The relationship between online retailing and the regional economy

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Abstract
Computer technology is steadily penetrating everyday life, offering many new opportunities. Information technology has enabled different organizations to increase sales and generate additional sources of income. The purpose of this study is to examine the influence of web-based retail on the regional economy of Russia. The research methodology is based on a correlation and regression analysis. The study is based on 85 Russian regions, which are part of 8 districts, for 2016–2020. The study is based on key indicators characterizing web commerce in the regions: share of web sales in total retail sales, share of organizations engaged in web sales, and percentage of the population that purchases goods online. The correlation analysis made it possible to assess the level of correlation both between the studied factors and each of them in relation to the integral indicator of the socio-economic status of the regions. Despite the importance of all the studied factors of e-commerce development for Russia, there are significant differences in their adequacy in the regions, which are combined into districts.

The regression modeling performed allowed identifying which factors are the most significant for individual districts of Russia and the country as a whole. The study provides results that characterize the lack of a close relationship between the level of socio-economic development and the share of the population using the Internet for shopping for most regions. The most significant are the business aspects of e-commerce - increasing the share of Internet sales in the total volume of retail sales and the share of organizations engaged in Internet sales. Therefore, the creation of an appropriate business climate and regulatory conditions for the functioning of e-commerce should be a priority in the formation of a strategy for regions’ socio-economic development.

Keywords COVID-19 · e-commerce · e-tailing · Socio-economic development · Regional market · SDGs

JEL Code P25 · R1
1 Introduction

Computer-aided technologies have become an integral part of how businesses operate today. It did not take long for the public to realize the advantages of e-tailing (electronic retailing) and people all over the world began to prefer online shopping. E-commerce opens up new opportunities for all market participants (sellers, buyers, intermediaries, and other commercial organizations) and thus changes the world of business. Today, the e-commerce industry gains strong momentum, creating a new sector of the economy (Kazakova & Pushilin, 2014). In today’s world, the Internet has become a big part of society. The purchase of goods and services is often done through the Internet. According to the Global Digital 2021 report, as of January 2021, Internet penetration stood at 59.5%, 66.6% of the world’s population use cell phones, of which 27.5% spend time online to buy goods (Kepios, 2021). At the same time, statistics on the age characteristics of the audience indicate that at the moment a significant amount of online purchases are made by users under the age of 35–44 years, so in the future one should expect an increase in buying activity, which will lead to an increase in the volume of goods sold on e-commerce platforms. The response to the COVID-19 pandemic, the social distancing regime, quarantines, lockdowns, and other restrictive measures have led to a global shift in the pattern of use of digital communication tools, and consequently in e-commerce. Significant increases in remote consumption of services and demand for online shopping are evidence of the fundamental growth of e-commerce in both B2C and B2B segments (Gu et al., 2021).

In the realities of today’s world, e-commerce is the only market that combines online sales, online marketing, online banking, payment system transactions and advertising. E-commerce should be considered broader than just making online sales, because in addition to trade and financial transactions, which are carried out through networks, e-commerce involves the formation of a chain of business processes (Tsindeliani et al., 2021). In this regard, e-commerce relates to the social and economic development of a country.

In 2020, the global e-commerce sector is growing at an estimated 27.6% to more than $4 trillion, a trillion more than the year before. Not only is the industry growing, but e-commerce is also growing as a share of total retail sales, rising from 13.6 to 18% (Statista, 2021).

At the beginning of 2021, the Russian e-commerce market reached a turnover of 431.3 billion rubles. Russia will become the fastest-growing e-commerce market in 2020–2024: its compound annual average growth rate will be 34%. The e-commerce sector is one of the most promising in Russia, as the market in question has not yet reached the stage of full saturation, it has relatively few participants, and the regions of the country are actively pursuing high-speed Internet, allowing potential customers to access online shopping. An increase in the number of Internet users by itself directly leads to an increase in the number of shoppers at online stores, all other things being equal in the marketplace (Data Insight, 2020). In an open online shopping environment, a number of the challenges and barriers faced by small and medium-sized businesses engaged in online retailing stem from the nature of their target audience segmentation. These circumstances impose some limitations on the potential for growth and development of e-commerce in Russia, since distance pur-
chasing methods are most in demand among the residents of remote regions, often without direct access to the entire variety of consumer goods that exist on the modern market. However, serving customers in remote areas poses another difficult task for web commerce - creating an effective system of supply and delivery of goods, which is not always an easy task in conditions of the existing transport infrastructure of the country. Thus, today there is a need to study the peculiarities of e-commerce and its relationship to the socio-economic efficiency of Russian regions. This study aims to fill this gap in science by assessing the relationship between e-commerce and the regional economic development of the country. The purpose of this study is to examine the relationship between the development of web commerce and the socio-economic situation of Russian regions. The study is based on key indicators that characterize web commerce in the regions: share of web sales in total retail sales, share of organizations engaged in web sales, and percentage of the population that purchases goods online (ages 15 to 74). In Russia, e-commerce was actively developing even before the pandemic. If in 2011 the volume of online sales was estimated at $7.5 million, then 2 years later it was already at $13 million. In 2016, this number approached $14 million, and $37.5 billion in 2020, with a 58% increase compared to 2019 (Data Insight, 2020). In this regard, the study is based on the data for 2016–2020, as this is the period with the highest growth of web commerce in Russia. To study the regional and territorial characteristics of web commerce in Russia, the study was conducted on the materials of 85 regions, which are included in 8 districts. This provides an opportunity to identify key factors in the development of web commerce, which have a close relationship with the socio-economic situation of the regions in their respective districts and the country as a whole.

