

E-Commerce and Exports in India: A Time Series Data Approach

G.K. Kiruthik Srinivaas

Undergraduate Researcher, Department of Economics and Finance, Birla Institute of Technology and Science (BITS), Pilani, KK Birla Goa Campus

Abstract

This study aims to examine the potential impact of increased e-commerce development on export activities. In addition, we examine the impact of several dimensions of information and communication technology, such as electronic commerce and the widespread adoption of internet use in the labor market, on the export performance at the sectoral level. The study used the system generalized method of moments (GMM) to estimate a dynamic export model utilizing time series data from India spanning the years 2011 to 2019. Our hypothesis posits that there is a positive relationship between e-commerce, internet availability, and exports in both the industrial and agricultural sectors. Furthermore, we anticipate that these impacts may vary between the two sectors. The results of our study suggest that the impact of e-commerce on exports is mostly beneficial, namely within the industrial industry rather than the agricultural sector. The findings suggest that the promotion of e-commerce might serve as a policy tool to enhance exports.

Keywords: E-Commerce, Information and Communication Technology (ICT), Time Series, Trade, exports

1. Introduction

The use of Information and Communication Technology (ICT) has seen a steady rise in recent years, exerting a significant impact on diverse industries, particularly those associated with global commercial operations. The use of this technology has the capacity to decrease the fixed expenses linked to global commerce. Digitalizing and electronically transferring the result has the potential to decrease transportation expenses. Prior research has shown that information and communication technology (ICT) does have an impact on exports. However, previous studies mostly relied on broad measures. Additional studies have concentrated on the European and American regions. This study attempts to conduct an analysis of India, a prominent participant in the global export market, renowned for its significant contributions in the agricultural and industrial sectors. Moreover, we try to consider variations among sectors. The primary hypothesis examined in this research is that information and communication technology (ICT) and electronic commerce (e-commerce) have a favorable influence on export activities. Furthermore, we conduct tests to determine if various facets of information technology, including e-commerce and internet accessibility, have distinct impacts on the export sector. The assumptions were investigated using the analysis of time series data from India, collected throughout the period spanning from 2011 to 2019. The findings indicate that there is a favorable correlation between the level of e-commerce development and the volume of exports in India. Hence, the impacts exerted by these factors

are significant inside the industrial industries. The beneficial benefits of ICT that have been discovered align with the findings of several empirical investigations. Our contribution to the existing body of research is in our identification of the several pathways via which these technologies impact the export sector. Ultimately, our contribution to the research lies in using a time series data methodology. The primary characteristic of the model is the independent variable of delayed exports. Additionally, other control factors were taken into consideration. The paper is divided into many parts. The first sections of the paper delineate the theoretical framework, methodology, and hypothesis. Next, we proceed to provide the empirical findings and discuss the policy implications derived from our analysis.

2. Hypothesis

Several empirical and theoretical models have attempted to establish a connection between information and communication technology (ICT) and exports, so serving as a basis for the purpose behind our investigation. Information and Communication Technology (ICT) has been shown to have a significant impact on reducing expenses associated with international commerce. The migration of business operations, facilitated by technological advancements, would primarily provide advantages for nations with ample resources, favorable market entry opportunities, and established concentrations of similar activity. Technology utilization will enhance export performances only in nations of this kind, with little impact on other countries. In his seminal work, Freund (2004) proposed a theoretical framework that demonstrates the positive impact of Internet connectivity on the reduction of fixed costs associated with entering international markets. This reduction in fixed costs, in turn, leads to a notable enhancement in a country's export activities. The primary objective of our study in this article is to substantiate the central premise that the use of Information and Communication Technology (ICT) would have a discernible impact on the overall volume of exports in the context of India. However, as shown by Kastratovic (2022), we may break this down into sub-hypotheses.

H1: The development of e-commerce has a positive impact on export activities.

