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INDIA'S TRADE WITH ITALY: ANALYSING COINTEGRATION BETWEEN TRADE AND ECONOMIC GROWTH USING AUTOREGRESSIVE DISTRIBUTED LAG (ARDL) MODEL

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ABSTRACT

India and Italy both nations have a rich culture and history. In recent years, their relationship has strengthened into a Strategic Partnership in 2023 prompting a Joint Strategic Action Plan. This new framework is the result of a commitment to deepen their bilateral relationship. It also signals a leap forward in economic, cultural and scientific diplomacy. At the heart of this relationship, economic cooperation and trade are two significant pillars that fuel this partnership drive. Looking ahead, economic pundits are optimistic of heightened trade relations, given the chemistry between Indian Prime Minister, Narendra Modi and his Italian counterpart, Giorgia Meloni. Trade between India and Italy touched an all-time high of USD 15.2 billion in 2023. While exports to Italy were USD 8.3 billion, imports from Italy clocked over USD 6.8 billion during this period. The current study uses historical data for the period 1988-2023, while applying Autoregressive Distributed Lag (ARDL) modelling to analyze the relationship between India's trade (exports and imports) with Italy and India's GDP.Both the short-run and long-run relationships amongst the variables have been investigated to examine their impact on each other. The study concludes that India's GDP and India's exports to Italy are cointegrated and have a bi-directional relationship in the short-run and long-run. Further, a bidirectional relationship exists between exports and imports albeit only in the short-run.

***KEYWORDS**: India, Italy, ARDL, Cointegration, Trade, Economic Growth.*

Introduction

As ancient civilizations, India and Italy have much in common. They share a rich cultural tradition rooted in history. Italy, as a prominent country of Europe and India, the gateway to Asia, are known to have trade links since 2000 years. Marco Polo, the famous merchant and traveller from Venice, is said to have portrayed about his experiences of India after his visit in the 13th century.

India and Italy established diplomatic ties in 1947. Relations between the two were strained after the Enrica Lexie case in 2012, where two Italian marines were charged with the killing of Indian fishermen. In 2014, another case alleging kickbacks in the Augusta Westland dealdented relations between the two countries. However, a visit to Italy by Indian Prime Minister Modi in 2021 to participate in the G20 Leaders Summit softened the strained relations. A return visit by the Italian Prime Minister, Meloni in 2023 elevated the bi-lateral relationship to the level of a strategic partnership. Since then, the two countries are keen to foster growth by capitalising on emerging opportunities and expand their economic potential.

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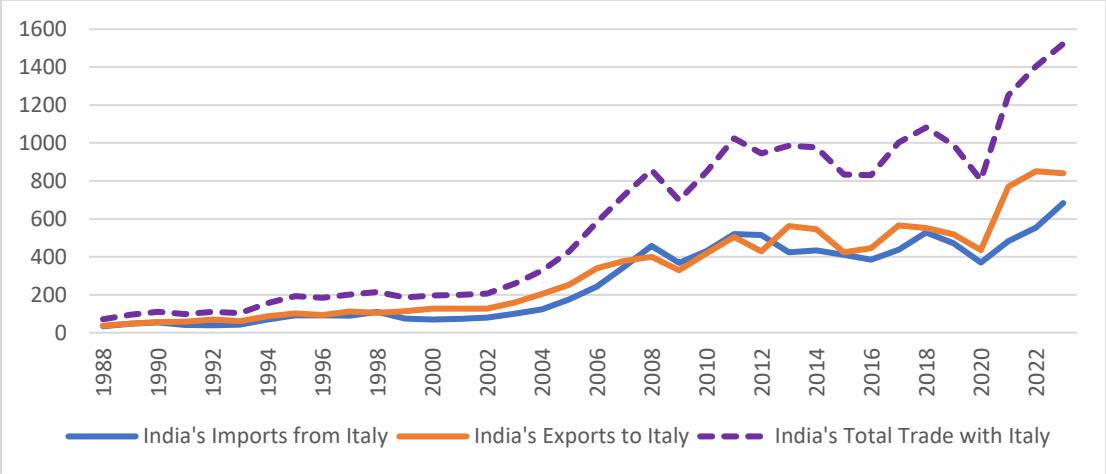
While, Italy is India's 4th largest trading partner in Europe after the Netherlands, Germany and Belgium, India is Italy's 2nd largest trading partner in Asia. Trade between the two saw a significant jump from USD 8.04 billion in 2020 to USD 12.52 billion in 2021[1]. The total trade between India and Italy amounted to USD 15.23 billion in 2023.