2 Literature review

Electronic commerce is an important and multidimensional phenomenon of the modern stage of economic development, interrelated and interdependent with its other elements. Its state and prospects are influenced by a number of economic, social, technical, legal, and other factors (Janow & Mavroidis, 2019). On the other hand, the processes taking place in this industry affect production, trade, advertising, labor markets, etc. in a certain way (Rahayu & Day, 2015). E-commerce has additional business opportunities. Thus, web-oriented retailing compared to traditional trade significantly reduces the cost of doing business, and therefore allows for additional profits (Azeem et al., 2015). Undoubtedly, this form of doing business accelerates the processes of innovative development, as well as has an impact on the country’s GDP (Minashkin et al., 2020). Internet commerce provides an opportunity for companies to gain new opportunities, such as entering international markets, optimize old business processes and implement new technologies, expand their customer base, and engage in active dialogue with stakeholders, etc. (Sila, 2013). On the other hand, with the development of digital business there are issues of security, reliability, privacy and others (Zharova & Elin, 2017). Therefore, it should be noted that not all researchers are equally faithful to the idea that e-commerce brings prosperity to business. In some studies, the impact of e-commerce on economic processes is assessed ambigu-
ously (Terzi, 2011). The authors draw attention to its social implications and point out that online commerce affects employment. Verhoef et al., (2015) point out that the results of online commerce depend largely on the electronic devices owned by online shoppers, the choice of channel, and the quality of online communication. Cardona et al., (2015) found that online retailing has a weaker relationship with economic development compared to offline retailing, which can be interpreted as a consequence of lower sales volume.

Retail trade is the leading sector of the regional economy of the Russian Federation. The expansion of its opportunities allows increasing the industry’s contribution to gross regional product (GRP) (Mandziuk, 2021). However, research shows that there are significant regional differences in the degree of popularity of online commerce in Russia (Sabelnikova et al., 2019). Therefore, another argument for economic growth may be the increase in the number of organizations that receive orders for their goods and services through the Internet. This was the premise for the formation of the first hypothesis:

H1: an increase in the proportion of organizations engaged in online sales is a key factor in improving the socio-economic situation of the regions.

Speaking about the increase in the share of Internet commerce in the global economy, one can identify a number of main drivers of its spread. Firstly, it is the development of the Internet, the increase in its speed and the expansion of broadband access, which has led not only to an increase in the number of new customers, but also to the emergence of fundamentally new markets (Anvari & Norouzi, 2016). Secondly, it is the spread of mobile Internet, increasing its stability, accessibility and ease of use. The number of mobile devices with Internet access and their use is growing steadily, allowing people to make purchases without spending a lot of time (Cruz-Cárdenas et al., 2019). Third, it is the development of payment gateway technologies. Services allow the use of credit cards, debit cards, online bank payments and electronic funds transfer. The gradual shift from cash payments to electronic payments continues, stimulating the development of payment gateways to ensure the sustainability of e-commerce (Gorshkov, 2022). Hypothetically, regions with a significant share of the population using the Internet to order goods and/or services have a higher growth rate of retail web sales, which positively affects the level of socio-economic development of the region. The second research hypothesis states:

H2: the growth rate of retail trade is positively related to the rate of Internet technology adoption, namely the proportion of the population using the Internet to order goods and/or services.

It should be noted that the Russian e-commerce market has a number of significant differences from markets in other countries, such as: a high concentration of retailers in Moscow and St. Petersburg, a disproportionately high share of orders from large cities, a high share of takeaway, the predominance of payment upon receipt, the weak position of international players, weak logistics infrastructure (Mena & Bourlakis, 2016). The perception of optimal delivery time also varies greatly in cities with different populations. The Central Federal District occupies the first position in the market share distribution. Orders from Moscow and St. Petersburg account for a significant share of this sector. The least amount of online purchases is made in the North Caucasian Federal District. Moscow and St. Petersburg are major centers which draw the
regions to themselves. They are a kind of indicator of online commerce market development in Russia as a whole, setting its trend. At the same time, both Moscow and St. Petersburg are already oversaturated (Revinova & Lazanyuk, 2018). Intuitively, it seems that as a city’s population grows, its information infrastructure improves and modern shopping habits are formed, which reduces the expected delivery time, conditionally speaking, the customer becomes more “spoiled” with developed service. However, in Russia this trend is more non-linear due to the unevenness of infrastructure development (Grishchenko, 2020). At the present time, the growth of regional indicators is proceeding at a faster rate year by year than in the Central Federal District, the delivery of goods is being optimized, and online players are actively entering the regions. Therefore, web commerce in all regions is expected to grow faster (Rathnayake, 2021). In this regard, the third hypothesis was formed:

H3: web commerce based on increasing the share of sales through the Internet in the total volume of retail trade turnover affects the level of socio-economic position of the region.

Given that neighboring regions of Russia may have different business climates for the development of e-commerce, a significant knowledge gap arises. The relationship between the features of e-commerce and the regional economy within countries has not been sufficiently studied. The aim of the study is to fill this gap in the science and assess the relationship between e-commerce factors and the socio-economic development of the regional economy on the example of Russia. To achieve the goal, the study addresses the following issues:

First, the factors of influence of e-commerce on a country’s regional economy are identified;

Secondly, a diagnosis of the relationship between regional development parameters in the context of e-commerce effectiveness was made;

Thirdly, regression modeling was conducted, which provides an opportunity to determine the relationship between e-commerce and a state’s regional economic development.

In this case, a possible relation to the socio-economic efficiency of regions is the share of companies in the sphere of web commerce. At the same time, the study aims to confirm the assumption that online retail sales can grow faster in regions with a higher share of the population using the Internet for shopping.

### 3 Materials and methods

The research methodology is based on a correlation and regression analysis of the relationship between factor features of e-commerce and Russian regions. The study was conducted on materials from 85 regions of Russia, which are part of 8 districts. The study uses a panel of data from 2016 to 2020.

