of Mixed Fixed and Random estimator to tackle the issue within and between group variations. Results shows that the causal relationship can be very different from one country to another. In another study, Chowdhury and Mavrotas (2005) analyse data from 1969-2000 for Chile, Malaysia and Thailand. For Chile they found causal relationship from economic growth to FDI while for Malaysia and Thailand, causality was bidirectional.

Before we dive into papers that use ARDL methods to analyse data over the short and long term, it will only do justice if we investigate some papers that incorporate other methodologies as well to develop a comprehensive understanding.

Reenu and Sharma (2015) investigated the relationship between FDI determinants and inflows in Brazil, China, Russia, and South Africa from 1975 to 2007 using the Hausman test. The study found a significant association between FDI and factors like market size, exchange rate, labor costs, and gross capital formation. Similarly, Papageorgiadis, Xu, and Alexiou (2019) studied the relationship between IP quality and FDI inflows in 23 European countries from 2003 to 2015, revealing a positive correlation. Abdul Hadi et al. (2018) analyzed FDI influences in six Asian countries and found diverse effects using Fixed Effect analysis. Adnan et al. (2019) observed a significantly positive relationship between FDI and its determinants in Bangladesh, Pakistan, India, and Sri Lanka using autoregression.

Feridun and Sissoko (2011) studied FDI-GDP per capita relationship in Singapore from 1976 to 2002. They found a positive effect of FDI on GDP per capita, with a one-way causality from

FDI to GDP per capita. Giirsoy and Kalyona (2012) investigated FDI's impact on growth in Georgia from 1997 to 2010 using cointegration and Granger causality tests. Their research confirmed a one-way link from FDI to GDP growth in Georgia. From the aforementioned studies, it becomes apparent that the majority of previous research focused on examining foreign direct investment variables in a straightforward manner, neglecting to investigate the short-term and long-term correlations between these variables.

Novel panel models fixed effects, random effects, and pooled ordinary least-squared models (OLS) can be used for structured (panel or time series) and unstructured data. However, such models have restrictive assumptions and are generically static. The current study aims to investigate the effect of FDI on sectorial exports in India. Notably, FDI as an investment is often associated with lagged effects. That is, an investment at time t may be realized after k years, at $t + k$. As a result, dynamic models that examine short-run and long-run effects have been postulated to examine such lagged effects in econometrics, including the autoregressive distributed lag (ARDL) model, have been widely adopted in econometric literature, such as to study the effect of remittances on economic growth and Sadik-Zada and Niklas (2021) to study the responsiveness of alcohol consumption to income and unemployment.

In Durairaj's study conducted in 2010, the ARDL cointegration method was employed to explore the relationships between GDP, FDI, and exports in India. The findings unveiled a lasting connection between exports, economic growth, and FDI. In the short term, a two-way causal relationship was observed between exports and economic growth, whereas a one-way causal link was detected from exports to FDI. This suggests that trade liberalization has a positive impact on economic growth by attracting more FDI inflows. Nguyen (2017) investigated the impact of FDI on Vietnam's economic growth using the ARDL model. The findings indicated significant positive long-term effects of FDI on economic growth, although the short-term relationships were not statistically significant.

Hao (2023) employed the ARDL approach to examine the relationships between trade openness, FDI, capital formation, and industrial growth in China. The study found a long-term cointegration relationship among these variables. The study also identified positive effects of capital formation and trade openness on FDI.

In their study published in 2020, Elian et al. examined the correlation between FDI inflows and economic growth in the BRICS economies. They utilized the ARDL bounds testing method to analyse the data. The results of the study indicated significant delayed effects of variables on FDI inflows in the short term. The ARDL technique has several practical advantages compared to renowned cointegration methods. First, ARDL can be used for small sample sizes (Pesaran & Shin, 1998). Secondly, the ARDL cointegration method does not require the same order of integration, $I(i)$, i.e., order of differencing to make data stationary (Pesaran and Shin, 1999). Additionally, the ARDL model estimates both short-run and long-run parameters simultaneously.

3 DATA

This section contains information regarding the different variables taken into this model as controls as well as their sources, as described in table 1 below. Index of economic freedom indicators used as control variables were Tax Burden Index and Trade Freedom Index. Both were obtained from the heritage database. FDI, Tax Burden Index and Trade Freedom Index have been collected from public databases from departments of the government of India while the others have been collected from world bank.

Table 1. Description of Variables

Variable	**Definition**	**Source**
FDI (industry specific)	Foreign direct investment, net inflows (BoP, real US$)	CEIC
Inflation (INFL)	Inflation, consumer prices (annual %)	World bank
Exchange rate (EXC)	Official exchange rate (LCU per US$, period average)	World bank
Tax Burden Index (TXDBI)	Tax Burden	CEIC
Trade Freedom (TRDBI)	Trade Freedom	DPIIT
GDP	GDP (Real USD)	World Bank

We will also describe the various sectors we have taken data from and their respective sources and sample sizes. It relies on unbalanced panel data between 2000-2021 which is used due to constraints in data availability for each sector for the entire time period. The automobile industry was excluded since the reported statistics are not valued but in counts of automobiles exported. Data for industry specific FDI inflows in USD dollars between 2000 and 2018 was collected from the CEIC database. The data between 2019 and 2021 was obtained from the Department for Promotion of Industry and Internal Trade (2023). All FDI inflows into the trading sector were obtained from the Ministry of Commerce and Industry.

