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Modeling the Impact of Key Regional Socio-Economic Factors on the Development of Creative Industries in the Russian Far East



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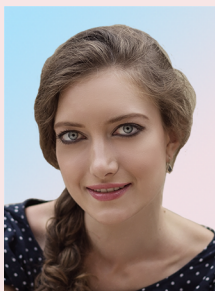
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Abstract. Amid the growing role of intangible factors of production and the shift toward a knowledge economy, the development of creative industries is becoming an important avenue for diversifying the national economy and stimulating economic growth. For Russia, marked by considerable territorial and socioeconomic heterogeneity, it is particularly important to identify the factors shaping the emergence and dynamics of the creative sector at the subregional and municipal levels. The study aims to assess how socioeconomic factors affect the likelihood of new creative industry organizations being established at the municipal level, taking into account the regional context and the center–periphery hierarchy. The empirical base consists of panel data for 220 municipalities of the Far Eastern Federal District of the Russian Federation for 2012–2020, compiled from the SPARK system and official statistics. We apply linear probability models with fixed effects, which account for unobserved territorial heterogeneity and capture the influence of key factors in creative sector development. The regression results reveal a statistically significant U-shaped relationship between the number of students and the likelihood of creative industry organizations being established, pointing to a threshold effect of human capital. The associations with wages and entrepreneurial activity are less robust and depend on the model specification and territorial context: in peripheral areas their statistical significance weakens, while the U-shaped effect of educational potential persists. These findings confirm the spatial heterogeneity of the factors behind creative sector formation and underscore the central role of local educational potential. The results contribute to understanding how the creative economy emerges in Russia and can inform further empirical research, as well as provide indicative benchmarks for designing differentiated regional policies to support the creative sector.

Key words: creative industries, creative economy, socio-economic development of territories, Far Eastern Federal District, regression analysis.

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Introduction

Creative industries represent one of the most dynamically developing sectors, generating value added through the capitalization of intellectual and creative potential (Gushchina, Tarabanova, 2022; Gouvea, Vora, 2018) and contributing to social cohesion, municipal development, and technological innovation (Borre et al., 2023; Gustafsson, Lazzaro, 2021). For Russia, whose transition to a post-industrial economy is complicated by numerous sanctions and accumulated socio-economic imbalances,

developing the creative sector is a strategic task aimed at reducing resource dependence (Shlychkov et al., 2023) and ensuring economic growth. Indeed, sovereign development – a subject raised in recent years both by the academic community (Ilyin, Morev, 2024) and by the country’s political leadership¹ – is impossible in a stagnating and/or unbalanced economy.

In 2022, creative industries accounted for 3.1% of global GDP and 6.2% of global employment (about 50 million jobs)². According to HSE

¹ Putin said Russia will protect its sovereignty just as in 1612. Available at: <https://www.rbc.ru/rbcfreenews/690a45139a794784717fa451>

² UNCTAD: Creative Economy Outlook 2024. Available at: https://unctad.org/system/files/official-document/ditctsce2024d2_en.pdf

University forecasts, their share in global GDP will triple to 10% by 2030³. In 2024, according to the WIPO ranking, the world leaders of the creative economy were Switzerland, South Korea, and the United Kingdom⁴. Despite the growth of the creative economy's contribution to Russia's GDP to 4.1% in 2024⁵, the country ranked only 53rd in that same ranking. The reliability of foreign organizations' estimates and rankings can be debated, but at present there is no basis for claiming global leadership in the development of creative industries. On the contrary, in his May 2024 decrees⁶, the President of Russia emphasized the need to further strengthen the role of creative industries in the national economy, which indicates that the limits of growth have not yet been reached.

The Russian Ministry of Economic Development classifies 16 enlarged types of economic activity as belonging to the creative sector, including fashion, film, television programs and movies, music, architecture and urban studies, design, and others⁷. However, the published draft Strategy for the Development of the Creative Economy in the Russian Federation up to 2036 notes that the boundaries and composition of these industries remain blurred⁸, pointing to the possibility of revising the list in the future. In addition to methodological heterogeneity, a number of other problems in the development of the creative sector can be identified, related to the protection (transfer and valuation) of intellectual property

rights (Domnin, Domnina, 2025), weak investment dynamics⁹, underdeveloped infrastructure, and a shortage of personnel (Koroleva, Sokolova, 2022).