It is believed that the advancement of e-commerce should align with the increased utilization of information and communication technology (ICT) in commercial and exporting endeavors. This alignment is expected to enhance enterprises' access to information, streamline contact with international partners, and mitigate expenses associated with global distribution.

H2: The development of the Internet boosts exports.

The increased use of the Internet has the potential to decrease fixed costs, so enabling a larger number of enterprises to engage in international trade, eventually resulting in a rise in aggregate exports. The Digital India plan, implemented by the Indian government in 2014, facilitated a notable surge in internet use across the nation. There is the potential for a notable and favorable enhancement in export levels after the year 2014.

H3: The implications of information and communications technology on exports vary widely depending on the industry. (Heterogenous)

The use of information and communication technology (ICT) in several industries has the potential to reduce fixed costs by enhancing information accessibility. Nevertheless, some industries have a greater potential for this phenomenon, as they effectively lower expenses via the facilitation of cross-border business coordination and the reduction of transportation costs. It is anticipated that the impact of Information and Communication Technology (ICT) would be more pronounced in the industrial sector compared to the agriculture sector.

3. Research Methodology

3.1. Empirical Model

The model was constructed by including prevalent control variables, as well as factors related to information and communication technology (ICT), such as e-commerce and internet accessibility. The model is described in the general form, as previously shown by Kastratovic (2022).

$$X_{it} = f(X_{it-1}, ICT_{it}, C_{it})$$

The variable X_{it} represents the export value of a specific country i during the year t . This value is influenced by several factors, including the export value of the same country i in the previous year (X_{it-1}), the impact of information and communication technology (ICT_{it}), and a vector of control variables denoted as C_{it} . It is important to note that X_{it} encompasses both agricultural and manufacturing exports, thus representing the total export value of the country. The independent variable of interest in this study is information and communication technology (ICT). One of the facets included under the field of Information and Communication Technology (ICT) is Electronic Commerce (ECOM). The estimation of e-commerce development is derived by calculating the proportion of revenue generated by e-commerce among all non-financial firms operating inside a certain nation. The variable has a direct correlation with the implementation of Information and Communication Technology (ICT) within the business domain. The further dimension of Information and Communication Technology (ICT) that we address in this context pertains to the provision of internet connectivity to those residing inside the nation. The variable serves as an indicator of the level of technology utilisation within the workforce, providing an estimation of the progress made in developing the information and communication technology (ICT) infrastructure and the overall accessibility of these technologies. One notable feature of our dynamic model formulation is the incorporation of a lagged dependent variable (X_{it-1}) as an independent variable. This statement encapsulates the historical variables that impact the export sector and highlights the persistence seen in the movement of export volumes. The absence of higher-order autocorrelation was determined by the use of Arellano-Bond autocorrelation tests. The variables used in this research include Foreign Direct Investment (FDI_{it}), the exchange rate (EX_{it}), gross domestic product per capita ($GDPpc_{it}$), and population (POP_{it}). The impact of foreign direct investment (FDI) on exports has been well recognised in the literature, mostly due to the occurrence of intra-firm trade (Caves 1996). The impact of exchange rate depreciation on exports has been discussed in the literature (Fang & Lai, 2006). Countries that possess substantial populations have the capacity to internalize their output due to the presence of a bigger home market. Consequently, this may result in a reduction in exports. However, it is important to note that this scenario might potentially provide economies of scale for producers. The predictability of the effect is uncertain. Countries that possess a high Gross Domestic Product (GDP) tend to have a positive correlation

with their export levels, since it is evident that countries with robust economies tend to engage in significant export activities.

