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Linder hypothesis and India's services trade

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Abstract

This study examines the empirical validity of the Linder hypothesis for India's service sector exports from 2005 to 2021, focusing on 35 major importing countries. We use a gravity model trade, applying Feasible Generalised Least Squares (FGLS) and two-step system generalised method of moments (GMM), incorporating country- and time-fixed effects. Our results confirm that the Linder hypothesis does not hold for Indian service exports, revealing an increase in trade intensity between countries with dissimilar income levels. The study finds that distance has a positive and significant impact on Indian service exports. Exchange rates have a negative and significant impact on India's service exports, while the results for the RTA dummy variable are inconclusive. Sharing a common border, a common colony, and a language has a positive and significant effect on Indian service exports.

Keywords

- Linder hypothesis
- service export
- gravity model
- India

JEL codes: C33, F12, F14.

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Introduction

The proportionate contributions of the industry, agricultural and service sectors to the global economy have undergone significant changes over the past two decades. Nayyar et al. (2021) assert that in 2019, the service sector accounted for 55% of total output in developing economies and provided employment opportunities for 45% of the workforce. The contemporary evolution of global trade dynamics is characterised by a confluence of factors, including the reduction of trade barriers, increased fluidity in the movement of production factors, and a surge in investments in digital technologies. These combined forces are reshaping the traditional contours of trade, particularly in services. Recent estimates indicate a discernible trend wherein the growth rate of trade in services surpasses that of trade in goods, signalling a profound transformation in the structure and emphasis of international trade patterns (Loungani et al., 2017). Between 2006 and 2022, global service exports increased from USD 3.03 trillion to USD 6.95 trillion. Developing and emerging economies are major exporters and consumers of services, with India being the largest exporter (UNCTAD, 2022). Since 1991, the percentage share of service exports in India's Gross Domestic Product (GDP) has increased from 4.0% to 12.0% in 2020 (World Bank, 2022). Between 2008 and 2018, service exports in India increased by 94%, from USD 139 billion to USD 205 billion, while merchandise exports increased by only 66%, from USD 200 billion to USD 332 billion (World Bank, 2022).

India is the eighth largest exporter of commercial services and continues to register robust growth compared to other major service exporters globally (World Trade Organisation, 2018). Banga (2005) observes that India's significant increase in service sector growth has immense potential for employment generation and for promoting economic growth. The proliferation of modern service sectors, encompassing IT solutions, engineering, communication, and business services, has been noted to stimulate economic output, generate employment opportunities, and drive the expansion of service exports (Eichengreen & Gupta, 2013). India's service exports have grown significantly compared to other sectors of the economy, driven primarily by a combination of factors, including the deregulation of financial markets, tax concessions, and the creation of special economic zones (SEZs) (Sahoo & Dash, 2014, 2017).

The theoretical discourse on trade, such as Absolute Advantage theory (1776), Comparative Advantage theory (1817), and Factor Endowment theory (1919), underscores the significance of supply-side determinants in shaping trade patterns. These theories posit that relative disparities in labour and capital proportions utilised in production processes dictate trade dynamics.

In 1961, Linder posited that a similar demand structure between trading partners leads to more intensive trade in manufactured goods. Furthermore, nations with higher per capita incomes tend to prioritise high-quality prod-

ucts, thereby developing a comparative advantage in goods with strong domestic demand (home market effect) (Krugman, 1979, 1981). Building on this concept, Fajgelbaum et al. (2011) theoretically argue that, driven by the home market effect, countries specialise in specific commodities and engage in intensive trade with each other. Previous research has focused on evaluating the relevance of the Linder hypothesis within the manufacturing sector, particularly for developed nations', thus corroborating Linder's postulation. For instance, Chow et al. (1999) examined the trade patterns between New Industrial Countries (NICs) and OECD countries; Fajgelbaum et al. (2011) analysed trade between Germany and Korea; Francois and Kaplan (1996) investigated trade between the USA and major OECD countries; Rauh (2010) studied German trade with Europe; Thursby and Thursby (1987) explored trade in 17 countries; Jošić and Metelko (2018) investigated 184 Croatia's import partner countries, and Bo (2013) examined trade patterns in China.

Recently, a few studies have examined the applicability of the Linder hypothesis to the service sector. In this context, Wernerheim and Waples (2013) employed quarterly time-series data from 1961 to 2006 for Canada's three principal trade partners—the United States, the United Kingdom, and Japan. Their findings align with the Linder hypothesis, revealing that 83% of Canadian service trade is intra-industry. They also identify a significant causal relationship between per capita GDP and trade in commercial services. Similarly, Fu et al. (2020) explored the interplay among income similarity, bilateral trade in services, and income inequality across 173 countries and 11 service sectors from 1995 to 2012. Their study demonstrates that income similarity and levels of inequality positively influence bilateral trade in services at the aggregate level. However, they observe considerable heterogeneity across the 11 service sectors. In contrast, using the Tobit model, Braymen and Briggs (2015) examined the relationship between service trade and income similarity from 2000 to 2010 across 2,683 country pairs. Their results diverge from the Linder hypothesis, indicating that countries with dissimilar per capita income levels tend to engage more in bilateral trade in services. This suggests that empirical investigations into the impact of similar per capita GDP on service trade have produced mixed and inconclusive results.

