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Research Article

Improving the Financial Infrastructure for Sustainable Development of Territories

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Abstract: Infrastructure development may have a dual influence on territories' sustainable development and create challenges for authorities in balancing economic growth, environmental protection, and social equity. In the research framework, we focus on the financial sector as a key element of the territorial economy and examine how the physical and digital financial infrastructure impact sustainable development. To achieve the goal of the research, we use panel data and ordered logistic regression models on a dataset of Russian regions for the period 2020-2022. The results show that regions with higher levels of physical and digital financial infrastructure development have higher SDG performance. The structural differences in the impacts of the physical and digital financial infrastructure on SDG performance were also observed. The theoretical contribution of the research is mainly in regional development by integrating financial infrastructure analysis into sustainability metrics, particularly within the context of emerging markets such as Russia. The research results are relevant for authorities and financial institutions to develop economic policies that promote infrastructure development and financial allocation to ensure sustainable development in different territories.

Keywords: Digital infrastructure; Financial sector; Physical infrastructure; SDG performance; Sustainable development

1. Introduction

According to recent research (Borremans et al., 2024; Thacker et al., 2019; Adshead et al., 2019) territorial infrastructure, perceived as a network system, ensures access to various types of services and promotes the achievement of sustainable development goals. Nevertheless, territorial infrastructure development often occurs at the expense of the local environment and the long-term challenge of climate change (Biswas and Rahman, 2023; Stepanov et al., 2023). This leads to a dilemma. On the one hand, the extension of infrastructure may have a negative influence on the environment and sustainable development. Effective infrastructure, including recycling and disposal infrastructure, is essential for minimizing the negative impact on sustainable development (Fei et al., 2021; Fay et al., 2011). The challenge of balancing the positive and negative impacts of infrastructure is relevant and focuses on replacing 'grey infrastructure' with 'green infrastructure" (Wesener and McWilliam, 2023; Depietri, 2022; The Global Commission on the Economy and

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Climate, 2016). The challenge is complicated by the fact that infrastructure is perceived by both physical and digital systems. Digitalization could provide solutions for developing territories efficiently. Existing empirical studies consider digitalization as a pervasive macro-factor to investigate its impact on the national/regional economy or a particular sector (Sandoyan et al., 2025; Glukhov et al., 2023; Avduevskaya et al., 2023, Zhang, et al., 2022). In the research framework, we analyze the influence of territories' infrastructure on sustainable development from the perspective of the financial sector, a key element of any economy.

To achieve the research goal, we use a dataset of Russian regions. Choosing Russia as the research sample is explained by the following reasons: 1) Russia is one of the world's leaders in the digitalization of the financial sector and one of the most advanced markets in terms of providing digital services. In 2019, Russia ranked third in terms of financial technology implementation, with the adoption rate almost doubling since 2017 to 82%, which is higher than the global average of 64% (Ernst and Young, 2019); 2) Russia is a vast and diverse country with significant regional disparities in economic development, making it an ideal setting to explore the impact of both physical and digital financial infrastructure on sustainable development outcomes across different regions. The challenge of ensuring the sustainable development of territories is rather relevant in countries with large geographical territories (Koshevarova et al., 2025; Martins, 2023; Timiryanova et al., 2021; Liu et al., 2018; Salvati et al., 2016).

Panel data and ordered logistic regression models were used on the balanced panel dataset. The results support the tested hypotheses. Regardless of the level of the physical financial infrastructure in the region, improving its digital infrastructure leads to better SDG performance. In regions with a low level of digital financial infrastructure, developing physical and digital infrastructure can contribute to SDG performance. Regions with a high level of digital financial infrastructure should prioritize upgrading their existing digital infrastructure to improve their SDG performance. For regions with average levels of digital financial infrastructure development, developing the physical infrastructure of the financial sector can increase their SDG performance.

This research provides a theoretical contribution to the literature on regional development by being the first to investigate territories' physical and digital infrastructure and integrate financial infrastructure analysis into sustainability metrics, particularly within the context of emerging markets such as Russia. The research also provides practical implementation of policymaking for municipal, regional, and state authorities and financial institutions to formulate economic policies that promote infrastructure development and financial allocation to ensure sustainable development in different territories.

