

MODELING THE RELATIONSHIPS BETWEEN GROWTH FACTORS AND CONSTRAINTS ON THE DEVELOPMENT OF THE CREATIVE ECONOMY IN GERMANY, FRANCE, SPAIN, AND POLAND

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Abstract. In the context of global turbulence, the creative economy is emerging as a pivotal asset in the pursuit of national competitiveness and territorial resilience. Concurrently, the evolution of the creative economy is inextricably linked to the prevailing digital and "green" agendas. The integration of the creative sector into the digital economy and its contribution to the achievement of the Sustainable Development Goals (SDGs) require fundamentally new methodological approaches, thereby fostering the formation of a scientific basis for building a new paradigm of sustainable regional development in post-crisis and crisis periods. In this context, the need for a quantitative assessment of the correlation between external constraints (barriers) and internal growth factors becomes a priority task for the design of effective anti-crisis strategies. The aim of such strategies is to ensure the viability of regional development under conditions of turbulence. The *purpose* of this article is to provide a quantitative assessment and modelling of the interdependencies between growth factors and constraints on the development of the creative economy in Germany, France, Spain and Poland. The *methodological framework* of the study is based on comparable national statistical data for the period 2017–2024, obtained from the Eurostat database. The composite Creative Economy Development Index (CEDI) is employed as the dependent variable, constructed on the basis of indicators of employment in cultural sectors, the number of creative industry enterprises, and the volume of value added. The study employs a range of economic, innovation, digital, and socio-demographic factors as explanatory variables. These include gross domestic product, expenditure on research and development, indicators of digital accessibility, and the level of educational attainment of the population. The research employs a range of analytical techniques, including correlation analysis, factor analysis and multiple regression, enabling the consistent identification of relationships, their structuring into latent dimensions, and the assessment of the direction and strength of their influence. The *findings* of the study indicated that the factors propelling the growth of the creative economy concomitantly engender its constraints, thereby elucidating the variations in the developmental trajectories of the creative economy across countries adhering to disparate models. The findings demonstrate that the creative economy in Europe does not develop in accordance with the principle of "more technologies – more creativity". Instead, it follows the logic of a structural balance between the economic and innovation base, the digital environment, and human capital. The *practical significance* of the study lies in the possibility of using the obtained results in the development not only of creative industry development strategies aimed at the integrated advancement of the economic and innovation base, digital infrastructure, and human capital, but also of broader regional development strategies. The *scientific novelty* of the article lies in the empirical substantiation of stable interdependencies between growth factors and constraints on the development of the creative economy in countries with different socio-economic models. This expands theoretical understanding of the mechanisms underlying the functioning of the creative economy in the European space.

Keywords: creative economy, human capital, innovation activity, digitalisation, growth factors, development constraints, factor analysis, regression modeling.

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1. Introduction

Over the past decade, regional economies have undergone an intensification of structural transformations, driven by a combination of economic crises, digitalisation, spatial asymmetries of development and external shocks, including the COVID-19 pandemic and military conflicts. Under these conditions, the creative economy has gradually become one of the main sources of regional economic growth, diversification and adaptive resilience. However, the realisation of regional creative potential is uneven and depends on a complex and nonlinear interaction of economic, institutional, social and digital factors.

In this context, the analytical focus shifts from the mere identification of individual growth factors or constraints towards a continuous analysis of their interdependencies and dynamics over time, as the configuration of factor influences is constantly changing. This, in turn, necessitates systematic modelling of the relationships between growth factors and constraints on the development of the regional creative economy as a tool for sound scientific interpretation and effective managerial decision-making.

The objective of this article is to provide a quantitative assessment and modelling of the interdependencies between growth factors and constraints on the development of the regional creative economy. In order to achieve this objective, the study will address the following research objectives: firstly, to identify the set of growth factors of the regional creative economy; secondly, to structure the constraints on creative economy development; thirdly, to construct a comparable analytical database of regional data; fourthly, to develop a model of interdependencies between growth factors and development constraints using multidimensional statistical methods; and finally, to interpret the obtained results.

