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THE ROLE OF DIGITALIZATION IN THE INTRODUCTION OF CUSTOMIZATION AND PERSONALIZATION OF PRODUCTS AND SERVICES – THE CASE OF SERBIA

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Abstract: *Nowadays, companies operate in an age of innovation and rapid evolution of technology. In other words, modern business takes place in the age of the digital revolution. Companies have to adapt to new business models, processes and culture with the help of modern technologies, in order to remain competitive in the market. The use of new machines, tools, devices and software along with the customization in one word means digital transformation. The aim of this paper is to examine the role of digitalization in the introduction of customization and personalization of products and services, as well as the impact of digital transformation on the economic growth of Serbia. For this purpose, a development model adopted from Cobb-Douglas production function was applied. A linear regression model was used to examine the influence of the basic variable ie. digital transformation variable, as well as investment capital, human capital, market openness, and government expenditure, on economic growth. It is believed that the model can serve policy makers as a useful tool in their work.*

Key Words: ***Digitalization, Customization, Personalization, Economic growth, Linear regression***

1. INTRODUCTION

Digital transformation does not only represent the application of new technologies in the business, but also the introduction of new digital business models, as well as significant changes in the way companies connect with customers and suppliers, which implies the creation of a new value chain and system, as well as a series of changes in areas of marketing, management, employment, access to the market and their interactions, including the change of interpersonal relations within each company (Čelik, 2024, p. 5). Digitalization of the economy is a shift from the Third to the Fourth industrial revolution, and it is manifested as not just using a computer in everyday, but as a new form of doing business (Aleksandrova, Truntsevsky & Polutova, 2022, p. 437). In order to develop and justify the path of digital transformation of the economy, it is necessary to solve several important tasks (Revenko, Romanenkov & Lebedchenko, 2024, p. 17):

I. Identifying areas of economic activity that have the greatest potential for implementing digital technologies;
II. Assessment of progress and alignment with strategic goals, objectives and measures;
III. Assessing the effectiveness of digital transformation and its impact on economic growth.

Customization and personalization stand out as significant strategies in the development and management of products and services (Anišić, Suzić & Tekić, 2015). Customization refers to changing, assembling or modifying components of products or services in accordance with the needs and wishes of customers, while personalization refers to selecting or filtering information about an individual consumer (based on his consumer profile), thus, negotiating with customer and making a selection of information (Anišić et al., 2015). Digitalization, in a word, is a prerequisite for customization and personalization.

Digital technologies have enabled organizations to transform faster, because in the past organizations transformed much slower than the speed of market transformation, consumer behavior and disruptive innovation (Zimonjić & Zimonjić, 2023). The key challenge for companies in 2024. is digital transformation, which represents a greater challenge than inflation, financing costs and the like. The digital economy is an economy based on intellectual property and knowledge workers, thus, in the new economy, companies retain a competitive advantage only if their employees are constantly educated and acquire useful knowledge faster than competing companies (Kahrović, 2021). In order for the digital economy to develop properly, it is necessary for the following segments to be evenly developed (Lazović & Đuričković, 2018, p. 91):

I. *Physical and technological infrastructure* – cable networks (xDSL – networks based on copper cables; FTTx – networks based on optical cables; networks of cable operators – networks based on coaxial cables; HFC – hybrid optical-coaxial networks) and wireless networks (Wi-Fi, 3G and LTE – 4G, 5G, etc.);

II. *Normative and institutional infrastructure* – law on electronic signature; law on electronic commerce; law on electronic communications; law on electronic administration; law on information security);
III. *Educational infrastructure* – IT education is important not only to have as many users as possible, i.e. consumers in the digital environment, but also that the consumers themselves become producers and offer their products on the digital market (ECDL certificate, etc.);
IV. *Security infrastructure* – safe digital economy implies both the adoption of security strategies and laws at the state level, as well as compliance with security standards (standards from the ISO/IEC 27000 series), rules and procedures at the level of companies and individual users;
V. *Business and entrepreneurial infrastructure* – startup business very often represents the dominant wave that promotes and expands electronic business, and the digital economy on a global level is mostly pushed by giant companies created on the startup platform (Google, Facebook, Amazon, etc.).

This paper is structured as follows: the first part of the paper (section 2.) gives an overview of previous research on the relationship between digital transformation and economic growth, as well as customization and personalization of products and/or services. The second part of the paper (section 3.) gives a brief overview of digitalization in Serbia and economic growth. The third part of the paper (section 4.) briefly gives examples of customization and personalization in Serbia. The fourth part of the paper (section 5.) presents data and methodology. The fifth part of the paper (section 6.) deals with the results of the research. In the last, sixth part of the paper (section 7.), discussion and conclusions are presented.

