

**ICT DEVELOPMENT AND EXPORT VOLUME IN UZBEKISTAN:
REGIONAL PANEL DATA ANALYSIS (2015–2024)***Sadriddinov Ulugbek Jaloliddin ugli**Assistant, Department of International Financial Management,
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Abstract: This article quantitatively studies the impact of the Information and Communication Technology (ICT) Development Index (IDI) on export volume based on panel data for 15 administrative-territorial units of Uzbekistan for 2015–2024. The annual export volume of the regions (in million US dollars, log) was taken as the dependent variable, and the IDI index calculated based on the ITU methodology was selected as the main independent variable. GDP (in US dollars, log), investment volume (log), urbanization level, and trade openness indicators were included as control variables. Four models were used, including random effects (RE), fixed effects (FE), and their robustness versions. A total of 150 observations were analyzed. The results showed that the IDI index had a statistically significant positive effect only in the fixed effects model ($\beta=1.513$, $p<0.05$), while in other models this effect was not statistically confirmed. GDP and investment had a strong positive effect in all models, while urbanization was not significant in any model. Trade openness was significant in the RE and FE models, and partially significant in the robustness versions. The results of the study show that the impact of ICT development on export volume is complex and not one-sided in the context of the regions of Uzbekistan, and relevant policy conclusions are drawn.

Keywords: ICT development index – IDI, export volume, panel data, fixed effects model, Uzbekistan, digitalization, trade openness.

Introduction

The penetration of digital technologies into the economy has accelerated dramatically globally over the past decade. Information and communication technologies (ICTs) are now fundamentally transforming not only manufacturing and service sectors, but also international trade. In countries and regions where ICTs are developed, market entry costs are reduced, information asymmetries are reduced, and exporters' connections with foreign markets are strengthened – which directly affects export volumes.

Uzbekistan has made significant steps in this direction in recent years. As a result of economic reforms implemented since 2017, the Digital Uzbekistan – 2030 strategy, and the expansion of the IT Park network, the country's ICT sector is developing rapidly. By 2023, Uzbekistan's IT services exports will reach 344 million US dollars,

more than doubling compared to a year earlier. The government has set a goal of increasing this figure to \$5 billion by 2030.

But the question arises: does the development of ICT really have a significant impact on the volume of regional exports? How is this relationship manifested across regions? In order to answer these questions, the study conducted a panel data analysis for 15 territorial units of Uzbekistan for 2015–2024.

The relevance of the study is manifested in several aspects. First, in the context of Uzbekistan, there are still very few empirical studies studying the relationship between ICT and exports at the regional level. Second, there are significant differences in the level of digitalization between regions in the country, and these differences are expected to affect export potential. Third, the results of the study can serve to link regional ICT policies with export strategies.

Literature review

The relationship between ICT and international trade has been studied in many studies, and the results are mostly positive. However, the strength and direction of the effect are found to vary depending on the country, region, and indicators used. For example, Fahlevi and others (2024) studied the impact of the ICT development index on trade volume using OLS, FE, RE, FMOLS, DOLS, and robustness models for Pakistan and its 13 trading partners over the period 1990–2020. The results confirmed that the IDI has a strong and persistent positive impact on exports and imports in all models. The authors noted that for developing countries, increasing investment in ICT infrastructure can significantly increase trade volume. In addition, Sobirov and others (2025) examined the long-term impact of ICT development on economic growth using FMOLS, DOLS and CCR methods, covering Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan for the period 2000–2022. The striking result is that ICT development has a negative impact on economic growth in the long run. The authors explain this by the region's low technological adoption capacity and insufficient level of institutionalization. This finding reminds us that we should not always view the impact of ICT as unilaterally positive.

Handoyo and others (2024) examined the relationship between ICT indicators – number of internet users, mobile subscribers, and broadband – and manufacturing exports classified by technology intensity over the period 2010 – 2018, covering 108 OECD and non-OECD countries. The study found that ICT indicators do affect exports, but the strength and direction of the effect differed across country groups – positive for developing countries but not the same. Another study on the topic is by Anon Higon and Bonvin (2022). They examined the impact of ICT use on export performance for Spanish manufacturing firms over the period 2000–2014 using a dynamic panel model. The results showed that the use of ICT tools such as websites directly increases the likelihood of firms entering export markets, but the impact on

export intensity mainly operates through the channel of production efficiency. In the case of Uzbekistan, Sharipov et al. (2026) studied the impact of digital trading platforms on high-tech exports in Uzbekistan and proved that digital infrastructure plays an important role in export growth. At the same time, they identified barriers to the adoption of digital platforms by the country's exporters.

Overall, the literature review shows that the relationship between ICT and exports is multifactorial and context-dependent. A specific empirical study examining this relationship at the regional level of Uzbekistan using the IDI index is missing in the literature—which is the main contribution of this work.