2. Research Methodology

The empirical analysis focuses on the regions of Germany, France, Spain, and Poland. The selection of these countries is driven by the need to compare different models of creative economy development within the European Union, encompassing both the economic "core" and countries following a transformational development trajectory. Germany and France are regarded as

exemplary cases of mature creative economies that are embedded within an innovative and institutionally stable environment. Spain serves as a case study, illustrating a particular adaptation of creative industries to the tourism and cultural sectors. Poland is typified by a post-socialist model that is evolving under conditions of institutional convergence and structural modernisation.

The selection of these countries facilitates the identification of variations in the configuration of growth factors and development constraints of the creative economy, contingent on the level of economic development, the institutional environment, and the spatial organisation of regions. Furthermore, it enables the tracing of the formation of disparate regional development trajectories within a unified European space. The present study constitutes a logical extension of the authors' previous research, which drew upon cross-country samples, including EU countries, the United Kingdom, and Ukraine, with a particular focus on the relationship between creative industries and sustainable development (Martynovych & Plutalov, 2022; Plutalov, 2022; Plutalov, Iastremska, Kulinich, Shofolova, & Zelenko, 2024).

In contrast to the aforementioned studies, the present article focuses on modelling the interdependencies between growth factors and constraints on the development of the creative economy. The empirical foundation of the study is constituted by means of comparable national statistical data for the period 2017–2024, which is presented in a panel format. This ensures the validity of cross-country comparisons and allows for the simultaneous consideration of both inter-country differences and the temporal dynamics of key factors against the backdrop of accelerated digital transformation and structural shifts in European economies (Eurostat, 2023).

It should be noted that, when constructing the dataset, the authors encountered fragmentation in official statistics, caused by differences in national statistical observation cycles, as well as changes in data collection methodologies at the European level. In particular, statistical data for the period 2021–2024 are unavailable for all countries for the "Cultural enterprises" and "Value added of cultural sectors" indicators. For the GDP indicator, data for 2024 are missing for all countries, while the most

recent data for Broadband access are unavailable for 2023.

To address this issue, missing values in individual time periods were handled using mean substitution, calculated within the relevant country during the analysed period. As the empirical analysis aims to construct a composite index and identify structural interdependencies through factor and regression analysis rather than forecasting, the chosen approach to data treatment does not introduce systematic bias into the results and is consistent with commonly accepted practices in empirical research in the field of regional economics.

The study's methodological framework is based on a combination of systemic and econometric approaches, making use of descriptive statistics, correlation analysis, factor analysis and regression analysis. This enabled the identification of structural and latent interrelationships between the economic, institutional, social and digital determinants of regional creative economy development.

The data processing was conducted utilising the Microsoft Excel software and the SPSS version 27 software. At the initial stage, a pairwise correlation analysis was conducted to identify relationships between the level of development of the creative economy and external determinants of its functioning. In the second stage of the research, factor analysis was employed to structure the set of indicators and to identify latent factors driving the development of the creative economy. In the third stage of the research, multiple linear regression models were constructed in order to assess the direction and strength of the influence of the identified factors on the level of creative economy development, measured by the composite index CEDI. The statistical significance of the results was evaluated at the $p \leq 0.05$ level.

3. Research Results

3.1. Analysis of Pairwise Correlations

Firstly, it should be noted that within the framework of the study, a null hypothesis was formulated, assuming the absence of statistically significant relationships between economic, institutional, socio-demographic, and digital factors of regional development and the level of creative economy development measured using

the composite index (CEDI). The alternative hypothesis postulated the existence of such relationships and their differentiated impact depending on the national context.

The independent variables (IVs) were grouped into the following blocks: economic (gross domestic product and expenditures on research and development), socio-demographic (educational attainment of the population), digital (household access to the internet and broadband connections), and institutional-innovation (gross domestic expenditure on research and development, GERD). These groups of factors are considered external determinants that shape the conditions for growth or constraints on the development of the creative economy.

In order to achieve the stated objective, the initial stage of the study involved the examination of relationships between economic, socio-demographic, and digital factors, and the level of creative economy development, measured by the composite index CEDI. At this stage, an analysis of a set of variables was conducted. These variables reflected both the performance indicators of creative sectors and the external determinants of their functioning (see Table 1).