In our next section we will look into some simple descriptive statistics for the variables.

Table 2. Sectors/ Industries included.

Sector/Exports	**Definition**	**Source**
Service	Service exports (BoP, current US$)	World Bank
Drugs and Pharmaceuticals	Exports of pharmaceutical products	Trade Economics
Electronics	ELECTRONIC HARDWARE exports in millions of USD	Ministry of Commerce and Industry
Computer Software and Hardware	COMPUTER SOFTWARE exports in millions of USD	Ministry of Commerce and Industry
Telecommunications	Exports of Information Technology Enabled Services (ITES) in millions of USD	Ministry of Commerce and Industry
Chemical	Inorganic, Organic & Agro Chemicals	Ministry of Commerce and Industry
Trading	Merchandise exports (current US$)	World Bank

Table 3: Sample size distributed via sector.

Sector	**N**	**Time frame**
Chemicals (Excluding Fertilizers)	10	2009 to 2018
Computer Software and Hardware	13	2009 to 2021
Drugs & Pharmaceuticals	22	2000 to 2021
Electronics	10	2009 to 2018
Service	22	2000 to 2021
Telecommunications	13	2009 to 2021
Trading	9	2013 to 2021
Total	**99**	

3.1 Descriptive Statistics

Table 4 gives us a general idea of the aggregate values of the variables that go into our model. As you can see, FDI has grown from its lowest point in 1998 at 2.169 to 64.362 right before the beginning of Corona Virus. Figure 1 shows us the 2 major dips that occurred in FDI inflow corresponding with the 2008 financial crisis as well as the 1st wave of Covid 19 hitting the world in the beginning of 2020. The hardest hit among these was the computer software and hardware sector, which was also notably accounted for the highest FDI inflow before the advent of Corona, characterised by a spike in 2018-2020. Exports from services, computer sectors and trading show a significantly increasing portion of total exports as compared to other sectors. From table 5 we can see that although Computer sector has the highest mean FDI inflow, trading and services still account for highest exports among all the sectors. Mean FDI inflow into electronics is lowest while lowest mean exports come from the Chemicals sector.

Table 4: Descriptive Statistics of Control Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
FDI (USD Billions)(Aggregate)	26	24.855	18.925	2.169	64.362
Exports (USD Billions)(aggregate)	26	287.762	198.452	40.976	643.08
Inflation	26	6.501	2.863	3.328	13.231
Exchange Rate	26	52.312	11.832	35.433	74.1
GDP (USD Billions)	26	1447.846	903.465	393	3180

Table 5: Sector wise stats for FDI and Exports

Sector	Variable	N	Mean	SD.	Min	Max
Chemicals (Excluding Fertilizers)	FDI (INR Bn)	10	59.14	42.52	17.80	136.26
	Exports (USD Bn)	10	7.41	3.07	3.59	13.56
Computer Software and Hardware	FDI (INR Bn)	13	407.90	553.29	31.35	1942.91
	Exports (USD Bn)	13	79.21	28.45	36.58	127.70
Drugs & Pharmaceuticals	FDI (INR Bn)	22	40.60	43.05	2.08	145.32
	Exports (USD Bn)	22	8.19	6.04	0.89	19.46
Electronics	FDI (INR Bn)	10	8.66	8.28	1.68	30.09
	Exports (USD Bn)	10	7.09	1.43	5.46	8.88
Service	FDI (INR Bn)	22	214.91	182.51	1.86	591.99
	Exports (USD Bn)	22	118.05	70.58	16.69	240.66
Telecommunications	FDI (INR Bn)	13	151.74	137.51	4.29	394.29
	Exports (USD Bn)	13	25.86	8.94	14.42	44.30
Trading	FDI (INR Bn)	9	233.87	88.19	81.91	337.79
	Exports (USD Bn)	9	310.00	40.17	265.00	395.00