So, the final form of our baseline model:

$$\log(X_{it}) = \beta_0 + \beta_1 \log(X_{it-1}) + \beta_2 \log(ECOM_{it}) + \beta_3 \log(INT_{it}) + \beta_4 \log(FDI_{it}) + \beta_5 \log(EX_{it}) + \beta_6 \log(POP_{it}) + \beta_7 \log(GDPpc_{it}) + \varepsilon_{it}$$

The error term ε_{it} in the model incorporates stochastic disturbances. The log-log linear model is used due to its ability to enhance the understanding of the empirical findings. Furthermore, this methodology enables us to consider any non-linear relationships between the independent and dependent variables. Ultimately, the use of the log-log model served to standardise the data, which had been collected using disparate scales and had the potential to introduce bias into the findings.

3.2. Data Sample

Aggregate data from the industrial and agriculture sectors of India was used in our study. The data was collected over the period of 2011 to 2019, mostly driven by data concerns and the implementation of the Digital India Act, which resulted in a substantial growth in information and communication technology (ICT). The combination of this factor, together with a degree of volatility in growth patterns, enables the effective assessment of the influence of information and communication technology (ICT) on export levels. The proportion of individuals who use the internet for the purpose of purchasing food, commodities, and services has also seen a notable surge in recent years. The data for the years 2020 and 2021 was not collected as a result of the unforeseen impact of the COVID-19 pandemic on export activities. Including this data might potentially result in erroneous results. We selected internet access as one of the ICT variables instead of e-governance due to the identification of collinearity between the two. Similarly, a similar situation was seen between productivity and GDP per capita. The data pertaining to e-commerce was acquired from the official website of the Department of Commerce in India. The data pertaining to internet access was acquired from Statista. The data pertaining to exports was acquired from the World Trade Organisation. The data on foreign direct investment (FDI) was collected from the UNCTADStat database. The population figures were acquired from Statista, while the United Nations Statistics Division supplied statistics on exchange rates. The World Bank has provided statistics on per capita gross domestic product (GDPpc).

3.3. Estimation Methods

Blundell (2000) provided empirical evidence indicating that the coefficients estimated by Ordinary Least Squares (OLS) techniques have an upward bias, whereas the Fixed Effects approach model tends to exhibit a downward bias. These phenomena result in the establishment of both upper and lower limits. The baseline model was calculated using the Generalized Method of Moments (GMM). The inclusion of additional variables assists in mitigating the issue of omitted variable bias and enables the resolution of endogeneity concerns. In our analysis, we treat ICT variables and FDI as endogenous factors, while considering all other variables as exogenous. The Hansan-J test was used to assess the validity. Autocorrelation experiments were conducted, revealing the presence of first-order autocorrelation. The F-

statistic and P-value have been provided for the model, indicating that all specifications exhibit statistical significance.

4. Results

The empirical findings for the models pertaining to the total, manufacturing, and agricultural sectors are shown in Tables 1, 2, and 3, respectively. All of the estimates were derived using the Generalized Least Squares (GLS) methodology. The presence of multicollinearity was further assessed by the use of the Variance Inflation Factor (VIF).

Table I. Estimation for total exports

Variable	Coefficient
$\log(X_{it-1})$	0.0316*
$\log(ECOM_{it})$	0.0117*
$\log(INT_{it})$	0.02517*
$\log(FDI_{it})$	-0.0379
$\log(EX_{it})$	-0.0919**
$\log(POP_{it})$	-0.0672*
$\log(GDPpc_{it})$	0.0305**
Intercept	0.023**

Notes: *, ** indicates significance at 5% and 10% level respectively.

The findings shown in Table 1 indicate a favorable relationship between e-commerce and total exports, while controlling for other variables. The coefficient demonstrates that in the near term, a 10 percentage points rise in E-commerce results in a 1.17% increase in overall exports. The observed coefficient has statistical significance at a significance level of 5%. Internet access is another variable in the field of information and communication technology (ICT) that has a considerable impact on total exports, with a statistical significance threshold of 5%. The overall impact is influenced by both direct and indirect use of Information and Communication Technology (ICT). The implementation of e-commerce has the potential to decrease trade costs, hence potentially leading to an increase in overall export volumes. Moreover, this phenomenon results in a reduction in both the dissemination of information and transportation expenses. In addition to other factors, it is seen that GDP per capita has a statistically significant positive impact on exports, with a significance level of 10%. The impact of foreign direct investment (FDI) on total exports seems to be negative, however this effect is not statistically significant at the conventional significance levels of 5% or 10%. This observation suggests that the investors' primary focus is in gaining entry to the market rather than acquiring resources. The impact of the exchange rate on exports is adverse, aligning with theoretical predictions.