It is important to note that the creative sector is also affected by the heterogeneity of regional socio-economic development levels and rates (Rumyantsev, Lukin, 2025), by geographic location, and by ongoing agglomeration processes (Kozhevnikov, Voroshilov, 2024). The compression of economic space, characteristic of current realities (Popov, 2023), reduces not only the potential production of creative goods but also their consumption. At the same time, in a rapidly changing environment and with the fluid nature of the creative market (Montalto et al., 2021), creative industries must adapt and develop quickly if they are to remain competitive (Kalfas et al., 2024).

Despite extensive coverage of the topic in Russian and international literature, the determinants behind the emergence of creative organizations in particular regions and municipalities of Russia remain underexplored. For example, scholars from Volgograd State Technical University do not consider the municipal level when assessing the growth potential of creative industries (Akimova et al., 2022), while in foreign studies the composition of creative industry activities differs significantly from Russian institutional definitions (Che Arshad, Irijanto, 2023; Campi et al., 2024), making their findings difficult to interpret for Russian territories.

³ Development of the creative economy. Available at: https://ncmu.hse.ru/chelpoten_trends/creat_economy

⁴ Global Innovation Index 2024. Unlocking the Promise of Social Entrepreneurship. Available at: https://www.wipo.int/web-publications/global-innovation-index-2024/assets/67729/2000%20Global%20Innovation%20Index%202024_WEB3lite.pdf

⁵ The creative economy's contribution to GDP in 2024 amounted to 7.5 trillion rubles. Available at: https://economy.gov.ru/material/news/vklad_kreativnoy_ekonomiki_v_vvp_v_2024_godu_sostavil_75_trln_rubley.html

⁶ On the National Development Goals of the Russian Federation for the period up to 2030 and for the future up to 2036: Presidential Decree of May 7, 2024. Available at: <http://kremlin.ru/events/president/news/73986>

⁷ On approval of the list of economic activities in the sphere of creative industries based on the All-Russian Classifier of Economic Activities: Order of the Ministry of Economic Development of the Russian Federation of April 23, 2025 No. 266.

⁸ Draft Strategy for the Development of the Creative Economy in the Russian Federation up to 2036. Available at: https://www.economy.gov.ru/material/departments/d04/kreativnaya_ekonomika/proekt_strategii_razvitiya_kreativnoy_ekonomiki_v_rossiyskoy_federacii_do_2036_goda.html

⁹ Creative industries in Russia: Trends and development prospects. Available at: https://www.hse.ru/data/2021/07/11/1434062388/CI_1.pdf

The issue of creative sector development is especially relevant for the Far Eastern Federal District (FEFD). The macroregion possesses both vast natural resources, unique cultural features, and proximity to developed Asian countries. This largely explains why provisions on creative industry development have been included in the draft Strategy for the Socio-Economic Development of the Far Eastern Federal District up to 2030 with a forecast to 2026¹⁰. Nevertheless, the overall socio-economic situation in the FEFD remains tense. There is a steady outflow of population, especially highly skilled young people, not only to other regions of the country but also abroad (Stroeve, 2025). Young professionals cite the desire for high incomes and the opportunity to realize their creative potential as key emigration factors (Oleinik et al., 2024). Negative net migration against the backdrop of depopulation of the Far Eastern territories means that, as of the second quarter of 2025, the FEFD is experiencing a significant labor shortage, and the average job search time (6.1 months) is almost a month longer than the national average (5.2 months) (Bravok, Naiden, 2025). Moreover, the economic development of the FEFD is further complicated by an unbalanced economic structure. Its resource-based orientation – expressed in the dominance of mining in the structure of shipped industrial output – and the absence of clear growth trends in deep-processing manufacturing reinforce the existing technological dependence of local production (Bukhvald, Kizil, 2026).

Under these conditions, the development of the creative sector is becoming a strategic priority, as it draws on the cultural capital of the FEFD, responds to young people's demand for self-fulfillment, and at the same time increases the share of non-resource output in GRP. Research confirms that the number of creative organizations, their revenue,

and employment have the greatest impact on the sector's contribution to GRP (Akimova et al., 2022). The development of creative industries also helps to address the chronic decline of peripheral territories (Bufetova, 2009; Kozhevnikov, 2019). The Italian experience shows that an increase in the number of creative firms has a positive effect on employment and value added dynamics (Piergiovanni et al., 2012). Thus, the development of creative industries in the FEFD will not only help mitigate the emigration problem but also stimulate more balanced economic development of the macroregion.

Given the above, it is worth assessing how socio-economic determinants influence the emergence of organizations in the creative industries across regions and municipalities. The analysis takes the Far Eastern Federal District as an example and accounts for the center–periphery hierarchy, thereby helping to inform regional policy aimed at developing the creative economy.