Note. USD: US Dollars; INR: Indian Rupee; Bn: Billion; SD: Standard Deviation

Figure 1 Trend analysis of FDI to and Exports from India

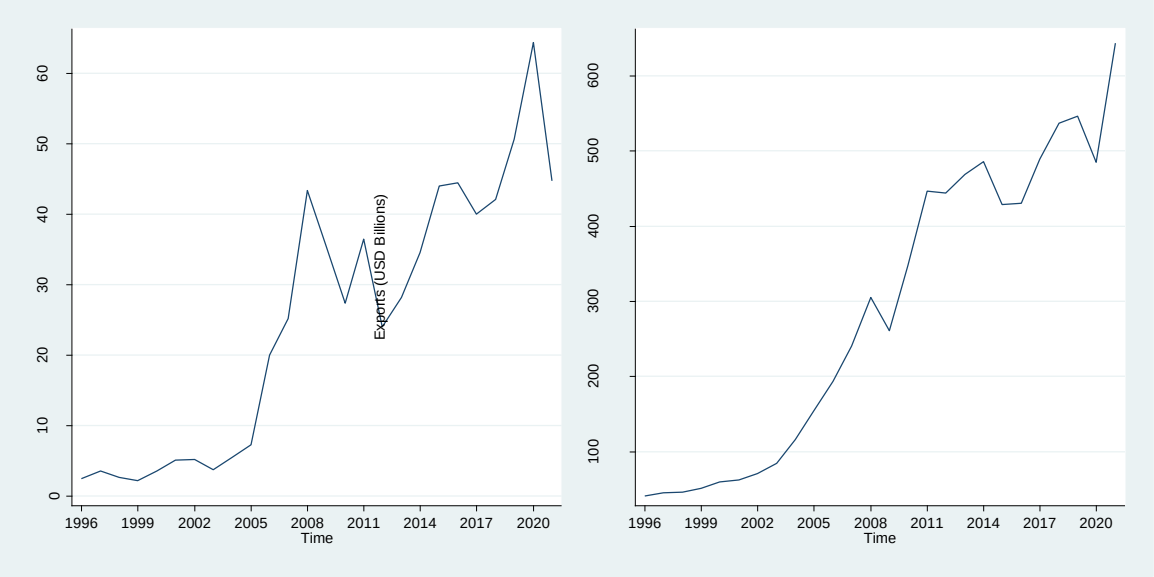
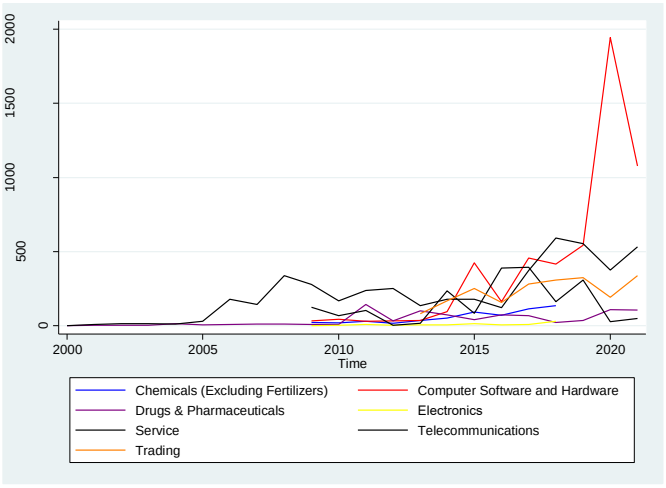
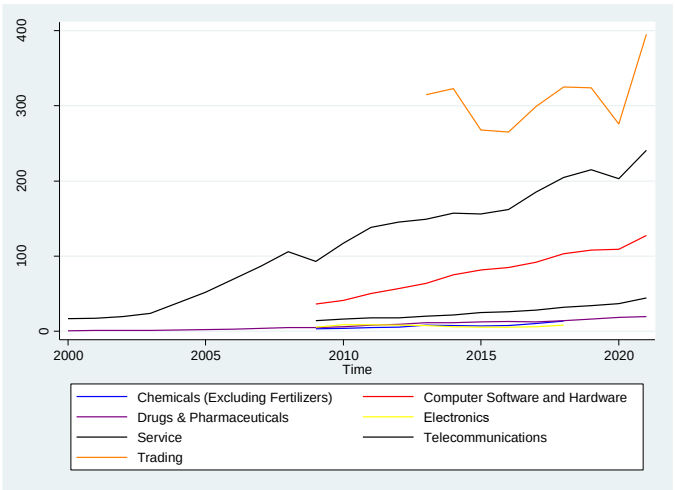


Figure 2 Trend of Sector Wise FDI inflow and Exports





3.2 Correlation analysis

Looking into table 6, FDI and exports show a high degree of correlation while Trade Freedom also looks strongly correlated with both. Tax burden has a moderate but significant correlation with FDI and exports while inflation doesn't seem to have any form of correlation with either. Exchange rate and GDP too have strong correlation with FDI and Exports respectively.

Table 6 Pairwise Correlation

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) FDI (USD Billions)	1.000						
(2) Exports (USD Billions)	0.897***	1.000					
	(0.000)						
(3) Tax Burden	0.549***	0.592***	1.000				
	(0.004)	(0.001)					
(4) Trade Freedom	0.904***	0.956***	0.610***	1.000			
	(0.000)	(0.000)	(0.001)				
(5) Inflation	0.009	-0.004	-0.524***	0.025	1.000		
	(0.964)	(0.983)	(0.006)	(0.903)			
(6) Exchange Rate	0.804***	0.850***	0.698***	0.794***	-0.315	1.000	
	(0.000)	(0.000)	(0.000)	(0.000)	(0.117)		
(7) GDP (USD Billions)	0.907***	0.977***	0.587***	0.937***	-0.103	0.912***	1.000
	(0.000)	(0.000)	(0.002)	(0.000)	(0.615)	(0.000)	