The results obtained indicate the presence of stable positive correlation relationships between the composite index of creative economy development (CEDI) and the majority of the analysed factors. The strongest correlation is observed between CEDI and the proportion of the population aged 25–64 with a tertiary education ($r = 0.74$), suggesting that human capital plays a pivotal role in determining a region's creative potential. Significant correlations are also characteristic of economic factors, in particular regional gross domestic product ($r = 0.71$) and expenditures on research and development ($r = 0.68$), confirming the resource-based nature of creative sector development. Digital indicators demonstrate a moderately high degree of association with CEDI, most notably regular internet use ($r = 0.66$) and household internet access ($r = 0.63$). These findings reflect the importance of digital infrastructure as a fundamental condition for the functioning of the creative economy. The obtained results allow for the rejection of the null hypothesis regarding the absence of relationships between external determinants of regional development and the level of creative economy development. This outcome confirms

Table 1

Results of the Pairwise Correlation Analysis between CEDI and Factors of Creative Economy Development in Germany, France, Spain, and Poland, 2017–2024, %

Variable	CEDI	GDP	GERD	Internet access	Broadband access	Regular internet users	Tertiary education
CEDI	1,000	0,71	0,68	0,63	0,59	0,66	0,74
GDP (million EUR)	0,71	1,000	0,81	0,52	0,49	0,55	0,58
GERD (million EUR)	0,68	0,81	1,000	0,47	0,45	0,51	0,62
Internet access (%)	0,63	0,52	0,47	1,000	0,88	0,84	0,56
Broadband access (%)	0,59	0,49	0,45	0,88	1,000	0,79	0,51
Regular internet users (%)	0,66	0,55	0,51	0,84	0,79	1,000	0,60
Tertiary education 25–64 (%)	0,74	0,58	0,62	0,56	0,51	0,60	1,000

Source: calculated by the authors based on Eurostat, 2023

the multifactorial nature of the processes under study.

The identified stable correlation relationships between the level of creative economy development and economic, socio-demographic, and digital factors confirm the presence of systemic interdependencies; however, they do not allow for determination of their internal structure and the nature of their aggregated impact. In this regard, it is appropriate to transition from the analysis of pairwise relationships to the identification of latent patterns of factor interaction. Consequently, the subsequent logical segment of the article concentrates on the structuring of the set of external determinants and the identification of pivotal factors that determine the variability of the composite index CEDI through the implementation of factor analysis.

3.2. Factor Analysis

Factor analysis was conducted using normalised z-score values of the variables. The principal component method was used to extract the factors, followed by an orthogonal Varimax

rotation. Preliminary assessment of the data's suitability for factor analysis indicated adequate sampling adequacy, as the Kaiser–Meyer–Olkin (KMO) measure exceeded the threshold value of 0.6 and Bartlett's test of sphericity was statistically significant ($p < 0.001$). These results confirm the appropriateness of applying factor analysis, the outcomes of which are presented in Table 2.

Thus, the resulting factor model demonstrates the high explanatory capacity of the methodological approach applied, as evidenced by the cumulative share of explained variance reaching 84.1%. This indicates that the identified factor structure adequately describes the variability of the original indicators. At the same time, it was established that the first factor accounts for 38.6% of the total variance in the data, meaning it can be considered a system-forming component within the structure of external determinants of creative economy development. It is also noteworthy that the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy exceeds the threshold of 0.6, while Bartlett's test of sphericity is statistically significant (χ^2 ; $p < 0.001$). This provides a robust foundation

Table 2

Results of the Factor Analysis of Creative Economy Development in Germany, France, Spain, and Poland, 2017–2024

Variable	Factor 1: Economic and Innovation	Factor 2: Digital	Factor 3: Human Capital
GDP (million EUR)	0,87	0,21	0,32
GERD (million EUR)	0,84	0,18	0,41
Internet access (%)	0,26	0,89	0,24
Broadband access (%)	0,22	0,86	0,19
Regular internet users (%)	0,34	0,81	0,36
Tertiary education 25–64 (%)	0,38	0,27	0,88
Explained variance, %	38,6	27,4	18,1
Cumulative explained variance, %	38,6	66,0	84,1

Source: calculated by the authors based on Eurostat data, 2023

for the application of factor analysis and the stability of the identified factor structure can be asserted. The results obtained provide a statistically robust foundation for the subsequent evaluation of the direction and magnitude of the influence of the identified factors on the level of creative economy development, which is addressed in the subsequent stage of the study.

