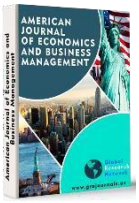

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Article

Econometric Assessment of the Impact of Electronic Commerce Infrastructure on the Dynamics of Economic Growth of Regions Based on Resource Market Indicators

Ravshanova Muhayyo Makhmanazarovna*[1]

1. Associate Professor, Department of Economics, University of Economics and Pedagogy

* Correspondence: muhayyo.ravshanova@mail.ru

Abstract: In this scientific study, the impact of e-commerce infrastructure on the dynamics of regional economic growth was assessed using econometric approaches based on resource market indicators. The impact of the level of digital infrastructure, internet coverage, logistics capabilities, the development of electronic payment systems, and the volume of electronic trade on regional economic growth was determined using panel data regression. The results of the study show that e-commerce infrastructure has a significant positive impact on the growth of the gross regional product (GRP) of regions. In particular, it was substantiated that the development of internet coverage and payment systems are important factors that directly contribute to economic activity. The results obtained are of practical importance in the formation of regional economic policy and strategies for the development of digital infrastructure.

Keywords: E-Commerce, Digital Infrastructure, Resource Market, Regional Economic Growth, Econometric Analysis, Panel Regression, Internet Coverage

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1. Introduction

In the current era of rapid digital transformation, e-commerce has become one of the most important drivers of the global economy. The digitization of the world economy, the automation of business processes, the optimization of the logistics chain, the transition of payment systems to online forms, and the fundamental changes taking place in the shopping culture of consumers have dramatically increased the importance of e-commerce in the economy. The experience of developed countries shows that e-commerce has a significant impact not only on the expansion of the domestic consumer market, but also on labor productivity, the efficiency of resource allocation, the diversification of business models, and the economic activity of regions.

The development of e-commerce infrastructure at the regional level is becoming one of the important factors of economic growth. In particular, the expansion of Internet coverage, the development of high-speed data transmission networks, the widespread use of electronic payment systems, the improvement of logistics infrastructure, the digitization of warehouse services, and the rapid growth of electronic trading platforms directly affect the economic activity of regions. In regions with a highly developed e-commerce infrastructure, the number of small businesses is rapidly increasing, the service market is

expanding, the efficiency of resource allocation within the market is increasing, and the volume of gross regional product is steadily increasing.

At the same time, the relationship between resource market indicators and e-commerce infrastructure is also of great scientific importance from the point of view of economic theory. The resource market is an economic area where labor, capital, technology and information resources are distributed based on supply and demand, and digital infrastructure has a significant impact on the effective functioning of this market. For example, the wide coverage of the Internet in regions increases the possibilities of remote work in the labor market, electronic payment systems accelerate capital turnover, and the digitalization of logistics systems optimizes the time it takes for goods to reach the market. As a result, e-commerce infrastructure stimulates economic growth by influencing the efficiency of resource markets.

Studies conducted by international organizations also confirm that the role of digital infrastructure in economic growth is increasing year by year. Studies show that a 10% increase in broadband Internet access increases GDP growth by an average of 1.3%. Also, the widespread introduction of electronic payment systems reduces transaction costs and increases the speed of economic turnover by creating a cashless economy. E-commerce platforms expand the opportunities for small and medium-sized businesses to enter the markets.

The importance of e-commerce is also growing rapidly in Uzbekistan. The development of the digital economy is identified as one of the priority areas in the state strategies until 2030. Over the past five years, the coverage of the Internet network has expanded significantly, electronic payment systems - such as Uzum Pay, Payme, Apelsin, Click - have taken an important place in economic circulation, logistics services and courier systems have been modernized, and the number of e-commerce platforms has increased sharply. Nevertheless, significant differences in the development of e-commerce infrastructure across regions remain. It is these differences that may be one of the main factors in the differences in economic growth rates.