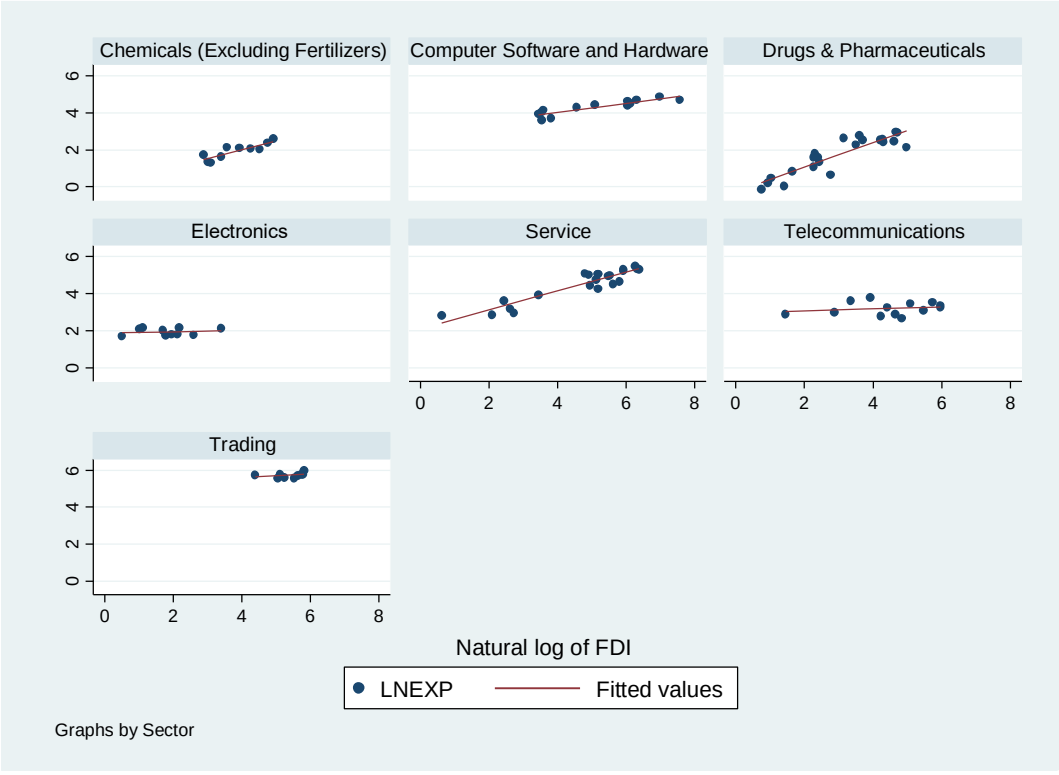
Note. *** *p<0.01, ** p<0.05, * p<0.1*

Table 7: Sector Wise correlation between FDI & Exports

	Pearson Correlation	p-value	N
Chemicals (Excluding Fertilizers)	0.892	0.001	13
Service	0.855	0.000	22
Computer Software and Hardware	0.729	0.005	10
Drugs & Pharmaceuticals	0.709	0.000	22
Trading	0.464	0.209	9
Electronics	0.203	0.573	10
Telecommunications	0.119	0.698	13

Table 7 tells us that, the correlation between FDI and exports is strongest in the chemicals (Excluding Fertilizers) sector (r= .892) but weakest in Telecommunications (r = .119). One thing to note is that Drugs and Pharmaceuticals, Computers and Services also have strong and significant correlation.

Figure 3 Correlation Matrix



4 Methodology

It is quite interesting that although a lot of research is available on FDI and growth, barely any consider the composition of FDI and its resultant effects on specific industries. Studies from Alfaro, 2003 found that the significant effect of FDI came up majorly in the manufacturing sector. The current study employs a panel design, which is unbalanced data between 2000 and 2021, as described in section 3. The study adopts the panel ARDL model to investigate the effect of FDI on sectorial exports in India.

In this section we will describe the model and an alternate version of the same without gdp as a control, followed by description of the stationarity tests, as well as the different panel estimators we will use to run the model. We will use Hausman tests to evaluate the consistency of each estimator. result section shed some light on the sensitivity of the short-run coefficients by re-estimating the parameters using the seven sub-samples obtained by deleting each sector as operationalized by Simões (2011) using the DFE estimator. Sensitivity analysis allows us to assess the robustness and reliability of results by analysing their sensitivity to variations in input parameters.

4.1 Model

The current study assumes that the Index of economic freedom indicators, namely, tax burden, and trade freedom, alongside two macroeconomic indicators (Inflation and Exchange rates), have a short-run relationship with exports. The FDI is the only predictor that might have short-to-run effects on exports. As discussed earlier, ARDL is suitable for non-stationary panels.