The methodology of the study is based on regression analysis. However, the logic of OLS regression easily extends to a multivariate model in which there are two or more independent variables. Therefore, this study uses multiple regression:

\[ IR_i = \beta_0 + \beta_1 SWS_1 + \beta_2 S O_2 + \beta_3 S P_3 + \beta_4 d_1 + \beta_5 d_2 + \beta_6 d_3 + \epsilon, \]  

(1)
Dependent variable IR – the indicator of the socio-economic situation of Russian regions. The independent variables used in the analysis were: SWS – share of web sales in total retail sales, %; SO – share of organizations engaged in web sales, %; SP – percentage of the population that purchases goods online (ages 15 to 74), %.

Dummy variables are introduced to reflect the specifics of factors affecting the income of the population in urbanized and northern regions: $d_1$ – dummy variable, taking values 1 - for Moscow and St. Petersburg, and 0 - for other regions; $d_2$ – dummy variable, taking value 1 for regions that include large cities (Rostov-on-Don, Kazan, Perm, Ufa, Nizhny Novgorod, Samara, Yekaterinburg, Chelyabinsk, Omsk, and Novosibirsk), and 0 for all other regions; $d_3$ – dummy variable, taking value 1 for the northern regions (Murmansk, Magadan, and Kamchatka regions; Khanty-Mansi, Yamalo-Nenets, and Chukotka Autonomous Districts; Komi Republic and Sakha (Yakutia), and 0 for all other regions.

The indicator of the socio-economic situation of Russian regions (RIA Reiting, 2021) was used as the dependent variable $Y$. The ranking was based on a comprehensive analysis of the socio-economic situation in the subjects of the Russian Federation. The methodology for constructing the rating is based on the aggregation of various indicators that characterize the most important factors determining the economic situation of the regions. Only formalizable (numerical) indicators of official statistics were used in compiling the rating, which avoids distortions associated with subjective evaluations and makes the results of the analysis as objective and transparent as possible. The information sources for the analysis are data from Federal State Statistics Service (Rosstat), Russian Ministry of Finance, and the Federal Treasury. All 85 subjects of the Russian Federation (RF) are included in the rating. When calculating the positions of complex constituent entities of the Russian Federation, namely the Tyumen and Arkhangelsk regions, indicators are used without taking into account the data on the autonomous districts that are part of them. Accordingly, the positions of the Tyumen region are determined without considering the data on Khanty-Mansi Autonomous Okrug, Yugra, and Yamalo-Nenets Autonomous Okrug, and the positions of the Arkhangelsk region, without considering the data on the Nenets Autonomous Okrug.

The basic principle of data processing is a comparative analysis of the subjects of the Russian Federation according to a wide list of indicators characterizing various aspects of socio-economic situation, and the calculation of an aggregate indicator that allows one to position the subject of the Russian Federation among other regions. The result of data processing is a ranked list of RF subjects, which characterizes their comparative positions by socio-economic development.

When compiling the rating, a significant array of indicators characterizing various aspects of the socio-economic situation in the subjects of the Russian Federation was analyzed. As a result of the analysis a set of key indicators was formed, which allows one to determine the position of the region by the level of socio-economic development. The analyzed indicators are conditionally divided into 4 groups:

- indicators of the scale of the economy: volume of production of goods and services; consolidated budget revenues; number of people employed in the economy; retail trade turnover;
**indicators of economic efficiency:** volume of production of goods and services per capita; investment in fixed capital per capita; share of profitable enterprises; ratio of tax arrears to the volume of taxes and fees received by the budget system of the Russian Federation;

**fiscal indicators:** consolidated budget revenues per capita; share of tax and non-tax revenues in total consolidated budget revenues; ratio of public debt to tax and non-tax revenues of the consolidated budget; ratio of non-tax and tax revenues to expenditures of the consolidated budget.

**indicators of the social sphere:** the ratio of money income to the cost of a fixed set of consumer goods and services; unemployment rate; life expectancy at birth; infant mortality rate; mortality rate of able-bodied population; the share of population with incomes below the subsistence minimum (RIA Reiting, 2021).

The relationship of the variables was assessed based on the correlation coefficient, interpreted according to the Cheddock scale. Correlation analysis of the relationships between the variables was carried out using the programming language R (RStudio environment). For the regression analysis, statistical data for 8 districts of Russia, which have 85 regions, as well as indicators for the country as a whole were used. A fragment of the original data, in which the variables are specified, is shown in Appendix (Table A1). Hypothesis testing was carried out using regression analysis, which makes it possible to evaluate the parameters of the model, determine the significance of each parameter, and assess which is best for the calculation procedure.

### 4 Results

To determine the relationship between the factors under study and the indicator of socio-economic efficiency of the regions under study, a correlation analysis was conducted. According to its results a correlation matrix was built for the share of web sales in total retail sales (SWS), share of organizations engaged in web sales (SO), percentage of the population that purchases goods online (ages 15 to 74) (SP) and the indicator of the socio-economic situation of the regions (Fig. 1). Correlation analysis provided an opportunity to assess the level of correlation both between the studied factors, which are further used as independent variables in modeling, and each of them in relation to the integral indicator.

The share of web sales in total retail sales, share of organizations engaged in web sales, and percentage of the population that purchases goods online are not significantly correlated. This is confirmed by the obtained correlation coefficients, which have a value below 0.5. There is a sufficient level of correlation between these factors and the indicator of socio-economic status of regions. At the same time, its highest level is present in relation to the percentage of the population that purchases goods online.