Methodology

Database and variables: The study used panel data covering 2015–2024 for 15 administrative-territorial units of Uzbekistan. A total of 150 observations (15 regions × 10 years) were involved in the analysis. The data were taken from the official regional statistical collections of the Statistics Agency of the Republic of Uzbekistan. Since it was possible to calculate the IDI index for the period up to 2015, the observation period begins from this year. The annual export volume of the regions (in million US dollars, in log form – log_export) was selected as the dependent variable. The IDI index (idi), calculated based on the ITU methodology, was included as the main independent variable - this index is a composite indicator combining ICT use, ICT access and ICT skills. The following control variables were used: GDP per capita (log_gdp), investment per capita (log_invest), urbanization level (urbanization), and trade openness (trade_open). Variables expressed in monetary terms were entered in natural logarithm form, which allows the coefficients to be interpreted as elasticities.

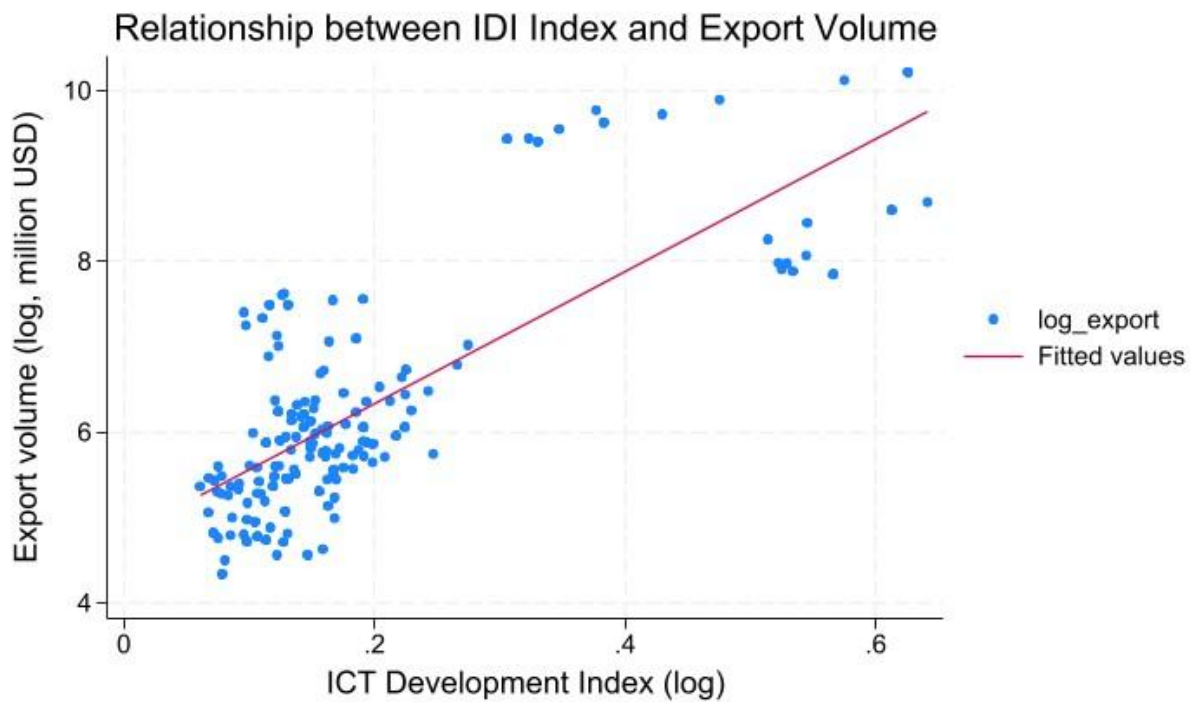
The following general panel data model was used in the study:

$$\begin{aligned} \log_export_{it} &= \beta_0 + \beta_1idi_{it} + \beta_2\log_gdp_{it} + \beta_3\log_invest_{it} \\ &+ \beta_4urbanizatsiya_{it} + \beta_5trade_open_{it} + u_i + \varepsilon_{it} \end{aligned}$$

Here *i* is the area index, *t* is the year index, *u_i* is the individual (area) effect, *ε_{it}* is the error term. To account for individual area effects, a random effects model (RE) and a fixed effects model (FE) were used in parallel. In order to check heteroskedasticity and robustness to external influences, robustness versions of both models were calculated. All calculations were performed in the Stata statistical program.

Results

Figure 1: Relationship between IDI index and export volume (scatter graph).



Source: compiled by the author in Stata.

Figure 1 shows the bidirectional relationship between the IDI index (log) and export volume (log). The trend line shows a clear positive trend as the IDI value increases, exports also tend to increase. However, the significant dispersion of the points from the trend line indicates that this relationship cannot be explained in isolation from other factors. This justifies the need for regression analysis.