Despite notable research on the application of the Linder hypothesis to the manufacturing sector in developed countries, there remains a significant gap in the literature regarding its application to the service sector in developing nations. Given the scarcity of empirical research in this critical and under-explored domain, this paper aims to address this gap by providing empirical evidence on the Linder hypothesis's applicability from a developing country perspective. Specifically, it evaluates the empirical validity of the Linder hypothesis for India, focusing on the period from 2005 to 2021 with its 35 major export partners. This research advances the trade literature and offers essential policy recommendations.

There are several compelling reasons for focusing on the application of the Linder hypothesis to service sector trade and specifically to India. Firstly, unlike goods, services are often intangible. These characteristic highlights the need to understand how countries specialise in certain services based on their comparative advantage, which drives inter-industry trade. Furthermore, the Global Value Chain (GVC) is particularly relevant in the service sector, where various stages of a service may be specialised across different countries. This specialisation significantly contributes to inter-industry trade in services, suggesting that similar demand patterns between countries do not necessarily lead to increased bilateral trade intensity in services. Secondly, the service sector plays a pivotal role in India's economy. Service sector accounted for 54% of India's Gross Value Added (GVA) and recorded a notable growth rate of 8.1% during the same fiscal year. Additionally, the sector contributed 34% of total employment during the 2017–2018. India also holds a prominent position in global service trade; in 2017, India was ranked eighth in exports and tenth in imports. Over the past decade, India's share of global commercial services exports has consistently increased, reaching 3.5% in 2017 (Ministry of Finance, Government of India, 2018).

The literature reveals that a few studies have explored the application of the Linder Hypothesis to the service sector using the gravity model (Braymen & Briggs, 2015; Fu et al., 2020). However, these studies exhibit several limitations. Firstly, their estimations have not addressed issues related to cross-sectional dependence, serial correlation, and panel group-wise heteroscedasticity. The estimated results produce bias in the presence of cross-sectional dependency, serial correlation, and heteroscedasticity (Marques & Fuinhas, 2012). Therefore, this study employed FGLS as the primary estimation method for its appropriateness in handling panel data with cross-sectional dependence, serial correlation, and heteroscedasticity (Nguyen et al., 2020). Secondly, their models have failed to account for potential endogeneity issues. Unlike prior research, the study employs a two-step system GMM to control unobserved heterogeneity, autocorrelation, dynamic endogeneity, and simultaneity (Blundell & Bond, 2000; Roodman, 2009). Thirdly, in contrast to previous research, we include a dummy variable for RTAs to evaluate their impact on India's service sector exports. RTAs often facilitate trade by reducing regulatory barriers and providing preferential access to member markets. They also encourage deeper economic integration, which can enhance trade flows. In this context, this study aims to answer the following questions: How does income similarity impact service trade? In other words, does Linder's hypothesis hold for the Indian service trade? Moreover, what impact do RTAs have on India's service exports?

The subsequent sections of the paper are structured as follows: Section 1 offers a literature review focusing on the applicability of the Linder hypothesis. Section 2 outlines the data sources, and Section 3 provides the analytical

framework employed in the study. Section 4 presents the results and discussions. The final section contains the study's conclusions, policy implications, and limitations.

1. Literature review

The factor-proportions model, proposed by Heckscher (1919) and refined by Bertil Ohlin (1933), Stolper, and Samuelson (1941), links trade patterns to relative factor endowments. Despite its influence, the model faces challenges, such as the "Leontief Paradox" (Leontief, 1953). In contrast, Linder's theory (Linder, 1961) emphasises demand-driven trade, suggesting that countries with similar factor endowments engage in trade due to overlapping demand.

Linder's (1961) demand-side proposition and the theoretical framework developed by Fajgelbaum et al. (2011) are prominent in trade literature. Linder's hypothesis suggests that countries with similar per capita incomes tend to have similar preferences and produce differentiated goods, leading to overlapping demand in trade, especially in manufacturing. However, the empirical validity of the Linder hypothesis remains ambiguous and contentious. The degree of empirical support for Linder's theory is debated within academic circles, leading to the emergence of two distinct strands of literature: one that supports Linder's hypothesis and another that challenges it.

Early examinations of the Linder hypothesis, notably by Sailors et al. (1973) and Greytak & McHugh (1977), yielded favourable results through rank correlation analysis. Their failure to incorporate regression analysis into their methodology has been scrutinised, as this analytical approach helps mitigate the confounding influence of distance on trade intensities. Although later studies have employed regression analysis to address the influence of geographic distance, the findings failed to conclusively validate the Linder model (Hoftyzer, 1984; Kennedy & McHugh, 1980, 1983; Qureshi et al., 1980). Nevertheless, a subset of studies, including those by Fortune (1971), Hirsch and Lev (1973), Kohlhagen (1977), Thursby and Thursby (1987), and Bergstrand (1990), support the Linder hypothesis.