The lack of a significant relationship between the studied factors of web-retail development and the economic state of the regions allowed conducting a factor analysis of variance to build a regression model. Its results are shown in Table 1.
To form a regression model based on the studied factors it is necessary to assess its applicability and compliance with a number of criteria. Based on the data obtained one can state the fact that for some factors in the studied districts of Russia p-value is above the permissible value of 0.05. For the increase in the level of socio-economic development in most districts the share of the population who make purchases via the Internet is insignificant. The special importance of this factor is recorded only for the Ural district. At the same time, the share of web sales in the total volume is less significant for the Ural Federal District compared to other districts. For the Siberian and Southern districts this factor is not significant. For these two districts, only the share of web trading companies is significant. However, if one takes into account the obtained coefficients of determination, one can state that web commerce has a significant relationship with the level of socio-economic development only in the Central and Ural Federal Districts. To diagnose the reliability of the obtained models, a similar analysis was carried out with the addition of dummy variables that characterize the districts in terms of urbanization and demography. The dummy variables were introduced to reflect the peculiarities of the factors influencing the population’s income in the urbanized and northern regions. The results are shown in Tables 2 and 3.

Based on the obtained coefficients of determination, there is a significant relationship between the studied factors and socio-economic development for the Ural, Central, Volga, Northwestern, and Siberian districts. However, this relationship in the Northwestern and Volga districts is dictated not by the factors that directly characterize the indicators of web trade efficiency, but by the presence of population density advantages and cities with one million inhabitants. This is due to the territorial/geographical differences between the regions. Russia is a huge country where many settlements are located some distance away from transport communications. The advancement of digital technologies enables the population scattered across a large area of the country to meet their own needs. The economic challenges facing the population, such as the lack of jobs and low wages, have promoted self-employment in the regions. More and more people across the country start their own businesses online by launching web-based trading platforms. For the Siberian district, the situation with the importance of the studied factors has not practically changed - the priority is still the share of companies engaged in web trading. To determine the
## Table 1: Regression models of web-retail’s relationship with Russian regions’ economic development

| Factor | Central Federal District | North-Western Federal District | Southern Federal District | North Caucasian Federal District | Volga Federal District | Ural Federal District | Siberian Federal District | Far Eastern Federal District |
|--------|--------------------------|--------------------------------|---------------------------|----------------------------------|------------------------|------------------------|---------------------------|----------------------------|
| Intercept | 39.15 *** | 39.04 *** | 36.10 *** | 24.08 *** | 40.30 *** | 52.54 *** | 33.14 *** | 29.78 *** |
| (0.78) | (1.63) | (1.71) | (1.22) | (1.09) | (1.66) | (1.77) | (1.21) |
| SWS | 8.96 *** | 7.60 *** | 2.25 | 5.08 ** | 6.97 *** | 3.85 * | 3.35 | 3.58 ** |
| (1.06) | (1.94) | (1.99) | (1.61) | (1.40) | (1.71) | (1.84) | (1.23) |
| SO | 5.96 *** | 6.47 *** | 6.97 *** | -1.46 | 6.53 *** | 7.19 *** | 5.33 ** | 5.24 *** |
| (0.86) | (1.69) | (1.79) | (1.52) | (1.19) | (1.68) | (1.80) | (1.28) |
| SP | -0.16 | 1.01 | 3.66 | -0.75 | -0.92 | 10.95 *** | 0.30 | 2.53 |
| (1.08) | (1.93) | (1.94) | (1.34) | (1.44) | (1.71) | (1.82) | (1.28) |
| N | 90 | 55 | 40 | 35 | 70 | 30 | 50 | 55 |
| R2 | 0.73 | 0.47 | 0.37 | 0.27 | 0.48 | 0.70 | 0.23 | 0.34 |

Note: all continuous predictors are mean-centered and scaled by 1 standard deviation. *** p < 0.001; ** p < 0.01; * p < 0.05

Source: Formed by the authors
relationship between the studied factors and the socio-economic development of the country as a whole, the analysis for Russia was carried out (Table 4).

For Russia, all of the studied factors, demonstrating the effectiveness of web trading in the context of socio-economic development, are significant. With the gradual introduction of dummy variables there is an increase in the coefficient of determination. A special impact on the socio-economic development of the country in the context of web commerce can have the development of this area of business, as in all models among the key factors studied there are high coefficients for the share of organizations engaged in web commerce. The presence of large cities and agglomerations in the regions plays an important role. The share of web commerce in total retail sales and the number of organizations that conduct e-commerce mostly relate to the Central, North Caucasian, and Ural federal districts. The share of the population shopping online does not relate that much. This can be explained by the fact that this country has a high level of coverage of the population that uses digital technology. Therefore, in the COVID-19, the share of the population shopping online also does not relate, as it has not actually changed. For the rest of the studied districts, the key factors is the share of organizations selling online, which demonstrates the significant role of web commerce in these districts. For the Ural Federal District and Russia as a whole, all the studied factors (indicators) of e-commerce development in the context of improving the socio-economic situation of the regions are significant. According to the modeling results, one can determine that the studied factors are insignificant in the regions with low population density. For the North Caucasus District, what is remarkable is the lowest coefficient in the equation for the percentage of the population that purchases goods online. For these regions, the socio-economic situation as of 2020 is also the lowest average: 25.06 for the North Caucasus District, 31.62 for the Far Eastern District, 39.18 for the Siberian District. For comparison, the highest average indicator of socio-economic status of regions was recorded for the Ural district (55.79) and the Central district, which are characterized by the ratio of all three factors (independent variables) and a high coefficient of determination for web trade.

Based on the models obtained, it is important for Russia to develop web commerce in the direction of stimulating e-business, as well as involving a wider range of the population to participate in purchases through e-commerce. It is true that normally, e-commerce is influenced by more than one factor. According to the results of the regression-correlation analysis, a synergistic action of all factors in the model may entail an increase in the level of regions’ economic development. This suggests that the indicators of regional economic development are dependent on the volume of e-commerce activity. Furthermore, it seems that the web-based retail development can be optimized through manipulating the key factors that underpin the growth of e-commerce and regional development.