The tentative long-run – short-run dynamic panel specification model $ARDL\ (p, q_1, \ldots, q_k)$ is presented in equation 1.

$$\Delta\text{LNEXP}_{it} = \sum_{j=1}^{p-1} \alpha_{i,j} \Delta\text{LNEXP}_{i,t-j} + \sum_{j=0}^{q-1} \beta_{i,j} \Delta LNFDI_{i,t-j} + \beta\Delta\text{LNGDP}_{t-j} + \gamma\Delta\text{LNTRDFI}_{\text{t}} + \vartheta\Delta\text{LNTXBDI}_{\text{t}} + \omega\Delta\text{LNINFL}_t + \delta\Delta\text{LNEXC}_t + EC_t + \mu_i + \varepsilon_{it} \quad (1)$$

Where, LNEXP and LNFDI are the natural logs of exports of sector i and FDI to sector i, respectively; LNGDP is the natural log of the country's real GDP. LNTRDFI and LNTXBDI are the natural logs of tax burden index and the trade freedom index. LNINFL and LNEXC are the natural logs of inflation and exchange rate (INR versus USD) respectively. p-1 and q-1 are optimal lags for each variable. μ_i is the industry-specific effect, ε_{it} is the error term, and EC_t is the error correction equation of the form in Equation 2.

$$EC = \phi(\Delta\text{LNEXP}_{t-1} - \theta\Delta LNFDI_{t-1}) \quad (2)$$

If $\theta = 0$ there is no conditional long run relationship between the levels of LNEXP_{t} and $LNFDI_t$. If $\phi = 0$, or insignificant, then LNEXP_{t} is I (1) and a short-run relationship only exists. Thus, $\phi \neq 0$ is the necessary condition for a long run relationship to exist.

This study would also try to investigate how the above model runs and what results we get if we don't include GDP as a control variable. We would try to take a different perspective into the relationship between FDI and export by considering only sectoral FDI and Exports in order to see the sector specific dynamics of the model.

To conduct a comparative study, we utilize three specific panel estimators: (1) a traditional fixed-effects (FE) estimator, (2) the mean-group (MG) estimator proposed by Pesaran and Smith, and (3) the pooled mean-group (PMG) estimators. The FE technique estimates and combines data from various sectors, accommodating different intercepts for each group. The

MG and PMG estimators are used to estimate long-run relationships in dynamic panels where the model parameters vary across panels. The MG estimator involves estimating separate time-series regressions for each group and averaging the intercept, slope coefficients, and error variances. All three estimators allow for variations across panels. The PMG estimator, developed by Pesaran, Shin, and Smith, combines the pooling and averaging of the regression coefficients..

Stationarity test helps us find the integreation order of a time series model. It helps identify the presence of trends or patterns in a time series. It also allows us to test for the presence of unit roots or structural breaks in the series. ARDL often requires that the variables be I(0), I (1), or both. According to Ouattara (2004), ARDL results are invalid at I (2).

Due to smaller sample sizes, the study uses the Fisher-type unit-root test based on augmented Dickey-Fuller tests. This is also more commonly known as the Phillips Peron test. It addresses limitations of the ADF test and provides more robustness in certain forms of serial correlation or heteroscedasticity. It tests the null hypothesis that Ho: All panels contain unit roots vs. alternative, Ha: At least one panel is stationary.

Hausman tests helps us understand the consistency of different estimators. It is done by comparing the difference in the estimated coefficients with their estimated covariance matrix. If the difference is significant, it shows that the alternative estimator is considered more consistent and suitable. In this study we will use Hausman tests to find out the consistency of our 3 estimators and see which one is more consistent.

5 Results

5.1 Unit root test

The findings of the fisher type unit root test imply that all the levels variables were non-stationary at level except LNTRDFI. However, all the variables are stationary at first difference, confirming that the ARDL (1, 1,1,1,1, 1) is suitable. The regressors will be assumed to be integrated in order I (1), satisfying the requirements of ARDL. See table 8.

Table 8 Fisher-type unit-root test based on augmented Dickey-Fuller tests.

Variable	df	Level		First- difference	
		Inverse chi-squared	p-value	Inverse chi-squared	p-value
LNEXP	14	18.6089	0.1804	41.1064	0.000
LNFDI	14	21.7096	0.0848	136.8946	0.000
LNTXBDI	14	10.4359	0.7297	42.5979	0.000
LNTRDFI	14	75.2975	0.000	396.7532	0.000
LNINFL	14	10.5058	0.7243	89.2491	0.000
LNEXC	14	1.9736	0.9999	58.3408	0.000
LNGDP	14	7.6779	0.9054	87.9225	0.0000

5.2 Panel ARDL estimation

Looking at the results depicted below, PMG regression results were not included since no feasible values were obtained. One possible explanation for not finding any viable values could

be attributed to the absence of a long-term relationship between exports and FDI in this particular case.

Also as indicated in table 9, no long-term relationship between exports and FDI was obtained in either DFE or MG as well. Only a significant short-term relationship between FDI and exports was established in the DFE regression (θ =0.0174, p<0.05) while no significant short-term relationship was found in the MG estimator. Specifically, a 1 % increase in FDI would increase exports in the short run by 0.0174%. The speed adjustment coefficient in the DFE is significantly negative (ϕ = -0.0417, p < .05), consistent with the established trend on both FDI and exports. The results meet the restrictions that $\phi < 0$ for there to be a short-run - the long-run relationship between two variables.

The DFE estimator also sheds light onto how tax burden, trade freedom and inflation can have short run impacts on exports. Higher tax burden trade tends to increase exports (ϑ = 2.108, p < 0.01), a higher trade freedom index tends to lower exports (γ =- 0.127, p < 0.1), whereas an increase in inflation (δ = 0.128, p < 0.1) increases exports. Exchange rates (δ = -0.673, p>0.1) and GDP did not significantly influence exports. Long-run FDI elasticities are insignificant implying the absence of long run-relationship. Clustered standard errors by sector in the DFE model are made to allow intragroup correlation.