The aim of this paper is to analyze and discuss the relationship between digital transformation and economic growth in Serbia using the linear regression model in the selected period of time, as well as the role of digitalization in the introduction of customization and personalization of products and services in Serbia.

2. PREVIOUS RESEARCH

A significant number of scientific research confirm the existence of a strong and positive connection between digital transformation and economic growth indicators.

Thus, according to the research conducted by Shuren and others (Shuren et al., 2024), a significant relationship between the following indicators was revealed – unemployment rate, the number of organizations using the internet, and information literacy, and the relationship between these indicators was explained by a linear equation with an average accuracy of 97%.

Another study (Török, 2024) confirmed that digital development has positively influence on economic growth of EU member states. In other words, more digitally developed member countries had a higher GDP per capita. Also, the results confirm that the development of digitalization and GDP increased more dynamically in the more digitally developed EU member states than in the less developed member states.

A study conducted by Lukmanova and others (Lukmanova et al., 2024) revealed a positive relationship between digital transformation and economic growth. Hence, percentages of the calculated digital transformation impact showed an increasing effect over time, and economic development indicators (GDP growth, employment, productivity, and corporate investments) all showed positive trends at the same time.

Kristyanto and Jamil (Kristyanto & Jamil, 2023) applied Principal Component Analysis (PCA) in their study to assess the key factors that shape the progress of digital transformation and inclusive economic growth in Indonesia. The PCA results revealed that medium and high-tech manufacturing play a key role in representing digital transformation, while GDP per capita growth and poverty reduction are of the greatest importance for measuring inclusive economic growth.

Novikova and others (Novikova et al., 2022) confirmed the hypothesis about the direct impact of digitalization on economic development, thus, each percent in digital sector output is accompained by a 0.827% increase in GDP, this means that in the past eight years, the implementation of digitalization in Ukraine has really been a factor of economic growth.

Reunova and others (Reunova, Namitokova & Alikaeva, 2023) conducted a study on the impact of digitization on world economic growth. Research has shown that the digitization of the economy in the modern world has a strong and complex impact on the world economy. Likewise, it was confirmed that digitalization of the economy and economic growth are interconnected – countries with a high share in world's GDP have a developed sector of the digital economy because they largely implement digital technologies in agriculture and industry.

In the research conducted by Piddubna et al. (Piddubna et al., 2024), analytical and inductive methods were used to define a set of basic digitalization indicators – internet coverage level; level of financial activity online; level of digital skills development among the population; degree of integration of digital technologies into government processes; and volume of online purchases. It was revealed that financial activity online is the most influential factor.

According to the study conducted by Georgescu and others (Georgescu et al., 2021), real GDP growth is affected by the share of businesses engaged in e-commerce, unit labor costs and resource productivity are affected by the high level of digitization seen by businesses analyzing customer data for marketing purposes, as well as a positive relationship between digital skills and R&D expenditure.

Irtyshcheva (Irtyshcheva, 2021) analyzed the impact of the effect of digital development on economic growth, on the example of Ukraine. The research showed that Ukraine is significantly behind the majority of developed countries in the degree of development of the production of information and communication technologies, i.e. that IT technology is completely import-dependent. Also, it was discovered that encouraging the development of IT technologies has a significant positive impact on the development of digitization in all areas of the economy and society, as well as on GDP growth.

A group of authors (Egala et al., 2024) conducted research that showed that the availability of IT

infrastructure and investments in digital innovations are significant organizational drivers that have a direct relationship with the attitude towards the integration of digital innovations among companies, while IT competences, management of digital innovations and knowledge about digital innovations are not significant with the attitude towards the integration of digital innovations.

Swargiary and Roy (Swargiary & Roy, 2024) confirmed in their research significant relationship between digital transformation readiness, employee engagement, budget allocation, awareness, integration of digital tools, and impact on competitiveness.

Research conducted by Wolniak and Grebski (Wolniak & Grebski, 2023) showed that customization seamlessly aligns with sustainability goals, reducing waste and expanding market reach, as well as that achieving a balance between personalization and customer preferences, addressing ethical issues and ensuring regulatory compliance is complex.

Pech and Vrchota (Pech & Vrchota, 2022) concluded that digitization and technological readiness play a leading role in product customization. The results of their research revealed that the variable of internal integration is crucial in the application of new technologies and digitization for adaptation. Also, the conclusion is that for the successful implementation of the adaptation process, it is necessary for the models to focus on the internal and external factors of the business environment.