5 Discussion

The relationship between e-commerce and regional economy in Russia was previously examined by opposing online retail and offline retail (Markhaichuk, 2018). It was found that retail, both online and offline, has a positive relationship with gross
regional product (GRP) and GRP per capita. The online retail sales, however, had a stronger influence on regional economy when compared to offline ones. This may be associated with the fact that online retail has an indirect effect on related industries
At the same time, the study of the relationship between e-commerce and GRP limits the obtained results in the context of their projection only on one economic indicator. Despite the importance of GRP in assessing the effectiveness of regional development, today a comprehensive approach to diagnosis is required. Therefore, the application of the Integral Indicator of Socio-Economic Status of Regions in the study allowed taking into account the totality of indicators that are included in its composition.

The advantage of this study is the possibility of a more detailed analysis of the relationship between e-commerce and the regional economy. At the same time, it has similarities with the results of other studies (Beckers et al., 2021) because it proves that the share of urban population has the smallest relationship with e-commerce and the regional economy. The opposite characteristic, which is observed in other countries (Yang et al., 2021), has been proven, namely the absence of a close relationship between the level of socio-economic development and the share of the population using the Internet for shopping for most regions. For Russia as a whole, this trend is maintained, indicating that e-commerce affects the regional economy. However, it remains a challenge to take into account consumer expectations (Toshimitsu, 2020).

Zhang (2016) emphasizes that only a few researchers focused on differences in economic growth and retail development between cities and regions. For instance, Thambiah et al., (2011) conducted a comparative analysis of the awareness, perception, and preferences on Islamic retail banking between the urban and rural banking customers of Malaysia. Black (2007) examined the online shopping behavior of American consumers residing in different regions of the United States. That work also investigated the link between the level of e-commerce development and the size of urban and rural population. For Russia, this relationship has not been established.

Some researchers believe that e-commerce is influenced by the two types of factors: geographic (type of settlement and population density) and digital literacy (increasing number of mobile users) (Karamshuk et al., 2013). Other authors state that a similar trend has been seen in Russia (Kazakova & Pushilin, 2014). It was found that Internet technology penetrated the central cities of Russia at a faster pace than other regions, which significantly affected the spread of e-commerce (Kazakova & Pushilin, 2014). This study supports the above assertion, as evidenced by the results of hypothesis testing.

### Table 2 (continued)

| District       | Factor | Est. | S.E. | t val. | p    |
|---------------|-------|------|------|--------|------|
| Russian Federation | (Intercept) | 4.39 | 2.07 | 2.12   | 0.03 |
|                | SWS   | 2.02 | 0.47 | 4.28   | 0.00 |
|                | SO    | 0.96 | 0.09 | 10.47  | 0.00 |
|                | SP    | 0.28 | 0.05 | 5.56   | 0.00 |
|                | d1    | 21.27| 4.68 | 4.54   | 0.00 |
|                | d2    | 10.36| 1.61 | 6.45   | 0.00 |
|                | d3    | 6.56 | 1.75 | 3.75   | 0.00 |

Source: Formed by the authors
Table 3  Regression models of the relationship between web-retail and Russian regions’ economic development (using dummy variables)

| Factor | Central Federal District | North-Western Federal District | Southern Federal District | North Caucasian Federal District | Volga Federal District | Ural Federal District | Siberian Federal District | Far Eastern Federal District |
|--------|--------------------------|---------------------------------|---------------------------|----------------------------------|-----------------------|-----------------------|---------------------------|-----------------------------|
| Intercept | 38.26 *** | 34.63 *** | 34.80 *** | 24.08 *** | 33.23 *** | 47.70 *** | 29.07 *** | 30.42 *** |
|          | (0.75)     | (1.71)  | (1.79)   | (1.22)  | (0.90)   | (2.43)   | (1.61)   | (1.81)         |
| SWS     | 7.09 ***   | 4.35    | 2.45     | 5.08 **  | 1.57     | 7.75 *** | 1.79      | 3.38 *         |
|          | (1.07)     | (2.56)  | (1.93)   | (1.61)  | (0.95)   | (2.02)   | (1.58)   | (1.31)         |
| SO      | 5.46 ***   | 3.04    | 6.12 **  | -1.46   | 0.81     | 8.76 *** | 5.23 ***  | 4.97 ***        |
|          | (0.80)     | (1.73)  | (1.79)   | (1.52)  | (0.88)   | (1.61)   | (1.38)   | (1.41)         |
| SP      | -0.30      | -0.76   | 2.31     | -0.75   | 1.13     | 4.63 *   | 0.28      | 2.99           |
|          | (1.00)     | (2.00)  | (2.01)   | (1.34)  | (0.87)   | (1.69)   | (1.39)   | (1.62)         |
| d1      | 15.98 ***  | 29.12 ***| (8.01)   |         |          |          |           |               |
| d2      | 10.42      |        |          |          |          |          |           |               |
| d3      | 9.71 *     |        |          |          |          |          |           |               |
| N       | 90         | 55     | 40       | 35       | 70       | 30       | 50          | 55             |
| R2      | 0.78       | 0.63   | 0.42     | 0.27     | 0.83     | 0.87     | 0.57       | 0.34          |

Note: all continuous predictors are mean-centered and scaled by 1 standard deviation. *** p<0.001; ** p<0.01; * p<0.05

Source: Formed by the authors
The scientific contribution of the conducted study is to prove the need for regional diagnostics of the connection between e-commerce and the effectiveness of the socio-economic situation within the country. The conducted study demonstrates that, despite the importance of all the studied factors of e-commerce development for Russia, there are significant differences in their adequacy by regions, which are combined into districts. The study provides results that characterize the lack of a close relationship between the level of socio-economic development and the share of the population using the Internet for shopping for most regions. The most significant are the business aspects of e-commerce: the increase in the share of online sales in total retail sales and the share of organizations engaged in online sales. Therefore, the creation of an appropriate business climate and regulatory conditions for the functioning of e-commerce should be a priority in the formation of a strategy for regions’ socio-economic development.