The scientific novelty of this study lies in filling the gaps in research on the dependence of creative industry development on regional and municipal socio-economic development. Specifically, it empirically substantiates the non-linear threshold effects of human capital and the context-dependent nature of the socio-economic determinants of creative industry firm creation at the regional and municipal levels, taking into account the center–periphery hierarchy.

Literature review

Theoretical approaches to explaining the emergence and growth of firms traditionally rest on several conceptual frameworks. The resource-based theory of the firm emphasizes the role of unique resources and capabilities in securing competitive advantages and growth (Kleiner, 2011). Human capital theory focuses on the knowledge, skills,

¹⁰ Strategy for the Socio-Economic Development of the Far Eastern Federal District up to 2030 with a forecast to 2036. Available at: <https://dfostrategy.vostokgosplan.ru/> (accessed: 27.07.2026).

and experience of entrepreneurs and employees as key determinants of success (Dyatlov, 1994). Institutional theory examines the influence of formal and informal institutions on entrepreneurial activity and growth of the number of firms (Sazanova, 2015).

Creative industries exhibit specific growth patterns (Loots, van Witteloostuijn, 2018) that distinguish them from other commercial organizations. In particular, creative organizations grow along separate dimensions – sales, assets, and employment – independently of one another, which contrasts with traditional models of balanced growth (Pfeifer et al., 2016). For example, in Croatia only 2.2% of creative enterprises showed simultaneous growth in sales, assets, and employment (Pfeifer et al., 2016). Moreover, even the nature of entrepreneurs' motivation differs: it is shaped not only by economic attitudes and goals but also by personal factors such as passion and inspiration (Bhansing et al., 2018).

Human capital is recognized as a key component of creative industries (Rustiadi, 2015). The share of highly educated employees is positively correlated with growth in knowledge- and technology-intensive sectors, including the creative industries (Pfeifer et al., 2016). The qualifications of workers, their creative abilities, and professional skills determine a firm's capacity to create innovative products and services (Gushchina, Tarabanova, 2022), while the gender and age characteristics of founders and entrepreneurs directly influence the development trajectory of such organizations (Protogerou et al., 2024).

However, a number of Russian and international researchers link the development of creative industries to educational trends in a particular territory. This issue is examined both from the perspective of training personnel who will later work as employees (Efimova, Bryukhanova, 2023) or establish creative organizations and ecosystems (Dent et al., 2024; Kim, Comunian, 2024), and

from the viewpoint of public consumption of cultural products (Zhang, Kloudova, 2011).

In addition to training personnel, higher education institutions serve as nodes of entrepreneurial ecosystems, facilitating the translation of knowledge into commercial products (Audretsch et al., 2022). For example, in the Republic of Sakha (Yakutia), the introduction of specialized educational programs and support for student initiatives laid the groundwork for the development of the IT sector and media industries (Verkhovtseva, 2024). The network interactions of creative companies are not limited to ties with other firms or universities but also extend to government bodies, which can interact with them directly (Gushchina, Tarabanova, 2022) or by designing institutional conditions (Gushchina, Tarabanova, 2022; Glebova et al., 2021).

It is also worth emphasizing that a substantial body of work studies creative industries through the lens of culture (De Bernard et al., 2022), whose relationship with education is linear (Dobrova, 2024). As a result, science is often regarded as a separate factor in the development of cultural industries (Martinaityte, Kregzdaite, 2015). Although scientific research is not included in the Russian list of creative industry activities, there is a phenomenon of scientific creativity that, according to some researchers, is fundamental to the entire creative sector (Martinaityte, Kregzdaite, 2015). Thus, G. Stumpf's work suggests that scientific research depends heavily on the individual (including their motivation and personal characteristics), and that scientific inquiry becomes the product of intellectual labor, although its originality may be subject to debate (Stumpf, 1995). We agree with A. Sviridenok's view that scientific creativity involves the emergence of an idea as a result, as well as creative realization based on existing knowledge, research methods, technologies, and material products (Sviridenok, 2014).

Another factor shaping the development of creative industries is the presence of tourism and historical-cultural potential (Kryukov, 2024). Its special role is particularly visible in industries whose value lies not in producing something entirely new but in preserving and interpreting cultural heritage. Libraries, archives, and museums are a case in point: their core activities center on safeguarding and disseminating heritage, although some scholars propose models for engaging museums in innovation processes (Nogare, Murzyn-Kupisz, 2022). Unlocking this potential requires both infrastructure and qualified specialists. Research shows that service infrastructure helps revitalize local economies (Sharp et al., 2002), while the development of tourist routes and the availability of qualified guides stimulate demand for related creative services (Lin et al., 2022).