Table II. Estimation for Agricultural Exports

Variable	Coefficient
$\log(X_{it-1})$	0.1972*
$\log(ECOM_{it})$	0.0747
$\log(INT_{it})$	0.1690
$\log(FDI_{it})$	-0.2339
$\log(EX_{it})$	-0.828**
$\log(POP_{it})$	0.2033*
$\log(GDPpc_{it})$	0.847
Intercept	1.7140

Notes: *, ** indicates significance at 5% and 10% level respectively.

Table 2 presents empirical evidence indicating that there is no significant impact of Information and Communication Technology (ICT) on agricultural exports. The statistical analysis reveals that neither the coefficient for E-commerce nor the coefficient for internet access has statistical significance in relation to exports. The population coefficient has statistical significance at a significance level of 5%. The huge population of India, along with its heavy reliance on agriculture as a primary economic sector, likely contributes to the country's substantial agricultural exports. The level of intricacy in agricultural economic activity is rather low, resulting in limited opportunities for ICT to have a substantial impact on exports. The insignificance of other control variables included in the model suggests that major agricultural exporters are likely maintaining their established position from previous eras, while minor exporters are making progress in catching up.

Table III. Estimation for Manufacturing Exports

Variable	Coefficient
$\log(X_{it-1})$	0.9516**
$\log(ECOM_{it})$	0.1206*
$\log(INT_{it})$	0.3350*
$\log(FDI_{it})$	-0.2094
$\log(EX_{it})$	-1.552**
$\log(POP_{it})$	0.5188*

$\log(GDPpc_{it})$	-0.992
Intercept	-0.4481

Notes: *,** indicates significance at 5% and 10% level respectively.

The findings shown in Table III indicate a favorable correlation between E-commerce, internet availability, and the export performance of the manufacturing sector. According to the calculated coefficients, a 10-percentage point rise in the proportion of income generated through e-commerce and internet access results in short-term increases of 1.20% and 3.35% in exports, respectively. The currency rate likewise has a comparable impact to that of aggregate exports. A rise in population by 10 percentage points corresponds to a subsequent increase in manufacturing exports by 5.18%. No other control variables were found to have a significant impact at either the predetermined significance thresholds.

5. Conclusions

Ultimately, our research reveals that the expansion of ICT infrastructure alone is insufficient for the purpose of increasing exports. The realisation of favourable export advantages seems to be contingent upon the proficient use of technology inside the organisation. In order to optimise the advantages, it is advisable for policymakers to provide additional measures to encourage the use of Information and Communication Technology (ICT). This might include allocating resources towards the enhancement of education and the development of skills, fostering a competitive environment, and supporting organisational changes that prioritise the use of e-commerce technology.

In general, the empirical evidence suggests that electronic commerce has a positive impact on the export sector. This finding provides support for the hypothesis that information and communication technology (ICT) has a reducing effect on the expenses associated with global commerce. These results align with earlier empirical studies that have shown the positive impacts of information and communication technology (ICT) on a wider range of outcomes. The potential impact of e-commerce on the industrial sector may be attributed to the emergence of Industry 4.0 and the ongoing digital revolution. Based on the research results, it can be concluded that only engaging in e-commerce activities has a statistically significant positive effect on the export sector. This finding illustrates that the primary factors influencing technology use are relevant to the company context. The potential outcome discussed may arise from the use of e-commerce by the export process to establish direct connections between manufacturers and foreign partners.