Table 9 Panel models with long and short run parameters

	Mean Group Estimation		Dynamic Fixed Effects Regression	
VARIABLES	**Long run**	**Short Run**	**Long run**	**Short Run**
Long run				
EC		-1.117		-0.0417**
		(1.279)		(0.0187)
Short Run				
D.LNFDI		-0.214		0.0174**
		(0.208)		(0.00793)
D.LNTXBDI		13.49		2.108***
		(10.58)		(0.603)
D.LNTRDFI		3.712		-0.127*
		(2.788)		(0.0666)
D.LNINFL		-0.488		0.128*
		(0.700)		(0.0728)
D.LNEXC		7.204		-0.673
		(12.12)		(0.464)
D.LNGDP		2.075		0.513
		(5.486)		(0.393)
LNFDI	-0.305		-0.0601	
	(0.459)		(0.376)	
Constant		-2.203		0.233***
		(2.146)		(0.0415)
Observations	92	92	.	.

Standard errors in parentheses;; *** p<0.01, ** p<0.05, * p<0.1; Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1;

Hausman test was used to determine the best suit, long-run models. The Hausman test results given in table 10 indicated that the null hypothesis (Ho) implying no significant difference in the coefficients is still valid since there is not one significantly better among the two estimates as per table 10. Thus, we can say that both models are equally consistent in this case.

Table 10 Hausman (1978) specification test

Pair	Chi-square test value	P-value
MG vs DFE	0.000	0.992

5.2.1 **Sensitivity Analysis**

This test aims to examine whether there is significant evidence of sectorial differential on the short-run effects of exports in India.

Table 11: Sectoral Sensitivity of Short Run FDI elasticity of exports (DFE)

	VARIABLES	Excluding Chemicals	Computer Software and Hardware	Excluding Drugs & Pharmaceuticals	Excluding Electronics	Excluding Service	Excluding Telecommunications	Excluding Trading
Short Run	EC	-0.0354**	-0.0426*	-0.0351	-0.0425**	-0.0532**	-0.0553***	-0.0360**
		-0.018	-0.0242	-0.0331	-0.0195	-0.0216	-0.0207	-0.0166
	D.LNFDI	0.0179**	0.0195***	0.0144	0.0121	0.0161	0.0259***	0.0176**
		-0.008	-0.0067	-0.011	-0.0081	-0.0098	-0.0089	-0.0069
	D.LNTXBDI	1.671***	2.086***	2.084***	2.122***	2.499***	2.297***	2.017***
		-0.374	-0.67	-0.802	-0.697	-0.714	-0.706	-0.624
	D.LNTRDFI	-0.109*	-0.124*	-0.213**	-0.133*	-0.128	-0.108*	-0.107*
		-0.0596	-0.071	-0.0881	-0.071	-0.129	-0.0594	-0.0578
	D.LNINFL	0.124	0.155*	0.147	0.0668***	0.154	0.131	0.136*
		-0.0804	-0.083	-0.0997	-0.0236	-0.101	-0.0824	-0.0816
	D.LNEXC	-0.711	-0.842*	-0.768	-0.581	-0.247	-0.523	-0.904**
		-0.491	-0.455	-0.642	-0.478	-0.514	-0.586	-0.373
	D.LNGDP	0.522	0.471	0.758	0.411	0.699	0.641	0.243
		-0.41	-0.434	-0.538	-0.352	-0.662	-0.488	-0.183
Error correction (EC)	LNFDI	-0.165	0.0235	-0.289	-0.0922	0.175	0.136	-0.201
		-0.494	-0.461	-0.79	-0.369	-0.251	-0.254	-0.439
	Constant	0.228***	0.224***	0.243***	0.259***	0.173***	0.219***	0.260***
		-0.0426	-0.0488	-0.0402	-0.0379	-0.0663	-0.0546	-0.0169

As per the results in table 11, the short-run FDI elasticity of exports becomes insignificant when the Drugs & Pharmaceuticals, Electronics, and Service sectors are omitted. On one end, FDI and exports had a strong correlation in the Drugs & Pharmaceuticals industry ($r = 0.709$, $p< 0.01$). They also show a strong correlation in the service sector. Conversely, the electronics sector has a weak positive correlation ($r = 0.203$, $p= 0.573$) but with fewer extreme scores. The short-run FDI elasticity of exports remains significant but improves relative to the baseline (0.0174) when the trading (0.0176), chemicals (Excluding Fertilizers) (0.0179), Computer Software and Hardware (0.0195), and Telecommunications (0.259) sectors are removed. Notably, the FDI and exports had the strongest correlation in the chemicals (Excluding Fertilizers) sector ($r= .892$) with moderate trading ($r = 0.464$). The results imply that changes in exports as a result of fluctuations in FDI is more sensitive in the case of Drugs & Pharma, Electronics and Service sector as removing these leads to an insignificant relationship between FDI and exports in the model.