The relevance of this study is that to date, there is a lack of comprehensive scientific work aimed at econometrically assessing the impact of e-commerce infrastructure on economic growth in the regions of Uzbekistan based on resource market indicators. Although there are many studies in the scientific literature on the general economic impact of e-commerce, studies on determining the exact measured impact in a regional context, especially through a panel data model, are rare.

Literature Review

The impact of e-commerce infrastructure on regional economic growth, especially in resource-based economies, is at the center of current academic debate. In the context of the high dependence of Central Asian countries, particularly Uzbekistan, on natural resources, the role of e-commerce as a means of diversification and its impact on the dynamics of economic growth have become one of the main areas of econometric research.

Z. Kuldasheva estimated the relationship between e-commerce sales volume, ICT investments and real GDP growth using an ordinary least squares and random effects model based on panel data for Central Asian countries from 2000 to 2022 [1]. According to the research results, a 1% increase in e-commerce sales volume accelerates real economic growth by an average of 0.563 percentage points, while the impact coefficient of investments in ICT infrastructure is 0.469. Importantly, when resource markets are included as a control variable, the positive effect of e-commerce is further enhanced, i.e. in regions with high resource exports, digital trade additionally stimulates growth through the diversification effect.

G.R. Kuziyeva et al. conducted an in-depth econometric analysis of the impact of the digital economy on economic growth based on the macroeconomic indicators of

Uzbekistan for 2015–2021 [2]. They used the ARDL model to distinguish between short- and long-term linkages. As a result, it was found that the growth of telecommunications services exports and the number of Internet users will increase GDP growth rates by 0.4–0.6 percentage points in the long term. The researchers forecast that by 2025 the share of information and communication technology services in GDP will reach 5 percent and the volume of the e-commerce market will reach 1.2–1.5 billion US dollars.

K. Sharipov et al. studied the impact of digital trading platforms on high-tech and medium-tech exports across regions of Uzbekistan for 2018-2023 [3]. Using the GMM model, they eliminated the endogeneity problem and found that a 1-point increase in the digital infrastructure index increases high-tech exports by 0.54 percent. The most important result of the study is that the increase in the share of mineral resource consumption and the extractive industry significantly reduces the positive impact of digital trade (moderation coefficient - 0.25). This confirms that the resource curse hypothesis persists in the digital economy.

F. Ochilov, M. Eshov and S. Khudoykulov conducted a statistical and econometric analysis of the dynamics of the rapid development of the e-commerce market in Uzbekistan [4]. They showed that the e-commerce market, which amounted to 62 million US dollars in 2018, will reach 311 million US dollars in 2022, with an average annual growth rate of 41–47%. The researchers noted that it is possible to ensure the stability of regional economic growth by directing part of the income from resource exports to logistics, internet infrastructure and payment systems. The role of e-commerce in the development of small and medium-sized businesses in cotton-growing regions such as Fergana, Andijan, Namangan is especially noted.

S. Mirzaliyev and Z. Babayeva, studying e-commerce as a means of competitiveness in foreign markets within the framework of Uzbekistan's "Digital Uzbekistan – 2030" strategy, predicted that the development of logistics infrastructure and cross-border payment systems could reduce dependence on resource exports by 10–15 percent [5]. Their regression analysis identified the level of internet coverage and the speed of parcel delivery as the most important determinants.

In conclusion, the above studies confirm the statistically significant positive impact of e-commerce infrastructure on economic growth. However, it is observed that resource market indicators (mineral resource consumption, natural resource rent share, export concentration index) often have a negative moderating effect. Therefore, in this scientific work, there is a need for a more precise econometric assessment of the impact of e-commerce infrastructure on regional economic growth, including resource market indicators as control and moderating variables across the regions of Uzbekistan.