Researchers also identify several purely economic factors behind the emergence and growth of organizations in general. Wages, in particular, act as the main economic stimulus for migration (Boldenkov et al., 2025) and for the concentration of talent (Leonidova, 2024). Growth in the creative sector raises overall wage levels in municipal economies but pushes the least productive industries out of cities (Lee, 2014). In addition, creative industries are closely linked to entrepreneurial activity (Muzychuk, 2023) and to the degree of market concentration. Empirical evidence shows that access to internal and external financing at the early stages is critical (Yudanov, 2010), while prudent use of resources and profit retention are associated with a higher probability of sales and asset growth (Pfeifer et al., 2016). Agglomeration effects, in turn, encourage the concentration of startups and creative firms in large cities, where access to markets and digital infrastructure is greater (Zemtsov et al., 2021); similarly, interaction among actors within regional clusters and art residencies supports creative development at the sub-federal level (Efimova, Bryukhanova, 2023).

Drawing on the literature review and current understanding of how socio-economic factors shape the emergence of creative industry organizations, we put forward the following hypotheses.

H1. The influence of human capital, proxied by the number of students, on the likelihood of creative industry growth is non-linear.

H2. The level of wages has a positive effect on the development of the creative sector, acting as a factor attracting talent, but this effect is stronger under the agglomeration advantages of regional centers and weaker in peripheral territories.

H3. Employment in science and culture has a complex non-linear relationship with the dynamics of creative industries, reflecting the specific nature of scientific creativity and differences in the mechanisms of knowledge transfer to the commercial sector.

H4. Overall entrepreneurial activity stimulates the growth of the number of creative industry organizations primarily through a linear mechanism, without pronounced non-linear effects, indicating a direct relationship between the general business climate and the entry of firms into the creative sector.

H5. The structure of determinants of creative industry growth is spatially heterogeneous and depends on the hierarchical position of a territory in the settlement system, confirming differences in development mechanisms between regional centers and the periphery.

Materials and methods

The empirical base of the study includes panel data on municipal entities (urban okrugs, municipal okrugs, and municipal districts) of the Far Eastern Federal District (FEFD) for 2012–2020. The choice of the municipal level of analysis is consistent with established practice in research on regional entrepreneurial dynamics and innovation (Anokhin et al., 2018). The FEFD is a strategically important and socio-economically heterogeneous macroregion of Russia (Ilchenko, Sirazhdinov,

2024), encompassing urban, suburban, and rural territories, which ensures variability in the data and generalizability of the conclusions.

The data were compiled from two sources. The first was information from the SPARK information and analytical system for 1999–2023 on organizations and individual entrepreneurs registered in the regions of the Far East, including industry affiliation, financial reporting indicators, and registration and liquidation dates. Business entities whose main activity code belongs to the official consolidated classification grouping of creative industries according to OKVED2 (Resolution of the Ministry of Economic Development of Russia No. 266) were classified as creative industries; this classification is a mandatory condition for receiving state support. At the municipal level, we calculated creative sector indicators for organizations and individual entrepreneurs: the number of established, operating, and liquidated entities, as well as the Herfindahl–Hirschman index. The second source was socio-economic indicators of municipalities from open data of Rosstat and regional government bodies. Administrative units were matched using the OKATO/OKTMO code directory; the matrix of geographic distances between municipalities was constructed on the basis of the coordinates of their administrative centers. The empirical models are estimated on a balanced panel for 2012–2020.

To analyze the factors behind the emergence of creative industries, we use linear probability models (LPMs) with fixed effects. The estimated coefficients are interpreted as changes in the probability of an event, which makes marginal effects easier to interpret substantively (Angrist, Pischke, 2009). For panels with many units and few time periods, fixed-effects LPMs yield consistent estimates even in the presence of unobserved heterogeneity specific to a municipality or region (Wooldridge, 2010). Non-linear fixed-effects models (including conditional logit) often produce biased estimates on short panels, because a large

number of individual effects must be estimated from a small number of years, especially when the dependent variable barely changes within units over time. Given that positive outcomes account for about 19% of observations, a linear probability model with fixed effects is preferable to a logit specification for these panel data (Timoneda, 2021). In all models, standard errors are clustered at the municipality level.

The dependent variable is the binary variable of creative industry emergence, (CI_create_{it}). It takes the value 1 if the number of operating creative industry organizations in municipality i in year t exceeds their number in year $t - 1$, and 0 otherwise:

$$CI_create_{it} = \begin{cases} 1, & CI_Ex_E_{it} > CI_Ex_E_{it-1}, \\ 0, & otherwise \end{cases}$$

where $CI_Ex_E_{it}$ is the number of creative industry organizations in municipality i in year t .