This study is organized into four sections: Section 1 is the introduction and literature review. Section 2 presents the data and methods. Section 3 describes the model results and hypotheses. The last section presents the conclusion, including the limitations of the study.

2. Literature review

We conducted a systematic literature review to formulate research hypotheses in the context of the financial sector's infrastructure and its influence on sustainable development. We constructed a bibliographic map and selected the most significant publications from the point of the research objective.

Based on the results of the literature review, we concluded the following theoretical aspects. Neoclassical growth theory states that the accumulation of input factors and technological progress are the main contributors to economic growth. Finance is directly related to these two factors (Thiel, 2001). Capital is a major input factor, and capital accumulation is a prerequisite for sustainable economic growth. Most studies have examined the impact of financial system development on economic growth or the impact of a particular subsystem (e.g., banking, insurance) on economic development (Asante et al., 2023; Fakher et al., 2021; Bakeev, et al., 2020; Rusko and Korauš, 2010). However, there is relatively little evidence on the impact of the financial sector on sustainable development (Ng et al., 2020).

A well-developed financial system is believed to increase social and economic performance. Financial inclusion prioritizes increasing the accessibility of financial services through the continuous development of financial infrastructure. Financial inclusion stimulates economic development and reduces income inequality by enabling individuals and businesses to access essential and affordable financial products and services (Suhrab et al., 2024; Lee et al., 2023). Moreover, the financial sector acts as a key contributor to sustainable development, particularly in terms of attracting investments in green technology development to reduce environmental risks (Ozili and Iorember, 2024; Ng et al., 2020). Based on the preceding reviews, we describe the following hypothesis:

Hypothesis 1 (H1): The development of physical financial infrastructure has a positive effect on territories' sustainable development.

One consequence of the global financial crisis was the active implementation of digital decisions in the financial sector. The digitalization of the financial sector contributes to the achievement of the Sustainable Development Goals (SDGs) adopted by the UN 2030 Agenda and the balanced development of regional economies by enhancing financial inclusion in remote, underpopulated, and underdeveloped regions (Ernst and Young, 2023; Bank of Russia, 2021a; United Nations, 2019). Empirical studies have confirmed the positive impact of digitalization on economic and social development (Suhrab et al., 2024; Singh and Jyoti, 2023; Mishakov et al., 2021). Therefore, we propose the following hypothesis:

Hypothesis 2 (H2): Digital financial infrastructure development has a positive effect on the sustainable development of territories.

Even though digitalization is a significant trend in finance, individuals and enterprises are not yet prepared to completely replace traditional physical financial services. Unbalanced development across regions is a fact for most countries because some remote regions still have underdeveloped digital infrastructure, which is essential for providing digital financial services. In addition, digital financial services are not universally adapted to the needs of all population groups, whereas disabled and senior citizens prefer to use physical financial services (Bank of Russia, 2021b). There are also certain barriers to the adoption of digital services. The attitudes of digital natives with high digital literacy (born after the technology revolution) and digital immigrants (born before) toward digital finance are different (Koroleva, 2022).

Empirical findings concluded that the development of physical infrastructure has a positive impact on the economy (Ahmed et al., 2020; Mohanty and Bhanumurthy, 2019). Differential development conditions across regions lead to disparate outcomes. Saygılı and Özdemir (2021) found that differences in digital and physical infrastructural endowments across Turkish regions explain a significant portion of regional economy disparity. From this perspective, we describe the next hypothesis:

Hypothesis 3 (H3): Structural differences exist in the impacts of physical and digital financial infrastructure on territories' sustainable development.

3. Data and Methods

The authors collected the dataset for this study, covering 79 regions of the Russian Federation over the period 2020–2022. Data on physical and digital infrastructure are collected from the open official statistics of the Bank of Russia (2024) and Federal State Statistics Service database (2024) and cover the number of components for measuring the financial sector's condition (Figure 1).