Many studies have investigated the influence of income similarity on manufacturing trade. McPherson et al. (2000) found empirical support for Linder's hypothesis on demand similarity in 18 of the 19 OECD countries studied. Hallak (2006) developed a framework to investigate the influence of cross-country disparities in product quality on bilateral trade flows. Through empirical analysis, Hallak's studies confirmed that affluent nations tend to import proportionally more from exporting countries that offer high-quality products. Moreover, these studies highlighted how variations in product quality between countries

exert a substantial impact on the dynamics and direction of international trade flows. Dalgin et al. (2008), in their study focusing on the United States, Germany and Japan, employed cross-country panel regression analysis covering the years 2000 to 2006. Their results revealed that if income distribution in the United States resembled that of Canada, the United States would experience an increase of approximately 13–19% in essential goods imports and a decrease of 9–13% in luxury product imports. Rauh (2010) validated Linder's hypothesis by analysing German manufacturing trade flows with European countries using a gravity model with fixed effects from 2003 to 2008.

Few studies have investigated the applicability of the Linder hypothesis to developing economies, and those have yielded mixed results. In this context, Chow et al. (1999) and Hanink (1988) revealed support for the Linder hypothesis in their research on trade between four East Asian nations and OECD countries. The Hanink hypothesis, which posits that the Linder hypothesis provides a reasonable explanation for nations with incomes above a specific per-capita threshold, was corroborated by manufacturing exports from Singapore and Hong Kong between 1965 and 1990. Given the comparable per capita income levels in Singapore and Hong Kong to OECD nations, trade intensity between these regions and OECD countries exceeded that between Taiwan, Korea, and OECD nations (Chow et al., 1999). A study conducted in six East African countries—Ethiopia, Kenya, Tanzania, Rwanda, Sudan, and Uganda—from 1984 to 1992, using the Tobit model, supports the Linder hypothesis, except for the Tanzanian economy (McPherson et al., 2001). An empirical study by Atabay (2016), covering the period from 1996 to 2010 in BRICS nations, supports the Linder hypothesis. The application of Linder's argument to trade between China and ASEAN-5 countries presents mixed results (Siah et al., 2007). Conversely, empirical analysis of trade between China and its 14 trading partners aligns with this hypothesis (Bo, 2013).

Choi (2002) argues that globalisation significantly strengthens the Linder hypothesis. However, a study by Kitenge (2021) found that the Linder hypothesis has gradually lost relevance during the globalisation process. Hallak (2010) noted that the degree of income similarity positively influences trade contingent upon product quality. Bo (2013) and Viciu et al. (2016) suggest that trade patterns in the emerging Romanian economy are primarily influenced by the country's political and economic conditions, contradicting Linder's assertion. Haq and Meilke (2011) analysed the hypothesis in the agricultural food and beverage products trade across 52 developed and developing economies from 1990 to 2000. Their findings do not support the traditional Linder hypothesis.

Nevertheless, a few studies have documented the nexus between per capita income levels and service trade (Braymen & Briggs, 2015; Fu et al., 2020; Wernerheim & Waples, 2013), mainly from a developed country perspective, yielding mixed and inconsistent results. Overall, the literature survey suggests that most previous studies have focused on similar demand patterns and their

impact on manufacturing sector trade. However, due to the unique nature of services, it is assumed that similar per capita income levels are unlikely to generate more demand for trade in services. To our knowledge, no studies have examined the impact of an overlapping demand structure using various specifications of Linder terms on Indian service exports within the gravity model framework.

2. Data sources and measurement

The selection of countries was based on two criteria: the proportion of India's trade with its import countries and the availability of consistent annual data for service exports. Bilateral trade in services (million US dollars) data were collected from the OECD-WTO Balanced Trade in Services Statistics (BaTIS). Our variable of interest, GDP per capita (current US dollars), was sourced from the World Development Indicators (WDI) database. Data on common borders, common languages, colonial ties, and distance (kilometres) were obtained from the Centre d'Études Prospectives et d'Informations Internationales (CEPII) developed by (Mayer, & Zignago, 2011). The common border variable assumes a value of 1 if the reporter and partner country share a common border and 0 otherwise. Similarly, the common language variable is binary, taking a value of 1 if countries i and j have a common official language and 0 otherwise. Colonial ties are also reported as a binary variable, assuming a value of 1 when countries i and j share a common coloniser and 0 otherwise. The exchange rate is measured as the real exchange rate. The RTA dummy variable assumes a value of 1 if the trade partners are members of one of India's RTAs; otherwise, it takes a value of 0. Before estimation, all variables were converted into natural logarithms to mitigate data measurement errors, multicollinearity, and heteroscedasticity (Chakradhar & Gupta, 2024). The dataset used in this study consists of a balanced panel comprising 595 observations encompassing 35 export countries over 17 years ($T = 17$, $N = 35$; $T \times N = 17 \times 35 = 595$). A detailed description of the variables, data sources, and sample countries is reported in Appendix (Tables A and B).