The distribution of the variable shows that 18.9% of observations in the panel correspond to cases of creative industry emergence, and no municipality exhibited sustained growth throughout the entire study period.

Thus, the model explains not the scale of the sector but the probability of the very fact of its emergence at the municipal level. Moving to continuous indicators (the logarithm of the number of organizations, revenue, employment) shifts the focus to models of creative industry development, which are more common in the literature. The main dependent variable is constructed from the dynamics of the number of operating organizations registered as legal entities. We deliberately excluded the number of newly emerged individual entrepreneurs from this indicator, since it is the establishment of a legal entity that makes it possible to obtain grants for supporting creative industries. Legal entities have the potential for scaling and corporate development that individual entrepreneurs do not possess; therefore, the emergence of a legal entity, primarily an LLC, signals the development of the commercial

potential of the creative industries, whereas establishing an individual entrepreneurship is an attempt to “stay in the shadows” of small business.

The set of independent variables was formed on the basis of theoretical ideas about the determinants of creative business emergence and includes indicators of human capital, economic conditions, entrepreneurial activity, and market structure.

The number of students (*students*) is measured as the number of university students per capita and is used as the main indicator of a territory’s educational potential. The wage fund (*wages*) is converted to constant prices and normalized per capita as a proxy for the state of the local labor market. Entrepreneurial activity (*firms*) is measured by the number of newly created enterprises in all industries per capita. The market concentration of creative industries (*HHIciRev*) is assessed using the Herfindahl – Hirschman index based on sector organizations’ revenue. Separately considered is the number of researchers and museum guides per capita (*sci_cult*). This indicator reflects employment in science and culture using available municipal data and is not used as a proxy for the number of researchers or R&D employment: the corresponding Rosstat indicators are not available at the municipal level in the database used. The main models focus on educational potential and

economic conditions; the *sci_cult* indicator is analyzed separately and interpreted with due regard to its aggregate nature.

The total proportion of missing values in the original dataset was 7.28%. To ensure methodological rigor and minimize bias, we developed a differentiated strategy based on analyzing the nature of the gaps (*Tab. 1*). The approach distinguished between cases where a missing value could reflect the actual absence of a phenomenon and cases resulting from systemic data collection issues. After applying this strategy, the final dataset was formed: a balanced panel of 220 municipalities over 9 years (2012–2020), yielding 1,980 municipality-year observations. All financial indicators were converted to constant prices using the inflation index.

It should be noted that to account for potential bias and control quality, we created a comprehensive system of binary indicators for each type of gap, which were then used in diagnostic analyses. Including these indicators in regression models as additional control variables did not change the main results, indicating the robustness of the estimates.

The mean of the dependent variable *CI_create* is 0.189, meaning that in 18.9% of observations an increase in the number of creative industry organizations was recorded (*Tab. 2*). All variables show sufficient variation for regression analysis.

Table 1. Missing data handling strategy

Indicator	Strategy applied
<i>students</i>	A differentiated approach was used for 33.41% of missing values: for 18 municipalities with no educational infrastructure, gaps were replaced with 0; for two municipalities with infrastructure, the median for small municipalities was used; for 212 municipalities with historical data, gaps during the systemic failure period (2018–2020) were filled by extrapolating the 2009–2017 trend.
<i>wages</i>	The first three years of observations (2009–2011) with systematic gaps and 12 municipalities with complete absence of data were excluded to form a balanced panel suitable for fixed-effects models. Remaining partial gaps were filled with the municipality median.
<i>sci_cult</i>	Missing values (3.20% of observations) were replaced with 0 based on an analysis of the data structure. The analysis showed that most observations already have zero values, and municipalities with gaps lack the corresponding cultural infrastructure. For population, minor gaps (0.86%) were restored using linear interpolation and the regional median.
<i>firms</i>	Missing values (6.29% of observations) were interpreted as no new firm creation in a given year, consistent with the logic of an indicator recording creation events.
Source: own compilation.	

Table 2. Descriptive statistics and correlations*

Indicator	Mean	Std. dev.	(1)	(2)	(3)	(4)	(5)
(1) CI_create	0.189	0.392	1.000				
(2) students	4252.95	6687.21	0.148	1.000			
(3) wages	475.4	2610.6	0.054	0.328	1.000		
(4) sci_cult	4.36	15.67	0.203	0.196	0.184	1.000	
(5) firms	56.52	227.41	0.160	0.412	0.421	0.195	1.000
(6) HHlciRev	0.15	0.22	-0.022	-0.178	-0.132	-0.098	-0.104

* wages – wage fund; sci_cult – number of researchers and museum guides; firms – number of newly created enterprises; HHlciRev – Herfindahl – Hirschman index of creative industry market concentration.
Source: own calculation.