Table 12: Change in FDI Elasticity of Sectorial Exports When Specified Sectors Are Excluded

Sector	**Coefficient**	**p-value**	**Full model) coefficient**	**Change in Coefficient**
Electronics	0.0121	0.137	0.0174	-0.0053
Drugs & Pharmaceuticals	0.0144	0.191	0.0174	-0.0030
Service	0.0161	0.100	0.0174	-0.0013
Trading	0.0176	0.011	0.0174	0.0002
Chemicals	0.0179	0.025	0.0174	0.0005
Computer Software and Hardware	0.0195	0.003	0.0174	0.0021
Telecommunications	0.0259	0.004	0.0174	0.0085

Potential heteroskedasticity across panels is minimized by using clustered standard errors for panel data. Wooldridge test for autocorrelation in panel data indicated the absence of first-order autocorrelation among the variables used (F (1, 6) = 3.284, p = 0.1199).

5.3 Panel ARDL estimation excluding GDP

From the results of Table 9, GDP has no significant short-run effect on the level of exports. For the sake of comparison and to test the robustness of the model, specifically to address possible multicollinearity issues arising from the positive correlation between FDI and other control variables (Trade Freedom and Exchange rate), Eq. 1 was re-estimated without incorporating GDP into it. Thus, the study evaluated the short-run relationship Between exports and FDI with and without GDP as a control variable to ensure that the results do not suffer from multicollinearity. The results converge, indicating sufficient evidence that there is no long-run but short-run relationship between FDI and exports. Although there is no post hoc test for multicollinearity in the ARDL design, the convergence of the model results excludes potential multicollinearity issues in the established short-run dynamics and interdependencies between FDI and exports over time. Since GDP is insignificant, it might not be mediating, at least not in sector-specific FDI-Export relationships.

Stationarity tests determine same as above that all variables are stationary at first difference, confirming that the ARDL (1,1,1,1,1,) is suitable. The regressors are assumed to be integrated in the order I, satisfying the requirements or ARDL. We were able to get results even in the PMG estimator for this instance.

Table 13: Panel model with short and long run parameters

Effect	Variables	Pooled Mean Group Regression	Mean Group Estimation	Dynamic Fixed Effects Regression
Short run	Error correction term	0.297	0.415	-0.0394**
		(0.579)	(0.527)	(0.0171)
	D.LNFDI	0.431	0.910	0.0178**
		(0.307)	(0.773)	(0.0077)
	D.LNTXBDI	-6.487	-11.48	1.671***
		(5.308)	(9.112)	(0.594)
	D.LNTRDFI	-1.022	1.532	-0.109**
		(2.566)	(4.521)	(0.0543)
	D.LNINFL	0.974*	1.451*	0.0929
		(0.541)	(0.878)	(0.0746)
	D.LNEXC	-3.748	-2.164	-1.193***
		(3.882)	(4.671)	(0.420)
Long-run	LNFDI	0.693***	1.954	-0.200
		(0.0053)	(1.717)	(0.401)
	Constant	1.180	-1.109	0.304***
		(0.746)	(2.395)	(0.0268)
	Observations	92	92	. 92
	Log Likelihood	150.2957		

Note. Standard errors in parentheses; Clustered standard errors by sector in the DFE model are made to allow intragroup correlation; *** p<0.01, ** p<0.05, * p<0.1

According to the results in table 13., the estimated long-run FDI elasticity in the PMG is significantly positive (θ = .693, p < .01). Specifically, a 1% increase in FDI increases the exports in the long run by 0.639%. The DFE estimate of the short-run FDI elasticity is significantly positive (θ = .0178, p < .01) but lower than the long-run effect in PMG. Specifically, a 1% increase in FDI increases the exports in the short run by 0.0178%.

Comparing the DFE and the PMG, the DFE estimator diminishes the long-run FDI elasticity but induces a significant speed adjustment.

The speed adjustment coefficient in the DFE is significantly negative (ϕ = -0.039, p < .05), consistent with the established long-run relationship between FDI and exports. The results meet the restrictions that $\phi < 0$ if a long-run-run relationship exists between exports and FDI. Further, the DFE provides new insights into how tax burden, trade freedom and exchange rates could have short-run impacts on exports. Higher tax burden trade tends to increase exports (γ_1 =1.671, p < 0.01), increasing trade freedom index tends to lower exports (γ_2 -0.109, p < 0.05), whereas increasing exchange rates tend to lower (δ = -1.193, p < 0.01) on exports as well.

When comparing the results in Table 9 to Table 13, we see that the coefficient on FDI increased by a small amount 0.004, which does tell us that removal of GDP only had a minor effect on the relationship between FDI and exports, implying. Value of ϕ went down, while the magnitude of coefficients for Tax Burden and Trade Freedom reduced. Inflation becomes insignificant in the short run we exclude GDP. Looking at just the exports and FDI, that too of specific sectors can help us understand a more direct relationship between them without, as mentioned, allowing broader economic context to alter the results. It also allows us to see the effect of other controls as well in the absence of GDP, in a simpler manner, since I am only considering sector-wise FDI and exports in this case and not the economy.