Physical

Components	Units
Number of banking institutions	units
Number of payment cards	thousand units
Number of ATMs	units
Number of terminals	units
Number of insurance branches	units

Digital

Components	Units
Personal computer usage in households	percentage
Internet usage in households	percentage
Number of mobile phones per households	units
Proportion of the population using data protection tools	percentage
Number of bank accounts	thousand units

Figure 1 Physical and digital financial infrastructure components

The authors formulated the physical and digital indexes according to instructive publications from authoritative official organizations for creating the composite index (European Union and EC-JRC, 2008) using the following algorithm:
- Data normalization under the next formula:

$$x_{scaled} = \frac{x_i}{x_{max}} \tag{1}$$

where x_{max} is the best meaning among regions. The normalized data are distributed within the interval (0,1], with 0 indicating the worst performance and 1 indicating the best performance.
- indexes are calculated using equal weights and GA.

In empirical studies, many variables can be used to measure the sustainable development of territories. One of the variables introduced in the national and regional economy to evaluate sustainable development is the SDG index, which includes four dimensions: environmental, social, governance and institutional. In academics and practice, ESG index (environmental, social, and governance) is another common used measure, which was initially conceptualized to ensure the achievement of corporate sustainability goals, and the principles are now becoming an integral part of national and regional sustainability strategies (Grishunin et al., 2023). Zhang (2024) reveals the positive relation between digital transformation and ESG-principles using the sample of state-owned enterprise in China. Ng et al. (2020) used country-level data to determine the positive impact of financial development on ESG performance in the context of Asian countries. In the context of Russian regions, data on sustainable regional development are collected from reports of MGIMO Center for Sustainable Development and ESG Transformation (2024) and Vaslavskiy (2022). The SDG index of Russian regions is developed according to the UN 2030 SDGs Agenda framework to assess and monitor the performance of the regions in achieving the SDGs.

The panel data regression models—fixed effects (FE), random effects (RE), and pooled ordinary least squares (POOL)—are applied for time series data of different regions to determine the impact of physical and digital financial infrastructure indexes on SDG performance. The following equation describes the generalized regression model contents:

$$SDG_{it} = \beta_0 + \alpha_i + \beta_1 * Physical_{it} + \beta_2 * Digital_{it} + v_{it} \tag{2}$$

$$v_{it} = \mu_i + \delta_t + \varepsilon_{it} \tag{3}$$

where i refers to the region, t refers to time series; β_0 is constant; β_1 and β_2 are coefficients; α_i is specific for each region; μ_i is individual-specific random error; δ_t time specific random error; ε_{it} is the error terms.

In the article, different levels of statistical significance are used, represented by varying p-values ($p < 0.1$, $p < 0.05$, $p < 0.01$, $p < 0.001$), to indicate the strength of impact of physical and digital financial infrastructure indexes on SDG performance. For instance: $p < 0.1$ provides preliminary evidence that may warrant further investigation; $p < 0.001$ signal evidence that is increasingly compelling and useful for results requiring high certainty.

This study applies thresholds to ensure clarity in interpreting the regression model outputs, enabling nuanced conclusions about the impacts of physical and digital financial infrastructure on SDG performance.

The individual specific component can be fixed for each individual or random. The following tests are implied in the research framework to identify the presence of fixed and random effects:

- Fixed effects are tested using the Fisher test (F test). The null hypothesis of the test is that all individual-specific components are equal to zero.

- The Breusch and Pagan's Lagrange Multiplier (LM) test is used to test random effects, and the null hypothesis is that all individual-specific components are equal to zero.

- The Hausman test verifies whether the individual characteristics of regions are correlated with the regressors. The null hypothesis is that the panel data model does not correlate the error term and the independent variables.

In addition to panel data regression, ordered logistic regression models are used for analysis. The relationships between an ordinal dependent and an independent variable are estimated. Table 1 and Figure 2 present the transformation of continuous variables to ordinal. Physical and digital financial infrastructure indexes take on the values 'Poor', 'Fair', 'Average', 'Good' and 'Excellent'. Accordingly, it is a numeric variable that takes on values ranging from 1 to 5. Similarly, SDG performance takes on values corresponding to a gradual increase in score.