The composition of the final specifications was determined on the basis of theoretical considerations and econometric requirements. To check robustness and the risk of bias from excessive or highly correlated regressors, we performed diagnostic analyses of alternative sets of control variables. The key criterion was the stability of estimates for the variables of primary interest, especially the quadratic effect of the number of students. If the signs of key coefficients changed or standard errors increased sharply when adding controls, the specification was additionally tested for multicollinearity. To control for bias related to missing data, binary indicators for gaps were included in all regressions; their inclusion did not alter the main results.

Two groups of models were constructed: the main models (1–4) to test the influence of human capital and economic conditions, and additional models (5–6) to analyze non-linear effects of employment in science and culture and entrepreneurial activity. Specifications with municipality fixed effects include year effects to control for nationwide trends and macroeconomic shocks. In Model 3, with region fixed effects, year effects are also included. Regional and time dummies are estimated jointly. Municipality and region fixed effects are not combined within the same model. To test non-linear effects, the relevant variables (number of students, employment in science and culture, entrepreneurial activity) were standardized in advance and included in the models in both linear and quadratic form.

The analysis was conducted in two stages. In the first stage, models were estimated on the full sample of all municipalities. In the second stage, the analysis was performed on a sub-sample excluding the administrative centers of the FEFD constituent entities, in order to check the robustness of the results and identify the specific features of growth factors in peripheral territories.

Research results

Table 3 presents the results of estimating linear probability models with fixed effects. The subscript *sq* denotes the quadratic term of the corresponding centered variable included in the model to test the hypothesis of a non-linear relationship. Column 1 presents a simplified specification including only the variables related to human capital (*students*, *students_{sq}*). Column 2 shows the baseline full model, which contains all the independent variables under consideration and uses municipality fixed effects and time effects. Column 3 provides a robustness check: municipality fixed effects are replaced with region fixed effects while retaining year effects. Column 4 reports the results of estimating the full model on a subsample excluding the administrative centers of the FEFD constituent entities.

Model 2 is adopted as the baseline specification. It includes the full set of independent variables and controls for both unobserved municipal heterogeneity and nationwide time trends. Its estimation results reveal a statistically significant U-shaped relationship between the number of students and the probability of creative industry

Table 3. Regression analysis results*

Variable	Model 1	Model 2	Model 3	Model 4
	Simplified specification (students only)	Baseline full model (all factors)	Robustness: region fixed effects (all factors)	Robustness: periphery subsample (all factors)
<i>students</i>	-0.0097 (0.0167)	-0.0085 (0.0169)	-0.0193 (0.0128)	-0.0013 (0.0178)
<i>students_{sq}</i>	0.3804** (0.1532)	0.3816** (0.1557)	0.4067*** (0.1122)	0.3336** (0.1539)
<i>wages_z</i>		-0.0255 (0.0190)	-0.0333** (0.0156)	-0.0053 (0.0283)
<i>wages_{sq}</i>		2.477e-12*** (6.195e-13)	2.497e-12*** (5.814e-13)	7.81e-13 (3.352e-12)
<i>firms</i>		0.0297 (0.0189)	0.0684*** (0.0100)	0.0268 (0.0237)
<i>HHIciRev</i>		0.0174 (0.0140)	0.0025 (0.0095)	0.0186 (0.0154)
Fixed effects	Municipality	Municipality	Region	Municipality
Time effects	Yes	Yes	Yes	Yes
Sample	Full	Full	Full	Periphery
R^2_{within}	0.0039	0.0135	0.0470	0.0089

* Dependent variable: CI_create. Standard errors clustered at the municipality level are in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Columns (2)–(4) present models with the full set of independent variables.
Source: own calculation.

emergence (the coefficient on *students_{sq}* is 0.3816, $p < 0.05$). Importantly, this non-linear effect appears already in the simplified specification containing only human capital variables (Model 1) and remains robust in both magnitude and significance when controls for economic conditions, entrepreneurial activity, and market structure are successively added.

The U-shaped relationship points to the threshold character of the influence of educational potential: near the mean level of the standardized number of students per capita, the marginal effect is minimal, while further growth in the indicator increases the probability of expansion in the number of creative industry organizations. The positive contribution of human capital thus materializes after the formation of a local critical mass rather than evenly across the entire range of values.

To check the robustness of the estimates to a change in the level of aggregation of unobserved characteristics, a specification with region fixed effects and year effects was estimated (Model 3).