3. Empirical framework

The panel data gravity model has been extensively employed to evaluate the empirical validity of the Linder hypothesis (Braymen & Briggs, 2015; Choi, 2002; Fu et al., 2020; Wernerheim & Waples, 2013). Tinbergen (1962)

and Pöyhönen (1963) introduced the gravity model. The model posits that the trade volume between two nations is directly proportional to their GDPs and inversely proportional to the physical distance that separates them. The gravity equation for trade can be written as:

$$\ln Trade_{ijt} = \beta_0 + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{jt} + \beta_3 \, dist_{ij} + \mu_{ijt} \quad (1)$$

where $\ln Trade_{ijt}$ represents the log of trade flow between countries i and j at t time, and GDP_i and GDP_j, denote the *GDPs* of countries i and j, respectively. The $dist_{ij}$ variable indicates the geographical distan*i*e between countries i and j. Here, β_0 is a constant and μ_{ijt} denotes the idiosyncratic error term. Panel data methodology offers several advantages compared to time series and cross-section models (Baltagi, 2005). It captures individual heterogeneity, reduces collinearity, as well as capturing more information and variability, which increases degrees of freedom (Wooldridge, 2002). It makes econometric estimations more efficient and reliable. The log-log augmented gravity model can be expressed as follows:

$$\begin{aligned} \ln Trade_{ijt} = {} & \beta_0 + \beta_1 \, Linder_{ijt} + \beta_2 \ln dist_{ij} + \beta_3 \, Border_{ij} + \beta_4 \, Commonlag_{ij} + \\ & + \beta_5 \, Col_{ij} + \beta_6 \ln RE_{ijt} + \beta_7 \, RTA_{ijt} + \delta_i + \gamma_t + \mu_{ijt} \end{aligned} \quad (2)$$

where $\ln Trade_{ijt}$ is the logarithm of service export from India i and partner country j at time t. Following the previous works of Braymen and Briggs (2015) and Hallak (2010), differences in per capita GDP between trade partners are measured using one of the four accepted Linder terms. Each term quantifies the difference in per capita GDP between India and its trading partners as follows: $(\ln y_0 - \ln y_d)^2$, $|y_0 - y_d|$, $\ln|y_0 - y_d|$ and $|\ln y_0 - \ln y_d|$, where y_0 and y_d takes the per capita GDP of India and its trading partners, respectively.

The negative sign of β_1 supports the Linder hypothesis, while a positive sign rejects it. Distance represents the physical distance between export and import countries. Greater distances between trading partners typically correlate with lower levels of service trade due to logistical challenges and higher transportation costs. However, in the modern era, advanced communication technologies and improved transportation infrastructure may reduce the significance of distance as a barrier to service trade. Factors such as digital connectivity and efficient transportation networks can mitigate the impact of distance on service trade (Luong & Nguyen, 2021; Nath & Liu, 2017; Tay, 2018).

This study also incorporates social and cultural proximity indicators, including common borders, language, and colonial history (De, 2013; Rahman et al., 2019; Truong et al., 2019). The influence of (RTAs on service trade is assessed based on whether the RTA explicitly includes provisions addressing the trade of services. The RTA variable is binary, assuming a value of one if India is a member of any of the following RTAs: Asia-Pacific Trade Area (APTA), India—MERCOSUR Preferential Trade Agreement (PTA), ASEAN-India Free Trade Area

(AIFTA), or South Asia Free Trade Area (SAFTA). Building on previous studies which suggest that exchange rates negatively affect trade flows (Kaushal, 2022; Thuy & Thuy, 2019), we have included the real exchange rate as one of the independent variables in the estimation process. δ_i is the country-fixed effect that controls for the impact of infrastructure, Multilateral Trade Resistance (MRT), and other country-specific effects (Jagdambe & Kannan, 2020; Mawusi, 2020). γ_t is the time-fixed effect that captures the volatility in trade due to fluctuations in business cycles and natural shocks in global trade (Jagdambe & Kannan, 2020; Mawusi, 2020). μ_{ijt} is the idiosyncratic error term that varies across cross-sectional units and over time. Model (2) can be estimated using the fixed effects and random effects models. However, traditional panel data estimates produce biased results in the presence of cross-sectional dependency, serial correlation, and heteroscedasticity (Marques & Fuinhas, 2012). Therefore, this study employed FGLS as the primary estimation method, which is suitable for managing panel data that exhibit cross-sectional dependence, serial correlation, and heteroscedasticity (Nguyen et al., 2020). The equation for the FGLS corresponds to Equation (2).

Endogeneity in gravity models, notably with RTAs, arises from reverse causality and omitted variable bias (Baldwin & Taglioni, 2006; Yotov et al., 2016). According to the "natural trading partners" hypothesis, countries often form RTAs with significant trading partners, causing the RTA variable to correlate with the error term. Instrumental variable (IV) estimation like two stage least square (2SLS) can address this, but finding valid instruments is challenging (Greene, 2003), as they must correlate with RTAs without directly affecting trade volumes.