An underlying SDG score is estimated as a linear function of the independent variables and a set of cut-points in the ordered logit model. The probability of observing outcome i corresponds to the probability that the estimated linear function, plus random error, is within the range of the cut-point estimated for the outcome of SDG_I:

$$\Pr(\mathrm{SDG\_I_j} = i) = \Pr(k_{i-1} < \beta_1 * \mathrm{Physical_j} + \beta_2 * \mathrm{Digital_j} + \mu_j \leq k_i) \quad (4)$$

where β_1 and β_2 are coefficients; μ_j is random error; k_{i-1} and k_i are cutpoints, and Pr is the predicted probability.

Table 1 Categorical infrastructure indexes and frequency counts

Physical infrastructure	Digital infrastructure	Categorical index	Cumulative percent
bottom 10%	bottom 10%	Poor	10.13
the 10th - 30th percentiles	the 10th - 30th percentiles	Fair	29.96
the 30th - 70th percentiles	the 30th - 70th percentiles	Average	70.04
the 70th - 90th percentiles	the 70th - 90th percentiles	Good	89.87
top 10%	top 10%	Excellent	100

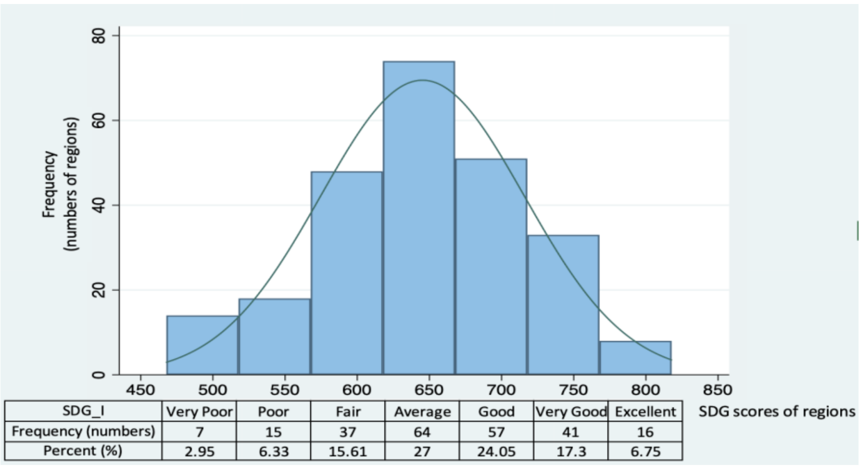

Figure 2 Distribution of categorical SDG scores and frequency counts

Regions have a true frequency of categorization, which could be assumed as latent variable $L_j = \beta_1 * Physical_j + \beta_2 * Digital_j + \mu_j$, and a region is categorized as 'Very poor' if $L_j \leq k_0$, as 'Poor' if $k_0 < L_j \leq k_1$, as 'Fair' if $k_1 < L_j \leq k_2$ and so on. Table 2 presents the dependent and explanatory variables' descriptive statistics.

Table 2 Descriptive statistics

Variables	Number of observations	Mean	Standard deviation	Min	Max
SDG (dimensionless quantity)	237	6.47	0.11	6.15	6.70
Physical (dimensionless quantity)	237	0.34	0.10	0.07	0.74
Digital(dimensionless quantity)	237	0.58	0.09	0.05	0.87

The sample includes 237 observations for 79 regions from 2020 to 2022. The original SDG score has a large standard deviation of 70.81; hence, its values are converted using logarithms. The descriptive statistics show that after transformation, regions in the sample have a mean SDG of 6.47 with a standard deviation of 0.11. Table 3 presents the correlation matrix used to check for the presence of multicollinearity.

Table 3 Correlation matrix used to check for the presence of multicollinearity

	SDG	Physical	Digital
SDG	1		
Physical	0.36	1	
Digital	0.26	0.26	1.00

Table 3 displays the correlation matrix, which indicates that the dependent variable SDG has a positive correlation with both explanatory variables: physical infrastructure index (0.36) and digital infrastructure index (0.26). The correlation coefficient between the two independent variables was 0.26. The variance inflation factor (VIF) test shows that the mean VIF is equal to 1.07, indicating that there is no correlation among the explanatory variables.