The correlation analysis made it possible to assess the level of correlation both between the studied factors and each of them in relation to the integral indicator of socio-economic status of regions. The obtained correlation indicators made it possible to determine that there is no significant relationship between the share of web sales in total retail sales, the share of organizations engaged in web sales, and the percentage of the population that purchases goods online. At the same time, each of these indicators has a sufficient correlation with the indicator of the socio-economic situation of the regions.

### Table 4 Regression models of the relationship between web-retail and economic development in Russian Federation (with the gradual introduction of dummy variables)

| Factor | Model 1  | Model 2  | Model 3  | Model 4  |
|--------|----------|----------|----------|----------|
|        | Intercept| Intercept| Intercept| Intercept|
|        | 36.49*** | 36.29*** | 34.82*** | 34.15*** |
|        | (0.54)   | (0.53)   | (0.55)   | (0.57)   |
|        | SWS      | SWS      | SWS      | SWS      |
|        | 3.57***  | 3.06***  | 2.05***  | 2.51***  |
|        | (0.58)   | (0.59)   | (0.58)   | (0.59)   |
|        | SO       | SO       | SO       | SO       |
|        | 6.61***  | 6.41***  | 5.39***  | 5.68***  |
|        | (0.56)   | (0.55)   | (0.55)   | (0.54)   |
|        | SP       | SP       | SP       | SP       |
|        | 4.15***  | 4.02***  | 4.13***  | 3.25***  |
|        | (0.58)   | (0.57)   | (0.54)   | (0.58)   |
|        | d1       | d1       | d1       | d1       |
|        | 15.04**  | 20.96*** | 21.27*** |          |
|        | (4.94)   | (4.76)   | (4.68)   |          |
|        | d2       | d2       | d2       | d2       |
|        | 10.71*** | 10.36*** |          |          |
|        | (1.63)   | (1.61)   |          |          |
|        | d3       | d3       | d3       | d3       |
|        |             |          | 6.56***  |          |
|        |             |          | (1.75)   |          |
|        | N        | N        | N        | N        |
|        | 370      | 370      | 370      | 370      |
|        | R2       | R2       | R2       | R2       |
|        | 0.70     | 0.71     | 0.76     | 0.78     |

Note: all continuous predictors are mean-centered and scaled by 1 standard deviation. *** p<0.001; ** p<0.01; * p<0.05
Source: Formed by the authors
The regression modeling performed allowed identifying which factors are the most important for individual districts of Russia and the country as a whole. Web commerce has a significant relationship with the level of socio-economic development in the Central and Ural Federal Districts. For the other districts e-commerce has not yet reached a level to be significant for the socio-economic situation of the regions. This points to the need to develop a clear policy to improve the processes of e-commerce in these districts, to identify the determinants of its development to achieve socio-economic effects for the regions. This will strengthen the contribution of e-commerce to the socio-economic development of Russia as a whole.

The limitations of this study are associated with low availability of data regarding the volume of web-based retail statistics. It is worth noting that a substantial portion of online sales is fraught with losses due to tax evasion, which distorts a real picture of online trade. A research limitation is also the number of indicators (publicly available and present in all regions of the country) that characterize the effectiveness of e-commerce in Russia. They allow one to actually assess the quantitative parameters of the increase in e-commerce volumes and the potential of the consumer platform, but do not provide a full opportunity to diagnose the qualitative parameters (what goods were purchased online and in what volumes, the age characteristics of online consumers, etc.). The inclusion of these indicators in the modeling process could expand the range of conclusions and recommendations made in the context of improving the socio-economic development of counties and their respective regions based on e-commerce.

The study results can serve as a platform for further research into the strategy of e-commerce activation and its key directions. It can be deepened through additional research on the level of logistics, population density, the level of urbanization, and other features that can expand the range of determinants for a successful policy of socio-economic development of regions through the prism of e-commerce.

7 Appendix

Table A1  Input data for the regression analysis

| Region             | Share of web sales in total retail sales. % (SWS – X1) | Share of organizations engaged in web sales. % (SO – X2) | Percentage of the population that purchases goods online (ages 15 to 74), % (SP – X3) | Integral indicator of the socio-economic situation of the region (coefficient) |
|--------------------|--------------------------------------------------------|---------------------------------------------------------|----------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| Central Federal District |                                                        |                                                         |                                                                                  |                                                                                 |
| Belgorod region    | 2.1                                                    | 29.6                                                    | 43.7                                                                              | 53.995                                                                          |
| Bryansk region     | 1.3                                                    | 15.9                                                    | 33.3                                                                              | 35.002                                                                          |
| Vladimir region    | 1.5                                                    | 22.4                                                    | 48.1                                                                              | 36.230                                                                          |
| Voronezh region    | 2.4                                                    | 19.3                                                    | 42.0                                                                              | 53.969                                                                          |
| Ivanovo region     | 2.0                                                    | 18.0                                                    | 33.2                                                                              | 27.019                                                                          |
| Kaluga region      | 2.0                                                    | 21.1                                                    | 22.5                                                                              | 45.083                                                                          |
| Kostroma region    | 2.1                                                    | 14.5                                                    | 38.8                                                                              | 25.093                                                                          |
| Kursk region       | 1.6                                                    | 13.4                                                    | 33.8                                                                              | 40.808                                                                          |
| Lipetsk region     | 2.3                                                    | 17.0                                                    | 27.5                                                                              | 46.552                                                                          |
| Moscow region      | 6.2                                                    | 28.3                                                    | 59.3                                                                              | 71.350                                                                          |
Table A1 Input data for the regression analysis