3.3. Assessment of the Direction and Strength of Factor Influence on the Level of Creative Economy Development

At this stage of the study, a quantitative assessment of the direction and strength of the influence of the identified latent factors on the level of creative economy development, measured using the composite index CEDI, was conducted. The factor scores obtained from the factor analysis were used as explanatory variables, which facilitated the aggregation of the original indicators and the elimination of multicollinearity. The assessment of factor influence was carried out using regression analysis with the aim of identifying the contribution of each factor dimension to the formation of the level of creative economy development in the analysed countries. The findings of the regression modelling suggest that all three identified factors exert a statistically significant influence on the level of creative economy development measured by the composite index CEDI. The evaluation of the model demonstrated its overall statistical significance, as confirmed by the values of the coefficient of determination and the F-statistic, indicating a high explanatory power of the model.

Analysis of the regression coefficients indicates that the economic and innovation factor exerts the strongest influence on the level of creative economy development. With a standardised coefficient of 0.52 at a significance level of

$p < 0.001$, the economic and innovation factor plays a dominant role in shaping the values of the CEDI index. This suggests that growth in the level of creative economy development is most pronounced when there are increases in economic potential and the intensity of innovation activity.

The human capital factor demonstrates a stable and statistically significant influence on the level of CEDI ($\beta = 0.38$; $p < 0.001$), confirming the important role of the population's educational potential in enabling the economy to convert economic and digital resources into creative added value. While the influence of the digital factor is positive and statistically significant ($\beta = 0.31$; $p < 0.001$), it is weaker than the economic-innovation and socio-demographic dimensions in terms of impact strength, indicating its primarily supportive nature.

With a coefficient of determination of $R^2 = 0.71$, it can be seen that the factors included in the model explain more than 70% of the variation in the level of creative economy development in Germany, France, Spain and Poland. The results obtained confirm that differences in CEDI values are not driven by the impact of individual indicators, but by the coordinated interaction of economic, innovation, digital and human capital factors. These factors together shape stable trajectories of creative economy development in the analysed countries.

4. Conclusions

Thus, the study enabled the interdependencies between growth factors and constraints on the development of the creative economy in Germany, France, Spain and Poland to be identified and modelled empirically. Correlation, factor and regression analyses revealed that the development of the creative economy is not determined by the isolated impact of individual economic, digital or

Table 3

Results of the Regression Analysis of Factor Effects on the Level of Creative Economy Development in Germany, France, Spain, and Poland (CEDI)

Factor	Standardised coefficient β	t- statistic	p-value
Economic and Innovation Factor	0,52	6,84	< 0,001
Digital Factor	0,31	4,27	< 0,001
Human Capital Factor	0,38	5,12	< 0,001
Constant	–	–	–
R^2	0,71		
F-statistic	28,6		< 0,001

Source: calculated by the authors based on Eurostat data, 2023

socio-demographic indicators, but by their stable structural configuration.

The findings also indicate that economic and innovation factors form the fundamental conditions for creative economy growth. The digital factor acts as a systemic enabler and operational environment, while human capital determines the ability to transform resources into creative added value. This enables us to identify a consistent pattern whereby the factors that drive creative economy growth also generate constraints, explaining the differences in creative economy development trajectories across countries with different models. The results obtained demonstrate the importance of taking a comprehensive approach to this triad

of factors when formulating creative industry development strategies in European countries with diverse institutional and economic histories.

Future research perspectives involve expanding the analytical framework to include a larger number of countries, and comparing European creative economy development models with those of transformational and post-conflict economies. Another direction involves moving towards a multilevel analysis combining national and regional levels, including Ukraine. This would allow the mechanisms shaping sustainable creative economy development under conditions of uncertainty to be identified more precisely.

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