Table 4 shows the cross-tabulation of the SDG index with the physical and digital financial infrastructure indexes.

Table 4 Cross-tabulation of the SDG and physical/digital financial infrastructure indexes

SDG_I	Physical infrastructure index					Digital infrastructure index				
	Poor	*Fair*	*Average*	*Good*	*Excellent*	*Poor*	*Fair*	*Average*	*Good*	*Excellent*
Very poor	3	1	2	1	0	4	1	2	0	0
Poor	2	6	6	1	0	2	6	6	0	1
Fair	9	7	10	10	1	5	12	16	0	4
Average	7	18	25	9	5	4	15	25	4	16
Good	0	10	26	16	5	7	7	24	6	13
Very good	3	5	17	8	8	1	4	18	8	10
Excellent	0	0	9	2	5	1	2	4	6	3
Total	24	47	95	47	24	24	47	95	47	24
	Pearson chi2(24) = 57.09			Pr = 0.000		Pearson chi2(24) = 60.00			Pr = 0.000	

As can be seen from the table, in both cases the χ^2value is significant, indicating a significant relationship between physical/digital financial infrastructure indexes and the SDG index.

4. Results and Discussion

The results indicate a significant positive impact of both physical and digital financial infrastructure on regional sustainable development, as measured by the SDG index. Table 5 presents the panel data regression results.

Pooled regression returns a relatively low goodness of fit (0.15) compared with FE regression (0.85). The pooled regression results show that both the physical and digital infrastructure indexes have significant positive coefficients. The physical infrastructure index has a significant positive coefficient (0.36 at 0.1% significance p-level), and the digital infrastructure index has a significant positive coefficient (0.22 at 1% significance p-level). The FE regression results indicate that the physical infrastructure index has a significant positive coefficient of 0.32 at the 0.1% significance p-level, whereas the digital infrastructure index has no significant coefficient.

The diagnostics reveal the FE regression preference. This is consistent with the basic econometric assumption that national (regional) macroeconomic data may be affected by their own internal characteristics: political, economic, and socio-cultural characteristics. Therefore, it can be concluded that the development condition of the region's physical financial infrastructure impacts the region's sustainable development.

Table 5 Results of panel data regression

Models	Pool	FE	RE
Digital	0.22***	0.04	0.15
	(0.08)	(0.12)	(0.09)
Physical	0.36****	0.32****	0.35****
	(0.07)	(0.08)	(0.06)
_cons	6.22****	6.33****	6.27****
	(0.05)	(0.07)	(0.06)
R2	0.15	0.85	0.15
N	237	237	237

* p < 0.1; ** p < 0.05; *** p < 0.01; **** p < 0.001.

There are considerable differences in the physical/digital financial infrastructure and SDG performance among regions, and estimating only the full sample data is difficult to capture the features of various regions with substantial differences. Therefore, further research on the internal structure of the sample is warranted. In the previous section, categorical classifications of regions on physical/digital infrastructure and SDG indicators are described in detail, based on which we investigate the impact of physical and digital infrastructure on ESG performance in various regions with different degrees of physical/digital infrastructure development. Tables 6 and 7 below display the results.

Table 6 Ordered logistic regression results

ESG_I	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Digital	4.48	1.83	2.44	0.015	0.89	8.07
Physical	6.43	1.33	4.85	0.000	3.83	9.03
/cut1	1.00	1.08			-1.11	3.11
/cut2	2.30	1.05			0.24	4.35
/cut3	3.58	1.05			1.51	5.65
/cut4	4.89	1.07			2.79	6.98
/cut5	6.07	1.09			3.93	8.22
/cut6	7.66	1.14			5.43	9.90
Number of obs = 237				Pseudo R2 = 0.0479		
LR chi2(2) = 39.72				Prob > chi2 = 0.0000		

Table 7 Regression results on different categories of physical/digital financial infrastructure index