As expected, moving control to the regional level affected the coefficient estimates, but the key finding of a significant U-shaped relationship with human capital (*students_{sq}* = 0.4067, $p < 0.01$) was confirmed. In this specification, the non-linear effect of wages and the positive coefficient on entrepreneurial activity are also significant. In baseline Model 2 with municipality fixed effects, the quadratic effect of wages is significant, while the linear effect of *firms_z* does not reach standard significance levels.

The final check was aimed at identifying territorial specificity. Estimating the full model on the sample excluding the administrative centers of the FEFD constituent entities (Column 4) revealed the context-dependent nature of factor effects. Whereas the U-shaped relationship with the number of students remains statistically significant even in peripheral territories (*students_{sq}* = 0.3336, $p < 0.05$), the non-linear effect of wages, significant in the full sample (Models 2–3), loses significance

in the periphery. The coefficient on entrepreneurial activity, significant in Model 3, also becomes insignificant. Thus, educational potential is robustly associated with the probability of an increase in the number of creative industry organizations both in the full sample and in the periphery, whereas the effects of wages and entrepreneurial activity are more sensitive to specification and sample composition.

It should be noted that the R^2_{within} values in all specifications are relatively low (e.g., 0.0135 in baseline Model 2). This indicates that the annual changes (within-municipality variation) in the socio-economic indicators used in the model explain only a small share of the annual fluctuations in creative industry growth. However, this result is expected for research based on panel data with fixed effects, where R^2_{within} is often low because the model absorbs all stable between-municipality heterogeneity. The low value underscores that the short-term dynamics of the creative sector are largely driven by factors not captured in the model (e.g., local institutional initiatives, the actions of individual entrepreneurs, or random events). At the same time, the study's key objective – estimating

stable statistical relationships rather than producing accurate forecasts – is achieved. This is confirmed by the high statistical significance of the non-linear relationships identified.

To examine specific effects, additional specifications were estimated (Tab. 4). Model 5 focuses on the aggregate indicator of employment in science and culture, including the variables *sci_cult* and *sci_cult_{sq}* while controlling for the baseline factors (*students*, *wages*). Model 6 tests the non-linear effect of entrepreneurial activity (*firms*, *firms_{sq}*) with the same controls. Both models use municipality fixed effects to control for time-invariant characteristics but do not include time effects, which makes it possible to focus on cross-sectional differences.

The results of Model 5 show a statistically significant non-linear relationship between the aggregate indicator of employment in science and culture (*sci_cult*) and the growth of creative industries. The positive sign of the linear term and the negative sign of the quadratic term (coefficients 0.0389, $p < 0.1$, and -115085.8, $p < 0.05$, respectively) formally correspond to an inverted U-shaped relationship. It is important to stress that, given the aggregated nature of the *sci_cult* variable,

Table 4. Additional analysis of non-linear effects*

Variable	Model 5	Model 6
<i>sci_cult</i>	0.0389*	
	(0.0223)	
<i>sci_cult_{sq}</i>	-115085.8**	
	(57270.0)	
<i>firms</i>		0.0410
		(0.0321)
<i>firms_{sq}</i>		-1281.7
		(11190.0)
<i>students</i>	0.0133	0.0147
	(0.0142)	(0.0142)
<i>wages</i>	0.0148	0.0128
	(0.0130)	(0.0146)
Fixed effects	Municipality	Municipality
R^2_{within}	0.0041	0.0061

* Dependent variable – *CI_create*. Standard errors clustered at the municipality level are in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Source: own calculation.

which combines different professional groups, interpreting this result as an “optimal level of scientific activity” would be incorrect. The estimate points to the existence of a complex, possibly non-monotonic relationship between the presence of personnel in adjacent sectors at the municipal level and the dynamics of creative industries, the nature of which needs to be clarified in future research using more detailed data.

In Model 6, the quadratic effect of entrepreneurial activity ($firms_{sq}$) is statistically insignificant, which does not allow us to reject the hypothesis of no non-linear relationship between the creation of new enterprises and creative sector growth in this specification. The linear effect of $firms$ also does not reach standard significance levels, which may indicate either the absence of a direct association within the chosen specification or the need to account for additional factors or a different level of data aggregation.

It should be noted that the models presented in this additional analysis are illustrative and exploratory in nature. They are estimated on a limited set of control variables and are intended as a preliminary test of possible non-linear effects. In particular, interpreting the results of Model 5 is complicated by the aggregated nature of the *research* indicator. Therefore, these results should not be regarded as established causal relationships but rather as indications of promising directions for more detailed study in future work. The methodologically grounded conclusions of the study follow from the analysis presented in Table 3.