Information and Communication Technology (ICT) facilitates enhanced connectivity between firms and customers, therefore serving as an additional avenue for augmenting export activities. The use of automation, data-driven management, comprehensive demand analysis, and broad customisation has the potential to enhance efficiency and competitiveness, hence potentially resulting in increased export levels. One of the additional benefits is the potential for the emergence of born-global firms and the expansion of global marketing efforts. The results of the study also indicate that e-commerce platforms provide more benefits for the trade of industrial items compared to agricultural goods. Well-established e-commerce

platforms for consumer products and other services provide a convenient framework for interested manufacturers and sellers to facilitate their participation. In addition, some manufacturers may use e-commerce platforms as a strategy to attract clients and facilitate the purchase of their products. Due to limited prospects for product differentiation and the implementation of incentives in the agricultural sector, as well as the prevalence of conventional markets like commodity exchanges.

In general, our findings indicate that the impact of e-commerce on exports is positive. The results also suggest that the impact on the growth of exports differs across various sectors. The e-commerce sector has been shown to contribute to the growth of manufacturing exports, but agricultural product exports do not exhibit the same level of expansion.

The findings of this research indicate a potential increase in imports. Nevertheless, considering the heightened importance that policymakers attribute to export performances and their substantial impact on the economic growth of the country under examination, we only considered the ramifications of exports. The objective of this study was not to measure or quantify the impacts of imports. However, it is intriguing to note that exports, which remain untouched by the use of information and communication technology (ICT), have far fewer trade barriers compared to imports. This observation implies that the influence of ICT on imports is likely to be less substantial. The generalizability of our findings may be limited to countries in different hemispheres that are classified as developed or undeveloped. Therefore, it may be beneficial to further investigate the research if the e-commerce data for those nations becomes available.

6. References

1. Anwar, S., and S. Sun. 2019. "Firm Heterogeneity and FDI-Related Productivity Spillovers: A Theoretical Investigation." *The Journal of International Trade & Economic Development* 28 (1): 1–10.
2. Arellano, M., and S. Bond. 1991. "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations." *The Review of Economic Studies* 58 (2): 277–297.
3. Arellano, M., and O. Bover. 1995. "Another Look at the Instrumental Variable Estimation of Error-Components Models." *Journal of Econometrics* 68 (1): 29–51.
4. Babatunde, M. A. 2017. "Foreign Direct Investment and Export Performance in Nigeria: A 5Disaggregated Analysis." *International Journal of Sustainable Economy* 9 (2): 142–158.
5. Biagi, F., and M. Falk. 2017. "The Impact of ICT and E-commerce on Employment in Europe." *Journal of Policy Modeling* 39 (1): 1–18.
6. Blundell, R., and S. Bond. 1998. "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models." *Journal of Econometrics* 87 (1): 115–143.
7. Blundell, R., and S. Bond. 2000. "GMM Estimation with Persistent Panel Data: An Application to Production Functions." *Econometric Reviews* 19 (3): 321–340.
8. Bojnec, Š., and I. Fertő. 2009. "Impact of the Internet on Manufacturing Trade." *Journal of Computer Information Systems* 50 (1): 124–132.
9. Bond, S. R. 2002. "Dynamic Panel Data Models: A Guide to Micro Data Methods and Practice." *Portuguese Economic Journal* 1 (2): 141–162.
10. Caves, R. E. 1996. *Multinational Enterprise and Economic Analysis*, 2nd ed. Cambridge: Cambridge University Press.