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*
Physical	"Excellent"	"Good"	"Average"	"Fair"	"Poor"
Digital	0.75***	0.63*	0.22*	-0.08	0.82**
	0.23	0.36	0.12	0.13	0.30
Physical	-0.25	-0.15	-0.15	-0.31	0.36
	0.23	0.79	0.54	0.79	0.39
_cons	6.22****	6.17****	6.40****	6.56****	5.89****
	0.15	0.35	0.20	0.23	0.13
r2	0.27	0.03	0.02	0.03	0.49
N	24	47	95	47	24
	Model 6	*Model 7*	*Model 8*	*Model 9*	*Model 10*
Digital	"Excellent"	"Good"	"Average"	"Fair"	"Poor"
Digital	0.76***	0.02	0.18	-1.47	-0.46***
	0.21	0.92	0.10	1.83	0.16
Physical	0.18	0.48***	0.26*	0.31	0.59***
	0.11	0.16	0.15	0.18	0.17
_cons	5.95****	6.31****	6.27****	7.14****	6.43****
	0.17	0.55	0.57	0.10	0.08
r2	0.33	0.17	0.01	0.02	0.43
N	24	47	95	47	24

* p < 0.1; ** p < 0.05; *** p < 0.01; **** p < 0.001.

The regression result shows that for a dataset of 237 observations, the likelihood ratio (LR) chi-square statistic is 39.72. The low p-value (<0.00001) means that at least one of the regression coefficients in the model is not equal to zero. McFadden's pseudo R-squared is 0.0479. Both ordered log-odds (logit) regression coefficients are significant at a 5% level. The physical infrastructure index has a significant positive coefficient of 6.43. The digital infrastructure index has a significant positive coefficient of 4.48. The positive coefficient for the physical (or digital) financial infrastructure index indicates that the likelihood of better ESG performance increased as the physical (or digital) infrastructure improved. Cutpoints differentiate the adjacent levels of the ESG_I, and all cutpoints except cut1 are significant. According to cut-point statistics, subjects with a value no greater than 1.00 on the underlying latent variable would be classified as 'Very poor," subjects with a value between 1.00 and 2.30 on the underlying latent variable would be classified as 'Poor', subjects that had a value between 2.30 and 3.58 on the underlying latent variable would be classified as 'Fair', subjects that had a value between 3.58 and 4.89 on the underlying latent variable would be classified as 'Average' , subjects that had a value between 4.89 and 6.07 on the underlying latent variable would be classified as 'Good' , subjects that had a value between 6.07 and 7.66 on the underlying latent variable would be classified as 'Very good," and subjects with a value greater than 7.66 on the underlying latent variable would be classified as 'Excellent' in terms of regional SDG performance.

Model 1-5 in Table 7 shows that for regions with a physical infrastructure index above 'Average', the digital infrastructure index has a significant positive coefficient. The coefficients for 'Average', 'Good', and 'Excellent' physical infrastructure are 0.22 (at 10% significance p-level), 0.63 (at 10% significance p-level), and 0.75 (at 1% significance p-level), respectively. The physical infrastructure index with the value of 'Fair' has no significant coefficient. The digital infrastructure index with the value of 'Poor' has a significant positive coefficient of 0.82 (at 5% significance p-level). The PFI index does not have a significant coefficient for any of the different classifications. Model 6-10 indicates that the digital infrastructure index has a significant positive coefficient of 0.76 (at 1% significance p-level) for regions with an "Excellent" digital infrastructure index, while the physical infrastructure index's coefficient is not significant. For regions with digital infrastructure category indexes of "Good" and "Average," the physical infrastructure index has significant positive coefficients of 0.48 (at 1% significance p-level) and 0.26 (at 10% significance p-level), and the coefficients of the digital infrastructure index are not significant for both cases. The coefficients for the physical and digital infrastructure indexes are not significant for regions categorized as 'Fair'. For regions categorized as "poor" in the digital infrastructure index, the digital infrastructure index has a significant negative coefficient of 0.46 at the 1% significance level of -0.46 and the physical infrastructure index has a significant positive coefficient of 0.59 at the 1% significance level.