In 2023, India's top exports to Italy were of Iron and Steel amounting to USD 1.76 billion, followed by electric machinery and equipment for an amount of USD 992 million. Nuclear reactors, boilers, machinery and mechanical appliances were at USD 686 million. Mineral fuels, mineral oils and products of their distillation; bituminous substances etc amounted to USD 588 million in 2023. During the same period, India exported organic chemicals worth USD 505 million to Italy.

On the other hand, India's top imports from Italy included machinery and mechanical appliances amounting to USD 2.4 billion, which accounts for approx. 35 per cent of India's total imports from Italy. This is followed by ships, boats and floating structures amounting to USD 613 million. Organic chemicals take the number three position in India's imports from Italy at USD 389 million, while electrical machinery and equipment imports account for USD 377 million in 2023. During the same period, optical photographic, cinematographic equipment etc. amounts to USD 232 million.

Figure 1 depicts the trade flows between India and Italy for the period 1988-2023. It can be seen that during this period, India had a trade surplus with Italy for the larger part except during the period from 2008-2012, where it had a trade deficit. The total trade between India and Italy has increased from USD 14.03 billion to USD 15.23 billion from 2022 to 2023, the imports have shrunk marginally from USD 8.5 billion in 2022 to USD 8.39 billion in 2023.

Figure 1: India's trade with Italy for the period 1988-2023(USD million)



The introduction is followed by a literature review, which looks at the trade-growth hypotheses in various forms. Then comes the research methodology which explains the sources of data, the justification of the tools used in the empirical analysis and the process of outcome. The empirical results are outlined in section 4, which also includes the discussion along with the results. The study concludes with the conclusion. The bibliography is attached at the end of the paper.

Literature Review

The important role of trade in enhancing economic growth has been well-accepted by proponents of classical as well as neo-classical liberals. Trade promotes competition which eventually leads to efficient allocation of resources (Helpman& Krugman, 1985). Bhagwati (1988) has argued that an increase in exports would promote economic growth and benefit a country in upgrading its human capital and bring in advancements in technology.

Extensive academic literature is available on trade led growth hypothesis, however, there is limited research available on cross-country trade-growth relationshipthrough the application of Autoregressive Distributed Lag (ARDL) model. Recently, Agarwal (2023) has used ARDL to examine the

[1] https://comtradeplus.un.org/TradeFlow

India-UK trade-growth relationship. In their analysis, a two-way relationship exists between India's merchandise trade and its economic growth, specifically between India's exports and economic growth, imports and economic growth and the trade of exports and imports with the UK. However, this bi-directional relationship is absent when analysing trade in services between India and the UK.

Researchers have used time-series data to examine the export led growth hypothesis. Empirical evidence available on the export led hypothesis remains mixed and inconclusive. Numerous analysis done by academicians support the hypothesis of an export led growth underlining a unidirectional relationship between exports and economic growth(McNab & Moore, 1998; Amirkhalkhali & Dar, 1995; Yaghmaian & Ghorashi, 1995; Coppin, 1994; Sprout & Weaver, 1993; Sheehey, 1992; De Gregorio, 1992; Alam, 1991; Dodaro, 1991; Otani & Villaneuva, 1990).

Awokuse (2003) has used Granger causality to find a relationship between exports and economic growth for Canada to examine cointegration through the application of Vector Error Correction Model (VECM) along with the augmented Vector Autoregressive (VAR) techniques. His analysis shows a unidirectional relationship between exports and economic growth for Canada. In another study, analysing the export led growth hypothesis for Chile using time series data and employing Granger non-causality in vector autoregressive (VAR) methodology, Silverstovs and Herzer (2006) found that exports have a causal relationship with economic growth, supporting the theory of export-led-growth.

On the other hand, no credible empirical evidence is available to accept the hypothesis of and export led growth in numerous studies undertaken (Bahmani-Oskooee et al., 1991; Ahmad & Kwan, 1991; Ram, 1987; Jung & Marshall, 1985). While analysing the relationship between exports and GDP for Greece using VECM and multivariate Granger causality, Panas and Vamvoukas (2002), found that there is no causal relationship of exports to economic growth, however,a robust and steady unidirectional causal relationship is observedbetweeneconomic growth and exports.

Different techniques have been employed by researchers and academicians to establish a causal relationship between trade and economic growth. Some researchers have used the Johansen-Juselius (1990) cointegration approach and found a bi-directional relationship between GDP and exports and GDP and imports for Portugal (Ramos, 2001). Similarly, while examining the relationship between exports and economic growth for Bulgaria, Awokuse (2007) found a two-way relationship between the two variables.