Discussion

Despite the significant results obtained, the study has a number of methodological limitations that should be taken into account when interpreting the findings and planning further research.

First, the estimation is based on a nine-year window, 2012–2020. This is sufficient for panel models with fixed effects but not enough for analyzing long-term structural shifts. Extending the

unified panel to the years after 2020 is complicated by changes in the administrative-territorial structure of municipalities in a number of FEFD constituent entities during the local government reform (consolidation, transition to municipal okrugs, adjustments to boundaries and names), which disrupts the comparability of observation units over time without a separate method for linking them. Moreover, generalizing the results to the post-COVID period and to conditions after 2022 is limited: those years are associated with different macroeconomic and institutional shocks and require separate analysis.

Second, the dependent variable only shows whether creative business creation occurred in a municipality – that is, whether the number of operating creative industry organizations increased relative to the previous year. It says nothing about the size of companies, their revenue, employment, sustainability, or product quality. The conclusions therefore refer to the factors affecting the probability of creation, not to the scale and efficiency of creative sector development.

Third, the employment indicator in science and culture is aggregated and does not separate the contributions of researchers and cultural workers. Rosstat data on the number of researchers and R&D personnel are not available at the municipal level in the database used. Their inclusion at the regional level is possible in future work. This limits the interpretation of the non-linear relationship identified for this indicator. Models with this variable are illustrative in nature.

Fourth, despite the use of a comprehensive strategy for handling missing values, the possibility of systematic bias related to the non-random nature of missing data cannot be fully excluded.

Fifth, even when controlling for municipality and time fixed effects, the risk of endogeneity associated with reverse causality and omitted variables remains. Specifications with lagged regressors ($t - 1$) yield less precise estimates of the

quadratic effect of students, which is consistent with the limited within-variation in a short panel. The estimated coefficients are therefore interpreted as stable statistical associations while controlling for unobserved heterogeneity.

Finally, the presented models include different sets of explanatory and control variables, reflecting the research logic of testing the robustness of key effects (such as human capital) to alternative specifications. Although this approach is methodologically sound and makes it possible to assess the context dependence of the results, it limits the direct comparability of coefficients across all models.

Conclusions

The results obtained allow several key conclusions to be drawn.

First, a non-linear relationship between a territory's educational potential and the emergence of creative industry organizations is identified (a U-shaped relationship). The threshold effect consists in the fact that near the mean level of the standardized number of students per capita, the marginal contribution of the indicator is minimal, while further growth in the number of students increases the probability of positive dynamics in the number of operating creative industry organizations. In other words, the positive role of human capital materializes after the formation of a local "critical mass" rather than evenly across the entire range of values.

Second, the robustness of the effects depends on the specification and the territorial context. The U-shaped relationship with the number of students holds in the full sample and in the subsample of peripheral municipalities. The non-linear relationship with wages is more pronounced in the full sample; the positive association with entrepreneurial activity emerges in the specification with regional and year effects (Model 3). In the periphery, both of these latter effects lose statistical significance. This points to the context-dependent nature of the mechanisms and prevents wages and

entrepreneurial activity from being interpreted as universal drivers for all types of territories.

Third, the relatively low coefficients of determination for within-group variation mean that the short-term (within-municipality) dynamics of creative industries are only weakly explained by annual changes in the included socio-economic indicators. Unobservable local factors (institutions, networks, initiatives) may play a substantial role; therefore, the estimates are interpreted as stable statistical associations with fixed effects controlled for, rather than as a basis for precise forecasting or strong causal claims.

The theoretical significance of the study lies in shifting the focus from linear notions of human capital to threshold effects and in taking into account the center-periphery hierarchy when analyzing the creation of creative industries at the sub-regional level of a peripheral macroregion. The work also contributes to the methodology of creative industry research by demonstrating the potential of panel models with fixed effects for identifying threshold effects and context dependence at the sub-regional level of a peripheral macroregion.

The practical significance lies in formulating differentiated recommendations for regional policy. For regional centers, measures that strengthen the link between the educational and entrepreneurial environments are more relevant. For the periphery, more relevant are measures supporting basic conditions and educational infrastructure sufficient to approach the threshold level of human capital, as well as local forms of cooperation. Given the low within-group R^2 and endogeneity limitations, these guidelines are indicative in nature and require verification on more detailed data and for the period after 2020. Prospects for further research are associated with identifying spatial growth points for creative industries, deeper analysis of factors at the regional, municipal, and local levels, and a subsequent transition to studying the profiles of individual creative industries.

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