Panel data and ordered logistic regression results show that the physical financial infrastructure index significantly positively impacts the SDG index. The regression results for the different categories of digital infrastructure yield the same finding. Models 7 and 10 estimate significantly positive coefficients. This indicates that physical financial infrastructure improves sustainable development in the context of regions (supports H1).

Panel data regression results show that the digital financial infrastructure index has a significant positive coefficient of 0.22 from pooled regression. The ordered logistic regression results show that the digital infrastructure index has a significant positive ordered log-odds (logit) regression coefficient of 4.48. Similar outcomes were found in the regression results for the different physical financial infrastructure categories, with significant positive coefficients estimated for Models 1 and 5. This indicates that digital financial infrastructure improves sustainable development in the context of regions (supports H2).

Regression results on different categories of physical and digital financial infrastructure indexes confirm the structural differences in their impact on sustainable development in the context of regions (supports H3). From the perspective of different levels of physical financial infrastructure, it can be concluded that digital financial infrastructure has a positive impact on sustainable development for regions with particularly poor or above-average levels of development. In terms of different levels of digital financial infrastructure, it can be concluded that the digital infrastructure has a positive impact on regions with a high level of development, while the physical financial infrastructure has a non-significant impact on sustainable development. For regions with less than an "Excellent" level of digital infrastructure development, the physical infrastructure has a positive impact on regional SDG performance. In regions with a "poor" level of digital infrastructure development, the digital infrastructure has a negative impact.

The findings of this study align with and extend prior research on the role of financial infrastructure in sustainable development. Similar to the findings of Mohanty and Bhanumurthy (2019), this study confirms that physical financial infrastructure significantly contributes to regional economic stability and sustainability. However, our research extends this understanding by quantifying its impact on SDG performance, specifically in the context of Russian regions. The positive influence of digital infrastructure on SDG metrics corroborates earlier studies, such as Ng et al., (2020), which highlighted the role of financial digitalization in fostering sustainability. This study further reveals that the effectiveness of digital infrastructure in different regions varies depending on the existing physical infrastructure levels. Similar to previous studies (Saygılı and Özdemir, 2021), this study demonstrates structural differences in the impacts of physical and digital infrastructure, emphasizing the need for context-specific interventions.

The research models and findings provide the following practical decision-making tools:

- guide policymakers in prioritizing regions that require immediate infrastructure investment. For instance, regions with low levels of digital infrastructure may require accelerated technological upgrades, whereas regions with high levels of digitalization may focus on enhancing physical infrastructure.

- simulating the impact of different policies on SDG performance, enabling decision-makers to choose strategies tailored to regional conditions with the most significant positive effects.

- ensure that policies are customized to address unique challenges and opportunities.

The research has the following main limitations: SDG performance is a relatively new metric in the context of regional studies. Therefore, the current open data cover a short time. Owing to data availability, we conducted the research using regions as the sample. The same research can be extended to cities, counties, towns, villages, and other territorial units. Two dimensions of financial infrastructure have been identified to investigate their impact on SDG performance. There may be other socioeconomic factors unique to each region. Future studies should consider a wider set of variables.

5. Conclusions

The study highlights the significant role of both physical and digital financial infrastructure in ensuring the sustainable development of regions. The findings reveal that well-developed financial infrastructure positively impacts SDG performance, emphasizing the need for balanced investments in both areas. The observed structural differences in the effects of physical and digital infrastructure offer valuable insights for policymakers aiming to optimize regional sustainability strategies. By integrating financial infrastructure into the broader framework of regional development, this study contributes to understanding how infrastructure can promote sustainable outcomes in emerging markets. Furthermore, the study provides practical recommendations for authorities and financial institutions to promote relevant policies that foster inclusive, sustainable growth across territories.

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Author Contributions

The authors confirm their individual contributions as follows: Shawuya Jigeer contributed to manuscript drafting, literature review, data collection, visualization; Ekaterina Koroleva was involved into conceptualization, manuscript drafting, review and editing. Sun Lin was responsible for the review, editing and recommendations. All authors have read and agreed to the published version of the manuscript.

Conflict of Interest

The authors declare no conflicts of interest.

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