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	(1)	(2)	(3)	(4)
VARIABLES	RE	FE	RE robust	FE robust
idi	0.906 (0.685)	1.513** (0.742)	0.906 (1.005)	1.513 (1.181)
log_gdp	0.693*** (0.0889)	0.398*** (0.116)	0.693*** (0.173)	0.398*** (0.131)
log_invest	0.175*** (0.0412)	0.188*** (0.0429)	0.175** (0.0693)	0.188** (0.0711)
urbanizattion	0.00595 (0.00681)	0.0110 (0.0662)	0.00595 (0.00495)	0.0110 (0.144)
trade_open	1.116*** (0.239)	0.836*** (0.258)	1.116** (0.550)	0.836 (0.530)
Constant	-2.203*** (0.807)	-0.0622 (3.376)	-2.203 (1.422)	-0.0622 (7.270)
Observations	150	150	150	150
R-squared	0.908	0.855	0.908	0.855
Number of region_id	15	15	15	15

Source: compiled by the author in Stata.

Table 1 presents the results of the four models. When the results are examined by variables, the ICT development index (IDI) showed a statistically significant positive effect only in the FE model ($\beta=1.513$, $p<0.05$). In the RE model, the coefficient is also positive ($\beta=0.906$) and is large in size, but not statistically significant (standard error: 0.685). In the robustness versions (RE robust and FE robust), the effect of IDI was not statistically confirmed due to the increased standard errors. This means that the positive relationship between IDI and exports is more manifested through regional variations (within variation over time), that is, when the IDI in a region increases, the region's own exports also tend to increase. However, this effect is not completely resistant to the robustness test, so the results should be interpreted with caution. Another important variable, GDP (\log_gdp), was positive and statistically highly significant in all four models ($p<0.01$). The coefficient is 0.693 in the RE model, 0.398 in the FE model, and the same values were maintained in the robustness versions. That is, when the regional GDP increases by 1 percent, the export volume is expected to increase by about 0.40 percent in the FE model and by 0.69 percent in the RE model. This result is fully consistent with the theoretical expectations that economic growth directly contributes to export potential. Investment (\log_invest) also yielded a positive and significant result in all models: $p<0.01$ in the RE and FE models, $p<0.05$ in the robustness versions. The coefficient ranges from 0.175 (RE) to 0.188 (FE) – a relatively small but consistent effect. This indicates that capital investments in the regions strengthen export infrastructure and production capacity. The level of urbanization was not statistically significant in any model ($p>0.1$ in all models). The coefficient is positive and very small (0.00595–0.0110). This means that for the regions of Uzbekistan, the increase in the share of urban population has a negligible direct impact on export volumes. It is likely that urbanization affects the domestic market and the service sector more than exports. Trade openness ($trade_open$) showed a value of $\beta=1.116$ ($p<0.01$) in the RE model, $\beta=0.836$ ($p<0.01$) in the FE model. It is also significant in the RE robust model ($p<0.05$). However, it is lost in the FE robust model ($\beta=0.836$, standard error 0.530). This is due to the expansion of standard errors, and the positive effect of trade openness on exports remains as a general trend, but when taking into account heteroskedasticity, this effect partially loses its stability.

The results obtained allow us to draw several important conclusions. For example, firstly, the fact that the IDI index is significant only in the FE model and is not confirmed in the robustness versions suggests that the impact of ICT development on export volume is not yet strong and stable for the regions of Uzbekistan. This is consistent with some studies in the literature (Sobirov et al., 2025), they also showed that the effect of ICT for the region is limited. However, this does not mean that ICT is insignificant - but rather that its effect is more pronounced over time (within

variation), that is, as regions move forward on the path of digitalization, exports tend to grow.

Secondly, the stable and strong positive effect of GDP and investment in all models indicates that the main driving forces of regional export volume are currently economic growth and capital investments. ICT complements these factors, but is not yet a strong independent factor.

Third, the lack of significant urbanization is an important finding for Uzbekistan - urbanization may affect exports not directly, but indirectly (through production, education, services).

Conclusion and recommendations

This study examines the relationship between the ICT Development Index (IDI) and export volume for 15 regional units of Uzbekistan for 2015–2024 using a panel data approach. The main conclusion is that the impact of the IDI index on export volume is statistically confirmed in the fixed effects model and is positive ($\beta=1.513$, $p<0.05$), but this effect is not confirmed in the robustness versions. GDP and investment have a stable and significant positive impact on exports in all models. The level of urbanization, however, was not significant in any model. Based on these results, the following recommendations were developed:

First, it is necessary to implement regional ICT policies consistently and in the long term. The fact that the IDI effect manifests itself over time (significant in the FE model) indicates that policy investments do not yield immediate results, but rather over time. Therefore, digitalization programs should be implemented based on a long-term strategy, not short-term goals.

Second, to strengthen the link between exports and ICT, it is necessary to create digital export platforms, e-commerce infrastructure and mechanisms that connect exporters with digital tools in the regions. It is not enough to increase the IDI index alone - this index must be oriented in a way that has a practical impact on export activity.

Third, GDP and investment have been identified as the strongest and most stable factors. Therefore, policies that stimulate regional economic growth and capital investment should be an integral part of the export strategy.

For future studies, in order to more accurately assess the relationship between ICT and exports, it is recommended to: (1) extend the observation period; (2) take into account the endogeneity problem through GMM or IV approaches; (3) analyze ICT indicators separately by separate components (input, use, skills).

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