| Region                     | Share of web sales in total retail sales, % (SWS – X1) | Share of organizations engaged in web sales, % (SO – X2) | Percentage of the population that purchases goods online (ages 15 to 74), % (SP – X3) | Integral indicator of the socio-economic situation of the region (coefficient) |
|----------------------------|---------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| Oryol region               | 2.1                                                     | 16.4                                                   | 25.7                                                                           | 27.929                                                                          |
| Ryazan region              | 1.3                                                     | 17.9                                                   | 26.6                                                                           | 37.312                                                                          |
| Smolensk region            | 1.3                                                     | 23.1                                                   | 37.3                                                                           | 29.440                                                                          |
| Tambov region              | 2.3                                                     | 16.5                                                   | 36.2                                                                           | 31.821                                                                          |
| Tver region                | 1.8                                                     | 16.7                                                   | 35.2                                                                           | 34.476                                                                          |
| Tula region                | 1.2                                                     | 19.3                                                   | 54.0                                                                           | 43.824                                                                          |
| Yaroslavl region           | 1.3                                                     | 20.9                                                   | 37.4                                                                           | 39.469                                                                          |
| Moscow                     | 9.3                                                     | 18.4                                                   | 60.5                                                                           | 83.929                                                                          |
| Northwestern Federal District |                                   |                                   |                                                                                     |                                                                                     |
| Republic of Karelia        | 1.4                                                     | 18.9                                                   | 37.6                                                                           | 24.784                                                                          |
| Komi Republic              | 1.0                                                     | 13.4                                                   | 36.3                                                                           | 36.882                                                                          |
| Arkhangelsk region         | 3.0                                                     | 16.1                                                   | 39.2                                                                           | 33.944                                                                          |
| Arkhangelsk region without autonomous district | 2.4                                                     | 10.0                                                   | 50.7                                                                           | 28.371                                                                          |
| Vologda region             | 2.9                                                     | 17.2                                                   | 41.8                                                                           | 44.407                                                                          |
| Kaliningrad region         | 1.4                                                     | 15.3                                                   | 34.9                                                                           | 41.812                                                                          |
| Leningrad region           | 2.3                                                     | 21.2                                                   | 40.0                                                                           | 60.557                                                                          |
| Murmansk region            | 1.5                                                     | 15.1                                                   | 50.9                                                                           | 47.386                                                                          |
| Novgorod region            | 2.1                                                     | 25.3                                                   | 35.2                                                                           | 24.93                                                                           |
| Pskov Oblast               | 1.1                                                     | 17.9                                                   | 35.5                                                                           | 23.547                                                                          |
| Saint-Petersburg (city)    | 7.3                                                     | 22.8                                                   | 54.0                                                                           | 80.347                                                                          |
| Southern Federal District  |                                   |                                   |                                                                                     |                                                                                     |
| Republic of Adygea         | 2.6                                                     | 18.1                                                   | 16.7                                                                           | 26.842                                                                          |
| Republic of Kalmykia       | 0.8                                                     | 11.7                                                   | 33.0                                                                           | 14.392                                                                          |
| Republic of Crimea         | 2.4                                                     | 10.6                                                   | 27.3                                                                           | 39.986                                                                          |
| Krasnodar Territory        | 2.9                                                     | 17.6                                                   | 30.1                                                                           | 58.291                                                                          |
| Astrakhan Region           | 0.9                                                     | 15.9                                                   | 39.3                                                                           | 39.912                                                                          |
| Volgograd region           | 2.6                                                     | 13.2                                                   | 35.1                                                                           | 43.633                                                                          |
| Rostov region              | 2.8                                                     | 17.6                                                   | 43.5                                                                           | 54.407                                                                          |
| Sevastopol city            | 7.8                                                     | 10.1                                                   | 52.4                                                                           | 29.189                                                                          |
| North Caucasian Federal District |                            |                                   |                                                                                     |                                                                                     |
| Republic of Dagestan       | 0.1                                                     | 3.4                                                     | 48.0                                                                           | 34.038                                                                          |
### Table A1: Input data for the regression analysis