Ideally, the explanatory variables on the right-hand side of the equation should not correlate with the error term, otherwise causes endogeneity. The Durbin-Wu-Hausman test examines the correlation between the residuals (error term) and the explanatory variables (Ullah et al., 2018). To address these endogeneity concerns, we utilise GMM estimation technique. This method offers consistent and efficient estimates, especially in situations where endogeneity may arise from factors like reverse causality or omitted variables (Ullah et al., 2018). GMM has several advantages over other estimators. Firstly, it can account for certain unobservable effects. Secondly, using appropriately lagged values of variables as instruments can control for the potential endogeneity of all explanatory variables, including the lagged dependent variable. Thirdly, GMM produces unbiased and robust results for panel data with short time periods (T) relative to the number of cross-sectional units (N), which fits the nature of our dataset. These benefits of the GMM estimator are particularly useful when N is larger than T (Roodman, 2006). Fourthly, it enhances efficiency by complementing the initial difference equations with equations in levels. By combining regression in differences with regression in levels, it can better address issues related to omitted variables, measurement errors, and potential endogeneity (Arellano & Bover, 1995; Blundell & Bond, 1998).

Therefore, for robustness purposes and to correct the endogeneity issue, our study employs the two-step system GMM estimation method.

$$\ln Trade_{ijt} = \beta_0 + \beta_1 \ln Trade_{ijt-1} + \beta_2 Linder_{ijt} + \beta_3 \ln dist_{ij} + \\ + \beta_4 Border_{ij} + \beta_5 Commonlag_{ij} + \beta_6 Col_{ij} + \beta_7 \ln RE_{ijt} + \\ + \beta_8 RTA_{ijt} + \delta_i + \gamma_t + \mu_{ijt} \quad (3)$$

In the equation provided, $\ln Trade_{ijt-1}$ represents the one-year lag of the dependent variable, while the descriptions of the other variables remain consistent with those in Equation (2). The reliability of the estimators depends on the assumptions that the errors are not serially correlated and that the instruments are genuinely exogenous. To verify these assumptions, we used the Arellano-Bond AR (2) test for autocorrelation to ensure that the errors in the first-difference regression do not show second-order serial correlation (Veeramani & Dhir, 2022). We also used the Hansen (1982) J test for over-identifying restrictions to confirm the exogenous of the instruments. Due to concerns that having too many instruments could reduce efficiency, we decided to keep the number of instruments below the number of groups. This was done by either limiting the number of lags used as instruments or by collapsing the instrument matrix, following Roodman (2009).

4. Results and discussion

Table 1 provides the descriptive statistics for the variables used in the panel data regression analysis. The mean value of service exports is 7.57, with

Table 1. Summary of descriptive statistics

Variable	N	Mean	Std. Dev.	Minimum	Maximum
Service exports	595	7.57	0.96	5.24	10.60
$(\ln y_0 - \ln y_d)^2$	595	28.07	3.05	21.98	32.46
$\lvert y_0 - y_d \rvert$	595	31003.03	24235.04	12.10	101463.31
$\ln\lvert y_0 - y_d \rvert$	595	9.64	1.63	2.49	11.52
$\lvert \ln y_0 - \ln y_d \rvert$	595	5.29	0.29	4.68	5.69
Distance	595	8.62	0.53	7.01	9.61
Common border	595	0.05	0.23	0	1
Common language	595	0.25	0.43	0	1
Colony	595	0.02	0.16	0	1
Exchange rate	595	4.59	0.15	3.81	5.37
RTA	595	0.34	0.47	0	1

Note: The summary of descriptive statistics is calculated using log conversion data.

Source: own elaboration.

a standard deviation of 0.96, while the mean squared log difference in per capita income is 28.07. The absolute difference in per capita income stands at 31,003.03. Additional statistics include a mean distance of 8.62, and binary indicators for common border (0.05), common language (0.25), and colonial history (0.02). The mean exchange rate is 4.59.

Prior to estimating the panel models, three preliminary tests were conducted: the Wooldridge test for autocorrelation (Wooldridge, 2003), the modified Wald statistic/Breusch-Pagan test for heteroscedasticity (Greene, 2003), and the cross-sectional dependence test proposed by Pesaran (2015). The results indicate the presence of serial autocorrelation and heteroscedasticity under fixed-effect specifications (Table 2). Consequently, following the methodology of previous studies (Nguyen et al., 2020), the proposed models are estimated using the FGLS methodology.

Table 2. Diagnostic test results for heteroscedasticity and serial correlation

Test	Endogeneity concern	Test statistic	*p*-value
Modified Wald ($\chi 2$)	Heteroscedasticity	134.85***	0.000
Wooldridge test (F-test)	Serial correlation	69.14***	0.000

Note: *** $p < 0.01$. Modified Wald test for groupwise heteroskedasticity in fixed effect regression model; H_0: sigma(i)^2 = sigma^2 for all i: No heteroscedasticity. Serial correlation: Wooldridge test for autocorrelation in panel data; H_0: No first-order autocorrelation.

Source: own elaboration.