Research findings conducted by Abbas (Abbas, 2024) highlight the effectiveness of personalization in increasing consumer engagement, with a significant correlation observed between personalized marketing techniques and increased conversion rates.

Borstrock (Borstrock, 2018) came to the conclusion that offering a customized product changes consumer perception, thus, customers believe that they are buying something different, but this is far from reality. Luxury brands are offering customization in an attempt to diversify and add value to their product offering. Also, customization and personalization are gaining importance and include sustainable ways of industrialized production, while the product offering lacks the integrity associated with a handmade luxury product.

3. DIGITALIZATION IN SERBIA AND ECONOMIC GROWTH – A BRIEF OVERVIEW

With the fourth industrial revolution, digitization becomes the main catalyst for innovation, modernization, economic growth, competitiveness and comprehensive socio-economic progress and development, thus, the Government of the Republic of Serbia has recognized the importance of digitization and the development of electronic administration, which has contributed to significant development in this area in the past few years (The Office for Information Technologies and eGovernment, n.d.). Moreover, digitization is one of the priorities of the Government of the Republic of Serbia.

Thus, individuals who use the internet are internet users in the last three months, and the internet can be used via a computer, mobile phone, personal digital assistant, games machine, digital TV, etc. (World Bank, n.d.a).

The following table (table 1) shows the percentage of individuals who use the Internet in Serbia, and secure internet servers in Serbia.

Table 1. *Individuals using the Internet (% of population) and Secure internet servers (in number) – Serbia, from 2004 to 2022, and 2010 to 2020*

Year	% of population	Secure internet servers
2004	23.50	-
2005	26.30	-
2006	27.20	-
2007	33.15	-
2008	35.60	-
2009	38.10	-
2010	40.90	54
2011	42.20	188
2012	48.10	382
2013	53.45	484
2014	62.08	664
2015	65.32	1001
2016	67.06	3894
2017	70.33	40739
2018	73.36	48178
2019	77.42	56061
2020	78.37	64584
2021	81.17	-
2022	83.54	-

Source: World Bank, n.d.a; World Bank n.d.b

From the presented table, it is possible to see that the percentage of internet users has a constant growth in the observed period (2004 to 2022). The same goes for the number of distinct, publicly-trusted TLS/SSL certificates found in the Netcraft Secure Server Survey (World Bank, n.d.b), from 2010 to 2020. These facts are encouraging because it means that Serbia is on a healthy path to digitization.

Table 2 represents fixed and mobile telephone subscriptions in Serbia.

Fixed telephone subscriptions refers to the sum of active number of analogue fixed telephone lines, voice-over-IP (VoIP) subscriptions, fixed wireless local loop (WLL) subscriptions, ISDN voice-channel equivalents and fixed public payphones (World Bank, n.d.c), while mobile cellular telephone subscriptions are subscriptions to a public mobile telephone service that provide access to the PSTN using cellular technology (the number of postpaid subscriptions, and the number of active prepaid accounts) (World Bank, n.d.d).

Table 2. *Fixed telephone subscriptions and Mobile cellular subscriptions, in number – Serbia, from 2004 to 2022*

Year	Fixed telephone subscriptions	Mobile cellular subscriptions
2004	2685419	4729629
2005	2527328	5510690
2006	2719402	6643722
2007	2993403	8452642
2008	3084872	9618767
2009	3105728	9912339

2010	3110339	9915348
2011	3030432	10182023
2012	2976849	9137894
2013	3031657	9198717
2014	2856134	9344977
2015	2770462	9155664
2016	2684419	9094447
2017	2609601	8621771
2018	2574691	8431365
2019	2565392	8453887
2020	2572254	8260758
2021	2540276	8501519
2022	2538727	8621147

Source: World Bank, n.d.a; World Bank n.d.b

A sharp decline in fixed telephone subscriptions was recorded in 2005 (2527328), after which a constant increase was recorded until 2010 (the highest value, 3110339). From 2013 to 2020, there is a constant downward trend, and in 2020 a slight increase was recorded, which may be a consequence of the Covid-19 pandemic. When it comes to mobile cellular subscriptions, from 2004 to 2011, growth was registered with the maximum value in 2011 (10182023), after which the trend of this parameter was unstable (slight growth or decline). Since 2020, there has been a constant growth, for which the Chovid-19 pandemic could also be the reason.

Gross domestic product (GDP) is a monetary measure of the market value of all the final goods and services produced in a period of time (Agarwal, 2018). GDP per capita growth is annual percentage growth rate of GDP per capita based on constant local currency (World Bank, n.d.f).

Table 3 shows GDP per capita in Serbia, and GDP per capita growth, from 2005 to 2023.