Hye and Boubaker (2011) established that Tunisia has an export-led growth as well as an import-led growth. In their study, they have shown a bidirectional relationship between exports and imports, which implies that the foreign deficit remains weakly sustainable in Tunisia.

Analysing the trade growth relationship of six SAARC countries, Hye et al. (2013) have applied ARDL model to establish a long-run relationship among exports, imports and economic growth. The results reveal that import-led growth is relevant to all six countries namely, Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka whereas, the export-led growth model is applicable to Bangladesh, Bhutan, India, Nepal and Sri Lanka (Pakistan being the only exception). Similarly, the growth-led import model is applicable to all six countries whereas, the growth-led export model is relevant to Bhutan, India, Pakistan and Sri Lanka.

Research Methodology

The current study has used time series data taken annually for the period 1988-2023. The secondary data has been sourced from databases of the WorldBank and UNComtrade. The study examines the relationship between India's economic growth and its trade with Italy. India's economic growth is represented by its GDP (G), exports to Italy are represented by (E) and imports from Italy are represented by (M) in the study. The series are transformed to natural logarithms to make them more robust and reliable. The representation of the variables namely, exports to Italy, imports from Italy and economic growth of India, after the logarithm values are LG, LE and LI. Econometric modelling is done using E-views-12 software.

The ARDL model estimates an unrestricted error correction model, allowing for the direct estimation of short-run effects while the long-run relationship is inferred indirectly. The model introduced by Pesaran et al. (2001), specifies the explainedvariable as a function of its own lagged values as well as the current and lagged values of regressors.

The generalised ARDL (*p, q*) model is specified as:

$$\boldsymbol{Y_t} = \boldsymbol{\Upsilon_{0n}} + \sum_{n=1}^{p} \boldsymbol{\delta_n Y_{t-n}} + \sum_{n=0}^{q} \boldsymbol{\beta_n X_{t-n}} + \boldsymbol{\varepsilon_{nt}} \qquad (1)$$

where:

Y: regressand

X: regressor

γ: denotes the drift

δ: coefficient of regressand

β: coefficient of regressor

ε: error term

p: lag of the regressand

q: lag of the regressor

n: denotes the number of lags

t: denotes the time

The specific equation for the ARDL model used in the study, which is an augmented form of granger causality test involving the error correction term (ECT), is formulated in the VECM form. This equation substitutes the variables used in the study and is given as

$$\begin{bmatrix}\Delta LG_t\\ \Delta LE_t\\ \Delta LI_t\end{bmatrix} = \begin{bmatrix}a_{01}\\ a_{02}\\ a_{03}\end{bmatrix} + \sum_{n=1}^{p}\begin{bmatrix}a_{11n} & a_{12n} & a_{13n}\\ a_{21n} & a_{22n} & a_{23n}\\ a_{31n} & a_{32n} & a_{33n}\end{bmatrix}\begin{bmatrix}\Delta LG_{t-n}\\ \Delta LE_{t-n}\\ \Delta LI_{t-n}\end{bmatrix} + \begin{bmatrix}\lambda_1\\ \lambda_2\\ \lambda_3\end{bmatrix}[ECT_{t-1}] + \begin{bmatrix}\varepsilon_{1t}\\ \varepsilon_{2t}\\ \varepsilon_{3t}\end{bmatrix}$$

where:

LG denotes natural logarithm of GDP,

LE denotes natural logarithm of exports

LI denotes natural logarithm of imports

t denotes the time period

n denotes the lag

a_{01}, a_{02}, and a_{03}represents the constants of the respective equations.

λ = Error Correction Parameters (negative sign)

ECT $_{(t-1)}$= is the lagged value of the residuals derived from the cointegrating equation of the regressand on the regressors.

'a_{11n}', 'a_{12n}', 'a_{13n}'are the short-run dynamic coefficients of the model as it converges towards long-run equilibrium

Stationarity of the variables either at I(0)-at level or at I(1)-first difference or a mix of orders is a pre-requisite before applying the ARDL Bounds test. Hence, the Augmented Dickey Fuller (ADF) test has been conducted to determine the stationarity of the variables.

Empirical Results

Table 1 outlines the results of the Unit Root test. None of the variables (LG, LE & LI) are stationary at level, as the p-value for all the test types are greater than 0.05 significance level. The null hypothesis of 'presence of a unit root' at level is accepted. Therefore, all variables are non-stationary at their level.

All variables become stationary at 0.01 significance level at first difference for all test types except LG (at without constant and trend), which is stationary at 0.10 significance level.