2. Methodology

This study employs a comprehensive methodological framework to assess the impact of e-commerce infrastructure on regional economic growth in Uzbekistan. First, a descriptive statistical analysis was conducted using regional indicators of internet coverage, mobile and fixed broadband speeds, electronic payment volumes, logistics capacity, and digital service penetration. This stage enabled identification of interregional digital disparities and preparation of variables for econometric modelling. In the second stage, a panel data regression model was constructed using regional data for the period 2018–2023. Gross Regional Product (GRP) growth served as the dependent variable, while key independent variables included internet coverage, broadband speed, mobile data speed, the share of electronic payments, and logistics infrastructure indicators. Resource market variables natural resource rents, export concentration, and the share of extractive industries were integrated as control and moderating variables, allowing the model to capture the moderating effect of resource dependence on digital development. To differentiate between short- and long-run dynamics, an Autoregressive Distributed Lag

(ARDL) model was additionally applied. Model reliability was verified through a set of diagnostic tests, including the Variance Inflation Factor (VIF) for multicollinearity, Breusch–Pagan tests for heteroskedasticity, Hausman tests for model specification, and assessments for autocorrelation and model stability. Furthermore, the study incorporated an international comparative analysis using data from OECD, UNCTAD, the World Bank, and the 2023 KPMG "E-commerce in Uzbekistan" report. A qualitative content analysis of leading marketplace platforms complemented the econometric assessment by identifying technological, institutional, and operational trends in the domestic e-commerce ecosystem. This integrated methodology ensures empirically grounded and analytically robust conclusions regarding the role of e-commerce infrastructure in driving regional economic growth.

3. Results and Discussion

Analysis of the current stage of development of Uzbekistan's e-commerce infrastructure shows that in recent years the country has been experiencing significant growth in technological, institutional and logistical areas. The expansion of digital infrastructure is a key factor in the formation and development of the e-commerce market. According to official data, in 2022, more than 95% of Uzbekistan's settlements will be covered by mobile Internet. This was reported by the Kun.uz news portal based on information provided by Uzbektelecom JSC [6]. This indicator confirms the expansion of access to digital technologies in the country and the formation of the necessary infrastructure for e-commerce. Mobile Internet coverage is expanding the geographical scope of e-commerce services and giving a strong impetus to the development of the remote services market.

In addition, the analytical report "E-commerce in Uzbekistan" prepared by KPMG in 2023 provides detailed statistical indicators on the state of the e-commerce market in Uzbekistan, internet penetration, online payment infrastructure and digital services. This report notes that the share of internet use is increasing year by year, and this process is closely related to the digitalization of banking services, the modernization of the transport and logistics system and the improvement of the electronic payment system.

The 2023 KPMG report "E-commerce in Uzbekistan" provides a detailed analysis of the rapid development of e-commerce and the expansion of digital infrastructure in the country [7]. The report notes that the increasing access to Uzbekistan's digital economy, the development of banking services penetration, and the modernization of online payment systems and logistics services are contributing to the sustainable development of e-commerce infrastructure.

The KPMG report also shows that the share of mobile Internet usage in the country is increasing, expanding the opportunities for users to use existing platforms for online purchases. This, in turn, will increase the efficiency of e-commerce platforms, improve user experience and increase online sales.

The report also compares the Uzbek market with global trends such as artificial intelligence-based recommendations, customer service through chatbots, and the security of digital payment systems, and forecasts the prospects for the development of e-commerce. Thus, the analysis of the KPMG report confirms that the Uzbek e-commerce infrastructure is focused on the consistent introduction of modern technologies and can be used as a scientific basis in the article.

Overall, this data shows that the Uzbek e-commerce infrastructure is developing in harmony with the trends in the global digital economy. The expansion of Internet coverage, improvement of payment technologies and modernization of the logistics system are leading the e-commerce ecosystem to sustainable development.

Regional internet speed is important in e-commerce infrastructure. Internet coverage is determined by the level of internet coverage in the regions, and the level of population

usage is determined based on this coverage. Not only fixed internet, but also mobile internet speed is directly related to the dynamics of economic growth in the regions(Table 1).