Table 3. *GDP per capita (current US$) and GDP per capita growth (annual %) – Serbia, from 2005 to 2023*

Year	GDP per capita	GDP per capita growth
2005	3720	5.85
2006	4383	5.52
2007	5848	6.87
2008	7101	6.11
2009	6169	-2.34
2010	5735	1.14
2011	6809	2.85
2012	6016	-0.20
2013	6755	3.39
2014	6600	-1.13
2015	5589	2.31
2016	5765	3.88
2017	6293	2.65
2018	7252	5.07
2019	7417	4.89
2020	7734	-0.24
2021	9233	8.75
2022	9538	5.16
2023	11361	3.25

Source: World Bank, n.d.e; World Bank, n.d.f

It is possible to observe an uneven trend in the movement of GDP per capita during the observed period, with several peaks (2008, 2011, and 2023 in which the highest parameter value of 11361 in current US$ was recorded). Also, there is a large number of peaks in the parameter GDP per capita grovth – in 2009 value was negative (-2.3), as well as in 2012 (-0.2), 2014 (-1.1), and in 2020 (-0.2). A sharp increase was recorded in 2021 (8.7), after which a decline was recorded.

4. EXAMPLES OF CUSTOMIZATION AND PERSONALIZATION IN SERBIA – A BRIEF REVIEW

Electric motor production program

Several decades of intensive production led to the diversification of the product range and a huge number of product variants, and customers were given to fill out a questionnaire for an asynchronous electric motor, which gave them the opportunity to adjust orders according to specific individual requirements (Anišić et al., 2015). The analysis of the production program revealed that there were more than 3500 products with different identification numbers (bill of material) that were divided into three similar groups, thus, more than 50% of all orders were in the amount of 1 or 2 pieces, so it was almost individual production, where additional customization was done on standard products (Anišić et al., 2015).

Personalization model for banking services

Through personalization, banks have the opportunity to gain customer loyalty in the following ways (Vekić, Orošnjak & Ćosić, 2018):

I. Personalization improves customer satisfaction;

II. Services that meet customers' specific needs should be more satisfactory;

III. Personalized services help customers believe that a bank is appreciative towards them, increasing trust and loyalty;

IV. Personalization increases stickness as a customer will view these services as difficult to replace with another provider.

Planning and creating web sites

Customization and personalization involve creating a record of each page visited by the customer, as well as each product viewed or purchased by the customer. In this way, a group of products that interests them can be identified for each customer (visitor), and information about such a group of products can be served to them on the website itself or via email, and it is very important that the shopping cart is as clear and easy to use (Petrović, 2008).

5. DATA AND METHODOLOGY

The aim of this paper is to explore the relationship between digital transformation and economic growth in the Republic of Serbia. Secondary data were taken from the official website of the World Bank. The analyzed period is from 2013 to 2023, K, L, TOp, GExp and DT appear as independent variables in the model, and GDP is dependent variable. Statistical data processing was applied using IBM SPSS Statistics 25 software. In order to achieve linearity, all raw data was transformed into natural logarithms, thus, multivariate linear regression

model was performed. Table 4 represents the summary of variables.

Table 4. *Summary of variables*

Variable	Notation	Definitions and calculations
Economic growth	lnGDP	GDP per capita (constant 2015 US$)
Investment capital	lnK	Investment capital per GDP (% GDP)
Human capital	lnL	Labor force (total number)
Trade openness	lnTOp	Import-export ratio per GDP (% GDP)
Government expenditure	lnGExp	Government expenditure per GDP (% GDP)
Digital transformation	lnDT	Individuals using the internet (% of population)

Source: SPSS output

The production function explains a basic technological relationship between scarce resources, or inputs, and output (Gordon & Vaughan, 2011). It can be expressed in the following aggregate form:

$$Y = f(K, L) \quad (1)$$

Y – output level; K – capital input; L – labour input.

A special functional form of the production function is the Cobb-Douglas (C-D) production function. This functional form includes the assumption of a constant share of labour in output (Hajkova & Hurnik, 2007). The stohastic form of C-D production function (Husain and Islam, 2016) is written as follows:

$$Y = f(K, L) = AK^{\alpha}L^{\beta}e^{u} \quad (2)$$

A – technological level; α – production elasticity with respect to the input ofcapital factor; β – production elasticity with respect to the input of labor factor; e – basis of natural logarithm; u – stochastic disturbance term.