Table 1: Augmented Dicky Fuller (ADF) Unit Root Test

At Level				
		LG	**LE**	**LI**
With Constant	t-Statistic (p-value)	0.4399 (0.9819)	-1.2926 (0.622)	-1.0112 (0.7385)
With Constant & Trend	t-Statistic (p-value)	-2.4767 (0.3369)	-2.5993 (0.2829)	-1.7354 (0.7138)
Without Constant & Trend	t-Statistic (p-value)	5.1328 (1.0000)	2.6882 (0.9976)	2.2192 (0.9924)

At First Difference				
		∆(LG)	∆(LE)	∆(LI)
With Constant	t-Statistic (p-value)	-5.7117 (0.0000)***	-6.7331 (0.0000)***	-4.5412 (0.0009)***
With Constant & Trend	t-Statistic (p-value)	-5.6818 (0.0003)***	-6.6891 (0.000)***	-4.4343 (0.0064)***
Without Constant & Trend	t-Statistic (p-value)	-1.84 (0.0633)*	-5.4744 (0.0000)***	-4.1544 (0.0001)***

(*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1%

The results of the descriptive statistics, based on 35 observations, of the differenced variables are shown in Table 2. The average rate of change inLG over the sample period is 0.0709, while that of LE is 0.0891 and that of LI is 0.0858. The variability of change (standard deviation) in LI is the greatest at 0.2047, followed by LE at 0.1758 and lowest for LG at 0.0821. LG and LI are negatively skewed indicating that they tend to have a longer tail to the left or more extreme negative values, whereas LE is positively skewed. The distribution ofLG is more peaked than normal, implying a leptokurtic distribution, while LE is close to normal and LI is flatter or platykurtic. The Jarque-Bera test of normality shows that the distribution for all variables are normally distributed at 0.05 significance level.

Table 2: Descriptive Statistics

	∆LG	**∆LE**	**∆LI**
Mean	0.070924	0.089175	0.085887
Median	0.064871	0.099385	0.129263
Maximum	0.257771	0.571991	0.495204
Minimum	-0.172564	-0.252987	-0.388378
Std. Dev.	0.082186	0.175863	0.20478
Skewness	-0.296847	0.21902	-0.348874
Kurtosis	4.081595	3.132472	2.596347
Jarque-Bera (p-value)	2.220049 (0.3295)	0.3054 (0.8583)	0.9476 (0.6226)
No. of Observations	35	35	35

ARDL Model Estimation

The specific lag structures for each ARDL model are detailed in Table 3. All three models demonstrate very high values for both R-squared and adjusted R-squared, indicting that they effectively explain most of the variability in their respective dependent variables (LG, LE, and LI). Additionally, the p-values for the F-statistics are significant at 1 per cent significance level, suggesting that the models are statistically valid. However, Durbin-Watson statistics indicate potential autocorrelation. To address this issue, the Newey-West (1987) HAC (Heteroskedasticity and Autocorrelation Consistent) estimator has been applied to each model.

The Newey-West HAC estimator is commonly used in time series analysis to correct for heteroskedasticity and autocorrelation issues, ensuring that statistical inferences are valid even when these problems are present.

Table 3: ARDL Model Summary with R-Squared, F-Statistic and Diagnostic Metrics

	ARDL	**R-square**	**Adjusted R-square**	**F-statistic (p-value)**	**Durbin-Watson stat**
LG/LE, LI	(1,1,0)	0.9959	0.9954	1833.013 (0.0000)***	2.5
LE/LG, LI	(1,1,1)	0.9833	0.9804	341.2051 (0.0000)***	2.23
LI/LG, LE	(1,1,0)	0.9767	0.9736	314.9737 (0.0000)***	1.59

(*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1%

In Table 4, India's GDP is significantly influenced by India's exports to Italy at 1 per cent significance level. Specifically, a 1 per cent change in India's exports leads to a 0.28 per cent change in India's GDP, all other factors remaining constant. However, India's imports do not significantly influence India's GDP in the short-run.

Table 4: Short-run Relationship using ARDL Model

	Independent Variables			
Dependent Variable	**Coefficients (p-value)**			**Short-run Causality**
	LG	**LE**	**LI**	
LG		0.2858 (0.0000)***	0.0547 (0.2958)	LE→ LG
LE	1.0988 (0.0013)***		0.2573 (0.0370)**	LG→ LE
				LI→ LE
LI	0.7296 (0.1139)	0.3822 (0.0984)*		--

(*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1%

India's GDP and India's imports from Italy both significantly influence India's exports to Italy, at 1 per cent and 5 per cent significance levels respectively. This means that a 1 per cent change in India's GDP will cause a 1.09 per cent change in India's exports to Italy, ceteris paribus and India's imports from Italy will cause a 0.25 per cent change in India's exports to Italy.