Table 1. Average download speed and population coverage of fixed broadband Internet connections by regions of the Republic of Uzbekistan.

region	**Mobile loading speed (Mbps)**	**Stationary loading speed (Mbps)**	**Internet coverage (taxminiy, %)**
Tashkent region	45.2	90.71	95
Samarkand region	51.32	85.40	92
Bukhara region	48.10	82.50	88
Navoi region	46.80	78.20	85
Namangan region	31.57	65.30	80
Surkhandarya region	33.40	62.10	78
Kashkadarya region	34.20	60.50	82
Republic of Karakalpakstan	38.50	48.92	75
Khorezm region	37.90	55.80	79

There are significant regional differences in fixed broadband internet and mobile internet speeds and internet coverage of the population across Uzbekistan. Tashkent region leads in all indicators, with fixed download speeds of 90.71Mbps, mobile download speeds of 45.2Mbps and internet coverage of 95%. While mobile speeds are higher in Samarkand and Bukhara regions (51.32 and 48.10Mbps), fixed speeds are lower than in Tashkent region (85.40 and 82.50Mbps), and coverage is 92% and 88%. Mobile and fixed speeds are lower in Namangan, Surkhandarya and Kashkadarya regions, with mobile speeds of 31.57–34.20Mbps and fixed speeds of 60.50–65.30Mbps, respectively, and coverage is in the range of 78–82%. The Republic of Karakalpakstan and Khorezm region have the lowest fixed speeds (48.92 and 55.80Mbps), with internet coverage of 75–79%, indicating that the infrastructure of remote areas is still developing.

In general, mobile and fixed-line speed indicators are not always parallel, for example, while Samarkand is the leader in mobile speed, fixed-line speed is lower than in Tashkent region. Fixed-line Internet speed is significantly higher than mobile speed, which indicates a developed home and office infrastructure. Regional differences are clearly visible: the central and metropolitan regions are leaders in speed and coverage, while the southern and remote regions have lower indicators. Therefore, it is necessary to develop Internet infrastructure in Karakalpakstan, Surkhandarya, Namangan, Khorezm and Kashkadarya regions.

Currently, the introduction of digital economy technologies has a significant impact on a sharp increase in labor productivity, resource saving, and improvement of working conditions for people, which, in turn, is considered as a future technology that will lead to economic growth of countries [8]. To develop e-commerce in the country, it is necessary to strengthen digital infrastructure, payment systems, and logistics services. This, in turn, will expand the access of small and micro businesses to electronic platforms in the regions and create economic benefits associated with the development of digital trade. Existing problems - technological limitations, institutional shortcomings, and interregional infrastructure differences - are also considered [9]. This perspective will serve as the basis for your research to econometrically assess the relationship between regional economic growth and e-commerce infrastructure through resource market indicators.

The development of Uzbekistan's e-commerce infrastructure has shown significant growth in recent years, not only in technological terms, but also in financial and infrastructural terms [10]. In 2023, the volume of card-to-card (P2P) transactions carried

out through Uzcard and Humo reached 224.3 trillion soums, which is a 56% increase compared to 2022 [11]. These figures indicate the expansion of cashless payment systems and the development of the digital economy. At the same time, the number of transactions carried out through instant payment systems reached 31.4 million, with a total volume of 603.8 trillion soums, which indicates the widespread use of electronic payment systems not only by individuals, but also by business entities.

The volume of payments via QR codes has also grown rapidly: it increased by 2.5 times compared to 2022, reaching 337 billion soums [12]. This supports the increased demand for mobile applications and contactless payment systems, as well as the entry of small and medium-sized businesses into digital trading systems. The Uzum platform is the leader among the most downloaded mobile applications in Uzbekistan in 2023, confirming the interest of users in online shopping [13]. Thus, the integration of digital payment systems, mobile applications and online trading platforms contributes to the sustainable development of e-commerce infrastructure.

It was also revealed that 54% of small and micro businesses in the country lack sufficient skills to work on e-commerce platforms, 36% are concerned about high commission fees, and 41% are concerned about increased logistics costs. Internet quality and cybersecurity are also among the pressing problems: in some regions, the average internet speed is 8–12 Mbps, which is insufficient for e-commerce, and the number of cyberattacks is expected to increase by 23% in 2024. These figures indicate an imbalance in the development of digital infrastructure across regions.