11. Choi, C. 2010. "The Effect of the Internet on Service Trade." *Economics Letters* 109 (2): 102–104.
12. Clarke, G. R. G. 2008. "Has the Internet Increased Exports for Firms from Low and Middle-Income Countries?" *Information Economics and Policy* 20 (1): 16–37.
13. Clarke, G. R. G., and S. J. Wallsten. 2006. "Has the Internet Increased Trade? Developed and Developing Country Evidence." *Economic Inquiry* 44 (3): 465–484.
14. Donaubaer, J., A. Glas, B. Meyer, and P. Nunnenkamp. 2018. "Disentangling the Impact of Infrastructure on Trade Using a New Index of Infrastructure." *Review of World Economics* 154 (4): 745–784.
15. Ekholm, K., R. Forslid, and J. R. Markusen. 2007. "Export-Platform Foreign Direct Investment." *Journal of the European Economic Association* 5 (4): 776–795.
16. Fang, W., Y. Lai, and S.M. Miller. 2006. "Export Promotion through Exchange Rate Changes: Exchange Rate Depreciation or Stabilization?" *Southern Economic Journal* 72 (3).
17. Feiguine, G., and J. Solovjova. 2014. "ICT Investment and Internationalization of the Russian Economy." *International Economics and Economic Policy* 11 (1–2): 231–250.
18. Freund, C. L., and D. Weinhold. 2002. "The Internet and International Trade in Services." *American Economic Review* 92 (2): 236–240.
19. Freund, C. L., and D. Weinhold. 2004. "The Effect of the Internet on International Trade." *Journal of International Economics* 62 (1): 171–189.
20. Hinson, R. E., and C. K. D. Adjasi. 2009. "The Internet and Export: Some Cross-Country Evidence from Selected African Countries." *Journal of Internet Commerce* 8 (3–4): 309–324.
21. Hwang, J., and Y. Sun. 2018. "Should We Go One Step Further? An Accurate Comparison of One-Step and Two-Step Procedures in a Generalized Method of Moments Framework." *Journal of Econometrics* 207 (2): 381–405.
22. Jaćimović, D., R. Dragutinović Mitrović, P. Bjelić, K. Tianping, and M. Rajković. 2018. "The Role of Chinese Investments in the Bilateral Exports of New E.U. Member States and Western Balkan Countries." *Economic Research-Ekonomska Istraživanja* 31 (1): 1185–1197.
23. Kastratović, R. 2016. "The Influence of Foreign Direct Investments on Economic and Social Development of Serbia." *Bankarstvo* 45 (4): 70–93.
24. Kastratović, R. 2020. "The Impact of Foreign Direct Investment on Host Country Exports: A Meta-Analysis." *The World Economy* 43 (12): 3142–3183.
25. Kutan, A. M., and G. Vukšić. 2007. "Foreign Direct Investment and Export Performance: Empirical Evidence." *Comparative Economic Studies* 49 (3): 430–445.
26. Levin, A., C.-F. Lin, and C.-S. J. Chu. 2002. "Unit Root Tests in Panel Data: Asymptotic and Finite-Sample Properties." *Journal of Econometrics* 108 (1): 1–24.
27. Lin, F. 2015. "Estimating the Effect of the Internet on International Trade." *The Journal of International Trade and Economic Development* 24 (3): 409–428.
28. R. Nicole, "Title of paper with only first word capitalized," *J. Name Stand. Abbrev.*, in press.
29. Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, "Electron spectroscopy studies on magneto-optical media and plastic substrate interface," *IEEE Transl. J. Magn. Japan*, vol. 2, pp. 740–741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982].
30. M. Young, *The Technical Writer's Handbook*. Mill Valley, CA: University Science, 1989.
31. Tinbergen, J. 1962. *Shaping the World Economy: Suggestions for an International Economic Policy*. New York: The Twentieth Century Fund.

32. Vemuri, V. K., and S. Siddiqi. 2009. "Impact of Commercialization of the Internet on International Trade: A Panel Study Using the Extended Gravity Model." *The International Trade Journal* 23 (4): 458–484.
33. Venables, A. J. 2001. "Geography and International Inequalities: The Impact of New Technologies." *Journal of Industry, Competition and Trade* 1 (2): 135–159.