India's exports to Italy are influencing India's imports from Italy at 10 per cent significance level. However, India's GDP and imports to Italy do not influence each other significantly in the short-run.

Table 5 shows the summary of Long-run Form and Bounds test. The ARDL Bounds Test is used to determine whether a long-term equilibrium relationship, known as cointegration, exists between time series variables. Cointegration implies that even if the variables may individually fluctuate in the short-run, they move together in the long-run. The Bounds test evaluates this relationship by comparing the F-statistic against critical values for the lower bound I(0) and upper bound I(1) at a specified significance level. The long run relationship is established when the value of F-statistic at a specified significance level is greater than I(1). However, if the value of F-statistic is less than I(0),there is absence of any causal relationship in the long run. In the case, where the value of F-statistic lies between the I(0) and I(1), the results are considered to be inconclusive.In this analysis, 5 per cent significance level is considered with a finite sample size of 35.

Table 5: Summary Table of Long-run Form and Bounds Test

	F-Statistic	**I(0)**	**I(1)**	**Results**	**Relationship**
		At 5% Significance Level (Finite Sample n= 35)			
LG/LE, LI	6.1287	4.183	5.333	F-Stat > I(1)	Long-run
LE/LG, LI	5.4069			F-Stat > I(1)	Long-run
LI/LG, LE	4.6220			I(0)<F-Stat<I(1)	Inconclusive

Table 5 shows that there exists a long run relationship of India's GDP with exports as well as imports where the value of F-statistics (6.12) is greater than I(1). Similarly, a long run relationship of India's exports with GDP as well as imports, where the value of F-statistics (5.40) is greater than I(1). In contrast, the regression for imports from Italy shows that the F-statistic (4.62) lies between the lower and upper bounds, making the result inconclusive.

Table 6 highlights the presence of cointegration between GDP, exports and imports in the long run. Specifically, when GDP is the dependent variable, there is evidence of long-term equilibrium with exports and imports. Similarly, cointegration is observed when exports are the dependent variable. However, the results are inconclusive when imports are regressed on GDP and exports.

The table also includes the Error Correction Coefficient (ECC) and its p-value(s). The ECC measures the speed at which short-run disequilibrium adjusts to equilibrium. For equilibrium to be restored, the coefficient must be negative and statistically significant.

Table 6: Estimates of Long-run Form and ECM

Dependent Variable	Independent Variables Coefficients (p-value)			Long-run Causality	Error Correction Coefficient (p-value)
	LG	LE	LI		
LG		0.7627 (0.0003)***	0.2963 (0.1294)	LE→ LG	-0.1846 (0.0001)***
LE	0.77971 (0.0003)***		0.153386 (0.4059)	LG→ LI	-0.4395 (0.0003)***
LI	0.0033 (0.9555)	1.0045 (0.1157)		--	Inconclusive

(*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1%

The results reveal that any short-run disequilibrium in GDP will be corrected at a rate of 18.46 per cent in subsequent periods, ensuring a gradual return to equilibrium. For exports, the speed of adjustment correcting the disequilibrium in the following periods is 43.95 per cent.

Conclusion

The current workemploys the ARDL method for cointegration analysis along with a modified Granger causality test to examine the relationship between the variables namely, India's GDP, and its trade with Italy.

Trading relations between India and Italy indicate an export-led growth and growth-led exports for India as there exists a bidirectional relationship between these two variables both in the short-run and long-run. This relationship underlines the importance of enhancing the competitiveness of India's major exports to Italy.

There exists a bidirectional relationship between exports and imports in the short-run only, implying that the hypothesis of export-led imports and import-led exports holds true.

No statistical relevance is observed between imports and GDP in the analysis. This implies that though the import of Italian goods does contribute to industrial and consumer needs, they do not directly enhance the long-term GDP growth.

The significant error correction terms confirm that deviations from the long-run equilibrium are corrected over time. For instance, trade imbalances arising from fluctuations in GDP or trade stabilizes over time through structural adjustments in trade flows.

India needs to improve supply chain efficiency, enhance product standards in order to strengthen trade relations with India. Policy changes aimed to promote trade with Italy should be undertaken to enhance economic growth of India.

The findings underscore Italy's critical role as a key trading partner in driving India's economic growth and to support India's aspirations to strengthen its presence on the international stage.

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