| Region                                | Share of web sales in total retail sales, % (SWS – X1) | Share of organizations engaged in web sales, % (SO – X2) | Percentage of the population that purchases goods online (ages 15 to 74), % (SP – X3) | Integral indicator of the socio-economic situation of the region (coefficient) |
|---------------------------------------|--------------------------------------------------------|--------------------------------------------------------|----------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| Republic of Ingushetia                | 0.1                                                    | 8.9                                                   | 28.6                                                                             | 18.931                                                                         |
| Kabardino-Balkarian Republic          | 0.3                                                    | 11.5                                                  | 21.9                                                                             | 20.332                                                                         |
| Karachay-Cherkessia Republic          | 0.6                                                    | 9.0                                                   | 22.7                                                                             | 16.16                                                                          |
| Republic of North Ossetia Alania      | 0.5                                                    | 10.3                                                  | 29.8                                                                             | 18.633                                                                         |
| Chechen Republic                      | 0.0                                                    | 6.5                                                   | 26.2                                                                             | 27.855                                                                         |
| Stavropol Territory                   | 1.2                                                    | 17.9                                                  | 40.0                                                                             | 39.5                                                                           |
| Volga Federal District                |                                                        |                                                       |                                    |                                                                                |
| Republic of Bashkortostan             | 0.6                                                    | 16.9                                                  | 30.7                                                                             | 53.187                                                                         |
| Republic of Mari El                   | 1.9                                                    | 16.2                                                  | 27.8                                                                             | 24.876                                                                         |
| Republic of Mordovia                  | 1.1                                                    | 12.8                                                  | 28.2                                                                             | 29.054                                                                         |
| Republic of Tatarstan                 | 3.8                                                    | 18.6                                                  | 36.9                                                                             | 69.263                                                                         |
| Republic of Udmurtia                  | 1.4                                                    | 15.0                                                  | 40.5                                                                             | 36.57                                                                          |
| Chuvash Republic                      | 2.0                                                    | 17.5                                                  | 32.3                                                                             | 31.937                                                                         |
| Perm Territory                        | 2.4                                                    | 24.7                                                  | 37.2                                                                             | 50.063                                                                         |
| Kirov region                          | 2.3                                                    | 14.5                                                  | 43.2                                                                             | 30.954                                                                         |
| Nizhny Novgorod region                | 3.9                                                    | 20.7                                                  | 46.0                                                                             | 55.4                                                                           |
| Orenburg region                       | 1.7                                                    | 16.9                                                  | 39.5                                                                             | 43.998                                                                         |
| Penza region                          | 1.3                                                    | 15.7                                                  | 35.0                                                                             | 33.478                                                                         |
| Samara region                         | 3.2                                                    | 19.4                                                  | 38.7                                                                             | 56.723                                                                         |
| Saratov region                        | 2.7                                                    | 16.2                                                  | 37.6                                                                             | 41.122                                                                         |
| Ulyanovsk region                      | 1.5                                                    | 13.8                                                  | 15.8                                                                             | 30.611                                                                         |
| Ural Federal District                 |                                                        |                                                       |                                    |                                                                                |
| Kurgan region                         | 1.7                                                    | 13.5                                                  | 25.4                                                                             | 23.553                                                                         |
| Sverdlovsk region                     | 4.1                                                    | 21.5                                                  | 40.8                                                                             | 62.167                                                                         |
| Tyumen region                         | 1.4                                                    | 18.0                                                  | 52.5                                                                             | 56.904                                                                         |
| Khanty-Mansiysk Autonomous Area       | 1.4                                                    | 19.1                                                  | 60.8                                                                             | 74.782                                                                         |
Table A1  Input data for the regression analysis

| Region                          | Share of web sales in total retail sales, % (SWS – X1) | Share of organizations engaged in web sales, % (SO – X2) | Percentage of the population that purchases goods online (ages 15 to 74), % (SP – X3) | Integral indicator of the socio-economic situation of the region (coefficient) |
|---------------------------------|------------------------------------------------------|-------------------------------------------------------|---------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| Yamalo-Nenets Autonomous Okrug  | 1.4                                                  | 14.6                                                  | 71.9                                                                            | 65.34                                                                           |
| Chelyabinsk region              | 2.8                                                  | 21.5                                                  | 45.5                                                                            | 51.997                                                                          |
| Siberian Federal District       |                                                      |                                                       |                                                                                 |                                                                                 |
| Republic of Altai               | 2.1                                                  | 16.0                                                  | 29.0                                                                            | 14.239                                                                          |
| Republic of Tuva                | 1.4                                                  | 6.2                                                   | 27.9                                                                            | 12.235                                                                          |
| Republic of Khakassia           | 0.7                                                  | 16.3                                                  | 22.7                                                                            | 20.043                                                                          |
| Altai Territory                 | 2.1                                                  | 14.2                                                  | 32.4                                                                            | 38.86                                                                           |
| Krasnoyarsk Territory           | 2.0                                                  | 14.5                                                  | 27.8                                                                            | 58.379                                                                          |
| Irkutsk region                  | 1.3                                                  | 15.3                                                  | 35.2                                                                            | 47.139                                                                          |
| Kemerovo region                 | 1.3                                                  | 17.5                                                  | 25.6                                                                            | 39.446                                                                          |
| Novosibirsk Region              | 8.0                                                  | 18.9                                                  | 34.8                                                                            | 46.426                                                                          |
| Omsk region                     | 2.5                                                  | 14.6                                                  | 36.8                                                                            | 42.138                                                                          |
| Tomsk region                    | 5.6                                                  | 18.9                                                  | 34.1                                                                            | 32.991                                                                          |
| Far Eastern Federal District    |                                                      |                                                       |                                                                                 |                                                                                 |
| Republic of Buryatia            | 0.5                                                  | 12.1                                                  | 40.9                                                                            | 24.367                                                                          |
| Republic of Sakha (Yakutia)     | 2.0                                                  | 11.4                                                  | 36.8                                                                            | 40.635                                                                          |
| Transbaikal Territory           | 0.9                                                  | 14.6                                                  | 19.4                                                                            | 26.885                                                                          |
| Kamchatka Territory             | 1.7                                                  | 10.7                                                  | 43.0                                                                            | 25.394                                                                          |
| Primorsky Territory             | 1.7                                                  | 16.9                                                  | 28.5                                                                            | 42.542                                                                          |
| Khabarovsk Territory            | 1.6                                                  | 14.4                                                  | 32.1                                                                            | 38.955                                                                          |
| Amur region                     | 1.8                                                  | 12.6                                                  | 25.6                                                                            | 35.899                                                                          |
| Magadan region                  | 1.5                                                  | 12.7                                                  | 37.2                                                                            | 27.725                                                                          |
| Sakhalin region                 | 1.2                                                  | 16.2                                                  | 38.2                                                                            | 52.921                                                                          |
| Jewish Autonomous Region        | 0.9                                                  | 12.2                                                  | 25.0                                                                            | 10.682                                                                          |
| Chukotka Autonomous Area        | 0.0                                                  | 9.6                                                   | 43.6                                                                            | 21.798                                                                          |

Source: Formed by the authors based on Rosstat (2020, 2021) and RIA Reiting (2021)

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