When both sides of the equation (2) are logarithmized, the following log-linear model is obtained:

$$lnY = lnA + \alpha\, lnK + \beta\, lnL + u \quad (3)$$

To examine the impact of digital transformation on economic growth in the Republic of Serbia, the starting point was the model (3), which was modified for the purposes of this study as follows:

$$lnGDP_t = \beta_0 + \beta_1\, lnK_t + \beta_2\, lnL_t + \beta_3\, lnTOp_t + \beta_4\, lnGExp_t + \beta_5\, lnDT_t + \varepsilon_t \quad (4)$$

ln – natural logarithm; t – observation subscript; $\beta_0 = lnA$; ε – error term; GDP – proxy of output level; K – proxy of capital input; L – proxy of labour input; TOp – proxy of trade openness; DT – proxy of digital transformation.

6. RESULTS

Descriptive statistical analysis was applied to present the minimum, maximum, mean, and standard deviation values of analyzed variables (table 5).

Table 5. *Descriptive statistics*

Descr. Stat.	lnGDP	lnK	lnL	lnTOp	lnGExp	lnDT
Mean	8.7525	3.0500	14.9958	4.6790	2.8163	4.2573
Std.	0.12337	0.16701	0.02624	0.13164	0.04484	0.13798
Min	8.61	2.80	14.96	4.48	2.76	3.98
Max	8.95	3.28	15.04	4.93	2.89	4.43
Obs. (N)	11	11	11	11	11	10
Valid N	10					

Source: SPSS output

Table 6 represents descriptive statistics from the regression output. Based on the coefficient of determination (R^2 = 0.984) – a measure of "explained variation", about 98% of the total variation in lnGDP is explained by the regression, and the standard error of estimate – a measure of "unexplained variation" is 0.02069.

Table 6. *Descriptive statistics from the regression output*

R	0.992
R^2	0.984
Adjusted R^2	0.964
Standard error	0.02069
Observations	10

Source: SPSS output

Next, F-test was applied to determine the validity of the entire regression model (4) and the availability of regression dependence. Since F = 49.482, the regression is statistically significant at the significance level α = 0.001 because the p-value is less than 0.05 (0.001). As a result, the validity of the regression model is confirmed, and the null hypothesis can be rejected, because there is a regression dependence between the observed variables (table 7).

Table 7. *F-test*

Model	F	Significance
Regression	49.482	0.001

Source: SPSS output

In order to examine the individual effectiveness of the independent variables in predicting the dependent variable, t-test was applied (Table 8).

Table 8. *Regression coefficients and t-test*

Model	B	t	Significance
Constant	-8.970	-1.065	0.347
lnK	0.291	2.632	0.058
lnL	0.940	1.551	0.196
lnTOp	0.368	1.980	0.119
lnGExp	0.384	1.669	0.171
lnDT	-0.018	-0.126	0.906

Source: SPSS output

It can be concluded, based on the results shown in table 8, that it is not possible to reject the null hypothesis for all observed variables (lnK, lnL, lnTOp, lnGExp, and lnDT), because their p-values (significances) are greater than 0.05. None of these variables is useful for predicting the dependent variable lnGDP. Embracing digitization

can help accelerate economic growth. Although the Covid-19 pandemic has encouraged digitalization, Serbia is still far from the digitalization that exists in the developed countries of the world.

7. CONCLUSIONS

With the fourth industrial revolution, digitization is becoming the main catalyst for innovation, modernization, economic growth, competitiveness and comprehensive socio-economic progress and development (The Office for Information Technologies and eGovernment, n.d.). The Government of the Republic of Serbia has recognized the importance of digitization and the development of electronic administration, which has contributed to significant development in this area in the past few years, thus, digitization as one of the priorities of the Government of the Republic of Serbia, transforms the way public administration works and increases its economy, transparency and quality of work (The Office for Information Technologies and eGovernment, n.d.).

A significant improvement in the use of the internet and computers is noticeable, as well as a slight reduction in the gap between urban and rural areas in the terms of the presence of computers (Stojiljković-Rolović, 2021). A major turning point in the field of digital inclusion occurred when the Republic of Serbia faced the Covid-19 pandemic in 2020, which globally forced billions of people to switch to the digital ecosystem as the main means of accessing information, and greatly accelerated digitization and in the Republic of Serbia (Stojiljković-Rolović, 2021).

Personalization of products and services on the Serbian market makes products and services stand out from the mass of similar products and services. Personalization has become a distinct strategy for e-commerce businesses that want to stand out in a crowded marketplace. By tailoring the customer experience to the individual, companies can build stronger relationships with customers and increase sales.

However, Serbia is still far from the digital inclusion that developed countries have, which means that the competent authorities will have to put in a lot more effort to reach an adequate level of digitization in Serbia.

This paper can serve as a good starting point for future researchers dealing with digitization and economic growth.

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