In accordance with the methodology outlined by Rasoulinezhad (2017), we specifically conducted the cross-sectional dependence (CD) test for the time-variant variables within our gravity equation. It is important to note that the CD test is not applicable to time-invariant variables. The results of Pesaran's (2015) cross-sectional dependency test are reported in Table 3. At the 1% significance level, the Pesaran test rejected the null hypothesis of cross-sectional

Table 3. Pesaran (2015) CD test for cross-section independence

Variable	CD-test	*p*-value
Service exports	93.13***	0.000
$(\ln y_0 - \ln y_d)^2$	102.51***	0.000
$\lvert y_0 - y_d \rvert$	29.24***	0.000
$\ln\lvert y_0 - y_d \rvert$	31.26***	0.000
$\lvert \ln y_0 - \ln y_d \rvert$	98.71***	0.000
Exchange rate	–0.016***	0.000

Notes: Under the null hypothesis of cross-section independence, $\mathrm{CD} \sim N(0,1)$; *** $p < 0.01$.

Source: own elaboration.

independence, indicating the presence of cross-sectional dependency within the panel. To address this issue, we incorporated both country- and time-fixed effects into the estimated model, as recommended by Irshad et al. (2018).

4.1. Service sector exports: FGLS model

Table 4 presents the results of the augmented gravity model using the FGLS method, incorporating time and country fixed effects. Across all specifications of the Linder term, the empirical findings consistently show that India's service sector exports increase notably when trading with partners that have substantial disparities in per capita GDP. This finding suggests that India's services exports thrive most in relationships with trade partners characterised by significant income differences. The relationship is consistently positive and statistically significant at the 1% level across all model specifications of the Linder

Table 4. Exports of service sector: GLS method

Variables	$(\ln y_0 - \ln y_d)^2$	$\lvert y_0 - y_d \rvert$	$\ln \lvert y_0 - y_d \rvert$	$\lvert \ln y_0 - \ln y_d \rvert$
With time effect and country effect				
Linder term	0.14***	0.15***	0.33***	1.41***
	(0.36)	(0.01)	(0.02)	(0.04)
Distance	0.39***	0.36***	0.22***	0.38***
	(0.03)	(0.06)	(0.06)	(0.03)
Common border	0.54***	0.76***	0.96***	0.54***
	(0.18)	(0.19)	(0.13)	(0.18)
Common language	0.22***	0.13**	0.11*	0.22***
	(0.04)	(0.06)	(0.07)	(0.04)
Colony	1.72***	1.91***	1.62***	1.72***
	(0.03)	(0.11)	(0.12)	(0.03)
Exchange rate	–0.73***	–0.21*	–0.49**	–0.70***
	(0.11)	(0.18)	(0.19)	(0.11)
RTA	–0.01**	0.61***	0.46***	–0.81**
	(0.03)	(0.06)	(0.06)	(0.03)
Constant	–3.13***	2.41**	–0.02	–6.65***
	(0.73)	(1.15)	(1.18)	(0.77)
Observations	595	595	595	595

Note: Standard errors in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: own elaboration.

term. Based on their analysis of a larger sample of cross-country datasets encompassing 2,683 country pairs, Braymen and Briggs (2015) found that dissimilar per capita income levels across trade partners positively and significantly influence services trade. Our results align with their conclusions. Moreover, the estimated outcomes provide compelling evidence countering the conventional Linder hypothesis concerning India's service exports. This explains why differing demand patterns in countries with varying factor endowments are likely to create a pattern of inter-industry trade in Indian service exports. It is worth noting that there appears to be an absence of any association between nations demonstrating higher domestic sales of services and those exhibiting greater international sales of the same service products. We assert that India's services exports are propelled by comparative advantages rooted in factors such as resource endowments, technological capabilities, and skill levels.

The coefficient of the distance between India and partner countries is positive, with a 1% significance level across all the Linder term specifications. In all the columns in Table 4, the coefficient of service export with respect to distance is positive. The likely reason for this outcome is that advancements in ICT have enabled trade in services globally. An optimal large distance also reflects time-zone differences, allowing for the synchronisation of work, which should positively impact service exports and provide both the exporting and importing countries with high-quality electronic infrastructure. However, the ultimate effect of distance will depend on the composition of aggregate services (Goswami et al., 2012). Moreover, unlike physical goods, service products do not necessarily need physical transportation from one location to another. The nature of services varies; some may require the movement of individuals, while others can be transmitted electronically. Consequently, the importance of distance in services trade may be reduced or even negligible, reflecting the varied modes of delivery inherent in the service sector. This finding is in line with Kimura and Lee (2006), Demirkan et al. (2009), Tay (2018), Tharakan et al. (2005) and Walsh (2006).

Furthermore, Table 4 affirms that control variables such as sharing a common border, common colony and language are found to have a positive and statistically significant effect on Indian service exports at 1% significance levels. The previous literature found that countries sharing a common border tend to increase trade flows due to shorter transportation distances, lower costs, cultural ties, and easier market access (Batra, 2007; Kim et al., 2022). The language variable is statistically significant in all four specifications of Linder term. This demonstrates that the two nations' shared language increased bilateral trade. Our findings supported previous research: language fostered trade as a network and communication instrument (Egger & Lassmann, 2012; Melitz, 2008; Rauch & Trindade, 2002).