After the above, Hausman test is used to determine the best suit, long-run models. According to the results in Table 14, its indicated that the null hypothesis (Ho): the difference in coefficients not systematic, should not be rejected at a 5% significance level as no significant values are obtained here thus implying that either of the above are consistent when compared. This might be due to the limited power to assess inconsistencies in a small sample.

Table 14: Hausman (1978) specification test

Pair	Chi-square test value	P-value
MG vs. PMG	0.356	0.551
MG vs DFE	0.001	0.979

5.3.1 Sensitivity Analysis

Table 15: Sectorial sensitivity of Short-Run FDI Elasticity of Exports Using the DFE estimator.

Sector excluded	**Coefficient**	**p-value**	**Baseline**	**Change in coefficient**
Electronics	0.0117	0.123	0.0178	-0.0061
Drugs & Pharmaceuticals	0.0159	0.212	0.0178	-0.0019
Trading	0.0177**	0.012	0.0178	-0.0001
Chemicals (Excluding Fertilizers)	0.0182**	0.02	0.0178	0.0004
Service	0.0193**	0.042	0.0178	0.0015
Computer Software and Hardware	0.0207***	0.001	0.0178	0.0029
Telecommunications	0.0217**	0.036	0.0178	0.0039

The above table shows us that the short-run FDI elasticity of exports becomes insignificant when the Drugs & Pharmaceuticals and Electronics sectors are omitted. The short-run FDI elasticity of exports remains significant but diminishes relative to the baseline (0.0178) when chemicals (Excluding Fertilizers) (0.0182) and Trading (0.0177) sectors are removed. Thus, removing these sectors could weaken the short-run FDI elasticity of exports. Lastly, the study postulates that the short-run FDI elasticity of exports in India is less sensitive to FDI inflows into telecommunications, Computer Software and Hardware, and service. These results are quite similar in terms of relative sensitivity of sectors as compared to the model with GDP included.

6 Conclusion

This paper attempts to investigate the relationship between FDI and exports in India specifically in the post liberalization period while taking into account unbalanced panel data from various economically significant sectors, specifically those that have received substantial inflows of FDI. This thesis addresses the gap in literature, by analysing recent data and focusing on the sector specific effects of FDI on exports. It employed a panel ARDL method to assess the relationship of FDI elasticity of exports while controlling for various economic factors. The stationarity of variables was tested using Philips Peron test. The methodology applied consisted of fixed effects, mean-group, and pooled mean group estimator to do a comparative study as to which estimator would provide more consistent results.

The findings reveal that although no long-term relationship between FDI and exports was established when including GDP as a control, a significant short-term relationship was observed in the fixed effects estimator. It also investigated the impact of other control variables like tax burden, trade freedom, exchange rate and inflation for both models with and without GDP. A higher tax burden tended to increase exports in both models. Inflation seems to have a positive effect on exports when including GDP but is insignificant in the model without it. Trade freedom and exchange rate seem to have a negative effect on exports but exchange rate is only significant when GDP isn't included.

Sensitivity analysis was conducted to test the robustness of the results, keeping focus on the short run effects of exports on different sectors. It showed that when certain sectors, like Drugs and Pharmaceuticals, Electronics, and Services were excluded, the FDI elasticity of exports became insignificant, implying that changes in exports because of fluctuation in FDI were more sensitive in these sectors, indicating sector specific dynamics.

GDP seemed to have no significant effect on exports in the short term. The model without GDP implied that although FDI elasticity of exports had only minimal changes on removing GDP, removing it did bring up changes in the coefficients and significance of inflation and exchange rates. A reason for this could be that GDP endogenously affects the control variables in the model leading to changes in results. Conducting a regression without GDP only aimed to check the simplified relationship between FDI and exports specifically with the considered sectors, without allowing broader macroeconomic factors to affect the relationship. Hausman tests were used to assess the consistency of the estimators, and the results indicated that either of the estimates resulted in equally consistent estimates.

The findings provide some valuable insights for policymakers in formulating strategies to attract more FDI as well as increase exports in specific sectors. It also provided insights into the overall reactivity of FDI and exports in each sector. Institutions should work forward into improving policies, encouraging entrepreneurship as well as collaborations with international companies so that they can benefit from the positive short-term effects and work on sector specific policies so that we can maximize the impact on targeted industries. Another initiative could be to work on improving the general economic freedom by improving on the policies that affect variables like tax burden, trade freedom and it can be achieved by reducing bureaucratic sluggishness, streamlining regulations to promote trade liberalization.

However, there is a lot of factors that were not considered in this study due to data limitations as well as modelling limitations.

Future studies can work further into this model by focusing more on the long run relationship between FDI and exports, adding in more sectors, specifically energy as it is one of the most crucial elements of any economy. They could try to investigate how the relationship between FDI and exports in each sector promotes or hinders sustainability and transitional into a low

carbon economy. Global production networks and value chains are today prominent features of international trade. Future studies could examine how FDI supports the integration of countries into said value chain and how it affects exports within each sector. Another major thing that could be included as control in future studies could be political situation and government policies towards globalization. Finally, comparing cross country and cross industry relationships between FDI and exports could provide insights into the heterogeneity of FDI effects on exports for each sector. Future research could work in determining those country and industry specific factors to allow for a better understanding of global patterns.

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