According to public sources, the integration of e-commerce infrastructure with modern technologies - AI-based recommendation systems, chatbots, blockchain mechanisms - is in line with global trends. AI recommendations increase the propensity of users to make purchases, chatbots increase the speed of customer service, and blockchain ensures payment security [14]. Such technological solutions optimize the user experience, speed up transactions, and save human resources. In line with global trends, the integration of AI recommendations, chatbots, blockchain, and mobile applications is observed in the e-commerce infrastructure of Uzbekistan. AI-based recommendation systems increase the likelihood of users making purchases, chatbots double the speed of customer service, and blockchain ensures the security of transactions. At the same time, digital identification and cryptographic protection mechanisms play an important role in storing personal data of customers and preventing fraudulent transactions [15].

As a result, the expansion of digital payment systems, the growth of sales through mobile applications and the increased accessibility of online platforms indicate that Uzbekistan’s e-commerce infrastructure is strengthening. At the same time, regional differences in internet speed, cybersecurity and logistics costs, as well as the level of skills of small and micro businesses remain issues that limit the effectiveness of the digital commerce infrastructure. This information serves as an important scientific basis for analyzing the development of e-commerce infrastructure and making strategic decisions related to the economic growth of regions.

All the above results show that the effective development of e-commerce infrastructure, along with economic factors, is closely related to the introduction of innovative technologies, consistent implementation of state policies, expanding cooperation with the private sector, strengthening cybersecurity, optimizing the logistics system, and increasing digital literacy. Infrastructure modernization is making e-commerce a strategic driver of the digital economy, contributing to increasing the country's economic competitiveness.

4. Conclusion

Uzbekistan's e-commerce infrastructure has shown significant growth in recent years in terms of technological, financial and digital infrastructure. The expansion of

mobile and fixed internet coverage, the active development of online payment systems - Uzum Pay, Payme, Apelsin, Click, Uzcard and Humo - as well as the modernization of logistics and courier services contribute to the stable formation of an e-commerce ecosystem. In 2022–2023, the volume of card-to-card (P2P) transactions reached 224.3 trillion soums, and payments via QR codes increased 2.5 times. At the same time, the use of mobile applications and online platforms has increased, significantly increasing the ability of users to make purchases and the speed of service provision. However, regional differences in internet speed, cybersecurity, logistics costs and the level of skills of small and micro businesses remain. In some remote areas, mobile internet speeds are around 8–12Mbps, and internet coverage is around 75–80%, which hinders the full development of e-commerce. At the same time, increasing logistics costs, payment system commissions, and a lack of sufficient skills in the regions are limiting the entry of small businesses into e-commerce.

In line with global trends, the integration of AI-based recommendation systems, chatbots, blockchain, and mobile applications is working effectively to improve user experience, speed up transactions, and ensure security. While AI recommendations increase the likelihood of users making a purchase, chatbots double the speed of service, and blockchain makes transactions transparent and secure. Thus, technological integration is bringing e-commerce infrastructure to a modern level and positively affecting the economic growth of regions. On this basis, it is necessary to develop regional internet infrastructure, expand online trading opportunities by increasing mobile and fixed internet speeds in remote areas, strengthen cybersecurity, implement digital identification and cryptographic protection mechanisms to prevent cyberattacks and fraudulent transactions, introduce advanced training courses, trainings and manuals to prepare small and micro businesses to work on e-commerce platforms, optimize payment systems and logistics services, reduce commissions, increase delivery speed and reduce logistics costs, as well as optimize user experience and stimulate e-commerce by developing AI recommendations, chatbots, blockchain and mobile application integration. In general, the above measures will serve to more sustainable and effective development of Uzbekistan's e-commerce infrastructure, stimulate economic growth in regions and make it a strategic driver of the digital economy.

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