Furthermore, the bilateral exchange rate consistently has a significant negative impact on service exports at conventional levels across all four specifica-

tions, respectively. This suggests that as the exchange rate of the host economy rises, the import price of services for partner countries also increases. Consequently, this price escalation diminishes the demand for service imports from the partner country, highlighting the sensitivity of service trade to fluctuations in exchange rates. The findings are consistent with those reported by Sahoo (2018) and are also corroborated by the studies conducted by Sahoo et al. (2019). Finally, the coefficients for the RTA dummy are found to have a negative effect on the export of Indian services, significant at both the 1% and 5% levels across two specifications of the Linder term. Our analysis concludes that the results for the RTA dummy variable are mixed. Prior research by Singh (2015) suggests that in RTAs, India has prioritised swift tariff liberalisation in goods, with less focus on the service sector. Moreover, these agreements largely focus on trade in goods and offer only limited engagement in trade in services. This suggests that India's trade agreements do not align with modern Regional Trade Agreements (RTAs), which typically include provisions beyond the WTO framework and emphasise deeper regulatory standards. As a result, the service sector's exports have not significantly benefited from these agreements.

4.2. Two-step system GMM approach

For robustness purposes, we have used the two-step system GMM approach. The results presented in Table 5 indicate that the impact of all independent variables on service exports remains consistent with the Generalised Least Squares (GLS) estimator.

Table 5. Exports of sector: Two-step system GMM approach

Variables	$(\ln y_0 - \ln y_d)^2$	$\lvert y_0 - y_d \rvert$	$\ln\lvert y_0 - y_d \rvert$	$\lvert \ln y_0 - \ln y_d \rvert$
With time effect and country effect				
Linder term	0.024***	0.030***	0.044***	0.243***
	(0.001)	(0.052)	(0.007)	(0.013)
One lag of SE	0.718***	0.806***	0.831***	0.722***
	(0.008)	(0.005)	(0.003)	(0.008)
Distance	0.090*	0.025**	0.026**	0.088*
	(0.048)	(0.038)	(0.023)	(0.045)
Common border	0.247*	0.217**	0.224***	0.237*
	(0.141)	(0.156)	(0.179)	(0.140)
Common language	0.156***	0.203***	0.185***	0.157***
	(0.036)	(0.045)	(0.023)	(0.036)

cont. Table 5

Variables	$(\ln y_0 - \ln y_d)^2$	$\lvert y_0 - y_d \rvert$	$\ln\lvert y_0 - y_d \rvert$	$\lvert \ln y_0 - \ln y_d \rvert$
Colony	0.797***	0.897***	0.664***	0.789***
	(0.112)	(0.314)	(0.166)	(0.112)
Exchange rate	–0.225***	–0.006*	–0.089***	–0.220***
	(0.019)	(0.030)	(0.023)	(0.019)
RTA	–0.068**	–0.184***	–0.101***	–0.064*
	(0.033)	(0.044)	(0.025)	(0.033)
Constant	–0.229	1.053***	0.294	–0.842*
	(0.493)	(0.404)	(0.248)	(0.453)
Observations	595	595	595	595
Number of countries	35	35	35	35
Number of instruments	24	24	24	24
AR (1) test	–4.42	–4.40	–4.44	–4.43
p-value	0.000	0.000	0.000	0.000
AR (2) test	1.29	0.25	–0.81	1.33
p-value	0.198	0.806	0.417	0.183
Hansen J statistics (p-value)	0.638	0.629	0.623	0.636

Notes: Standard errors are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Hansen J statistics test used to check over-identified restrictions in the estimated models. The AR(1) (AR(2)) test is the Arellano-Bond test for the existence of the first-order (second-order) autocorrelation in residuals.

Source: own elaboration.

The coefficient magnitudes differ when compared with GLS estimators. However, the overall conclusions of the two-step system GMM model align with the GLS model. Furthermore, the lagged dependent variables are found to be significant across all specifications.

Conclusions

The main objective of this study is to examine the impact of income similarity on India's service sector exports from 2005 to 2021 for 35 major import countries. To achieve this, we employ the gravity model of trade using FGLS and two-step system GMM econometric techniques incorporating country and time-fixed effects. The results of the FGLS and GMM estimations show that across all four specifications of the Linder term, there is a positive and significant effect of income dissimilarity on India's service exports, revealing a higher

trade intensity between countries with dissimilar income levels. Our findings indicate that the Linder hypothesis does not hold for Indian service exports at aggregate levels. Countries specialise in producing specific services driven by their comparative advantage, a phenomenon that fosters inter-industry trade. This comparative advantage is influenced by factors such as resource endowments, technological capabilities, and skill levels. The distance's positive and statistically significant coefficient across the Linder term specifications underscores the impact of geographical separation, suggesting that distance plays a positive role in influencing Indian service exports. Additionally, the exchange rate has a negative and significant impact on India's service exports. Furthermore, the positive and statistically significant effects of control variables, such as sharing a common border, a common colony, and a common language, highlight their role in driving Indian service exports. However, our results regarding the RTA dummy variable are inconclusive.

This study contributes to the theoretical discourse by challenging the Linder hypothesis within the context of India's service exports. These findings reveal specific outcomes that confirm expectations based on the traditional Heckscher-Ohlin (H-O) theory, which posits that trade patterns are primarily driven by differences in factor endowments with different supply capabilities. Our findings suggest that income dissimilarity, rather than similarity, drives trade intensity in the service sector, aligning with the recent study by Braymen & Briggs (2015). The present study shows that income disparities can enhance bilateral trade by creating diverse demand patterns and market opportunities, particularly in services. As such, this research adds to the growing body of literature that re-evaluates the applicability of the Linder hypothesis in modern and developing economies, providing new insights into the dynamics of international trade.

In light of our findings, we recommend that policymakers and practitioners in India's service trade sector focus on fostering trade relationships with nations possessing dissimilar per capita income levels. This strategy is likely to enhance trade intensity and provide substantial economic benefits. By targeting countries with diverse income levels, India can exploit potential markets for its service exports, which is crucial for expanding its network of trading partners. Additionally, efforts should be made to reduce trade barriers and improve trade facilitation measures, ensuring smoother and more efficient service trade flows. Finally, in future trade negotiations, India must include provisions for services to enhance trade with RTA member countries.

This empirical study presents evidence refuting the applicability of the Linder hypothesis to Indian service sector exports at aggregate levels. It should be noted that our analysis does not research the influence of a similar demand structure on the disaggregated service sector exports of India. Consequently, a substantive gap exists in our understanding of this specific aspect, warranting further and more detailed investigation to illuminate the nuanced dynamics at play in India's disaggregated service sector exports.

Appendix

Table A. Description of variables and sources

Variable	Description	Sources
Service exports	natural log of export services between India (*i*) and partner Country (*j*)	OECD-WTO Balanced Trade in Service Statistics
Linder term	$(\ln y_0 - \ln y_d)^2$, $\lvert y_0 - y_d \rvert$, $\ln\lvert y_0 - y_d \rvert$ and $\lvert \ln y_0 - \ln y_d \rvert$	Calculated and data is obtained from World Bank Development Indicators (WDI). https://databank.worldbank.org/source/world-development-indicators
Common border	the dummy variable takes the value 1 if country *i* and *j* share a common border or contiguous; 0 otherwise	The Centre d'Études Prospectives et d'Informations Internationales (CEPII) database. http://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele.asp
Common language	the dummy variable takes the value 1 if country *i* and *j* share a common official language; 0 otherwise	The Centre d'Études Prospectives et d'Informations Internationales (CEPII) database. http://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele.asp
Colony	colonial history/ties variables are dummy variables that take value one if the country *i* and *j* share a common coloniser; otherwise, 0	The Centre d'Études Prospectives et d'Informations Internationales (CEPII) database. http://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele.asp
Distance	log of geographical distance between country *i* and *j*, measured in kilometres and as the distance between two capital cities of trading countries	The Centre d'Études Prospectives et d'Informations Internationales (CEPII) database. http://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele.asp
Exchange rate	bilateral exchange rate between *i* and *j* in natural logarithm	World Development Indicators. https://databank.worldbank.org/source/world- development-indicators
RTA	dummy equal to 1 if *i* and *j* country are engaged in a regional trade agreement; 0 otherwise	World Trade Agreement (WTO)-Regional Trade Agreements Database. http://rtais.wto.org/UI/PublicMaintainRTAHome.aspx

Source: own elaboration.

Table B. List of countries in the sample

Country	Region	Income level
Angola	Sub Saharan Africa	Lower Middle Income
Australia	East Asia and Pacific	High Income
Bangladesh	South Asia	Lower Middle Income
Belgium	Europe and Central Asia	High Income
Brazil	Latin America and the Caribbean	Upper Middle Income
Canada	North America	High Income
China	East Asia and Pacific	Upper Middle Income
Denmark	Europe and Central Asia	High Income
France	Europe and Central Asia	High Income
Germany	Europe and Central Asia	High Income
Ireland	Europe and Central Asia	High Income
Indonesia	East Asia and Pacific	Lower Middle Income
Israel	Middle East and North Africa	High Income
Italy	Europe and Central Asia	High Income
Japan	East Asia and Pacific	High Income
Korea, Rep.	East Asia and Pacific	High Income
Malaysia	East Asia and Pacific	Upper Middle Income
Mexico	Latin America and the Caribbean	Upper Middle Income
Netherlands	Europe and Central Asia	High Income
Nigeria	Sub Saharan Africa	Lower Middle Income
Norway	Europe and Central Asia	High Income
Qatar	Middle East and North Africa	High Income
Russia	Europe and Central Asia	Upper Middle Income
Saudi Arabia	Middle East and North Africa	High Income
Singapore	East Asia and Pacific	High Income
South Africa	Sub Saharan Africa	Upper Middle Income
Spain	Europe and Central Asia	High Income
Sweden	Europe and Central Asia	High Income
Switzerland	Europe and Central Asia	High Income
Thailand	East Asia and Pacific	Upper Middle Income
Turkey	Europe and Central Asia	Upper Middle Income
United Arab Emirates	Middle East and North Africa	High Income
United Kingdom	Europe and Central Asia	High Income
United States	North America	High Income
Vietnam	East Asia and Pacific	Lower Middle Income

Source: own compilations based on data from OECD and New World Bank country classifications by income level: 2020–2021.

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