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Triple Bottom Line, Sustainability, and Regional Development

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Abstract

In a study of 74 Russian regions over the period of 2013–2018, this paper demonstrates that economic, social, and ecological dimensions of the triple bottom line triad positively and significantly affect regional development, thus validating the growing emphasis on sustainable development found in the literature and among policymakers. Investments in research and development, the creation of new firms, reductions in poverty rates, and lowering emission intensity lead to regional development. The study develops four models to analyze the regional resource allocation efficiency in relation to the economic, social, and ecological goals of sustainable development. To assess regional development, this paper calculates the technical efficiency of the regions concerning technological frontiers using Data Envelopment Analysis (DEA). As one of our variables (the border region dummy) is time-invariant, the study chose to estimate models with the help of a random effects estimator. The effects of startup rates and ecological factors are moderated by the per capita income within the region. The results suggest that the triple bottom line agenda is justified as a regional development paradigm.

Keywords

The triple bottom line, regional development, startups, ecological factors, emission intensity

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Introduction

The notion of the triple bottom line entered the lexicon of management scholars some thirty years ago (Elkington, 2018) and has inspired the philosophy of sustainable development at the macro level advocated by both academics (Carayannis & Campbell, 2018; York et al., 2018) and policymakers (United Nations, 2016). At its core, this notion implies the simultaneous pursuit of economic, social, and ecological agendas—the latter two dimensions typically seen as being at odds with economic development—and there is much debate in the literature as to whether these

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Data Availability Statement included at the end of the article

triple development goals may be truly aligned (Eisenmenger et al., 2020). Despite years of research, there is a dearth of knowledge with respect to the impact that the simultaneous pursuit of these goals is likely to exert on macroeconomic growth (Leal Filho et al., 2019).

We contend, however, that these three dimensions may be naturally aligned in promoting regional development. Specifically, new innovative efforts by existing firms and the creation of new startups are likely to bring about better overall efficiency within their regions directly (Vuković et al., 2012). Social improvements, such as poverty alleviation, and ecological advancements resulting in the reduction of emission intensity are likely to indirectly stimulate efficiency improvement as well. Taken together, the pursuit of the triple bottom line agenda by regional firms and policymakers may be expected to contribute to a visible improvement in resource allocation efficiency within the region.

The direct effect of innovative efforts on regional development is largely accepted within the literature (Gordon & McCann, 2005). The very goal of searching for new resource combinations—the essence of innovative efforts—is the identification of new ways of doing more with less (Radjou & Prabhu, 2015). Whether such improvements come from existing firms that funnel their resources into research and development (Shefer & Frenkel, 2005) or from de novo startups that are created to pursue opportunities left unaddressed by the existing firms (van Stel & Suddle, 2008), the end result is unambiguous: overall efficiency within the region improves (Cainelli et al., 2020), and regional well-being is promoted (Lenzi & Perucca, 2020). Innovation can be also interpreted in a broad sense, considering innovation in the economy, society, and ecology. However, based on the idea of this article, we explore innovation as an economic factor and select the appropriate variable that characterizes the impact of the economy. This article considers regional R&D investment as one of the test variables. We interpret it as an economic variable since most of the R&D investment is directed to technological product and process innovations. Of course, part of the R&D investment is directed to environmental innovation, but in Russia this share is low.

The effect of social goals' pursuit, looked at from the viewpoint of poverty alleviation, is less clearly understood. Poverty alleviation is seen as a government's responsibility, and many business owners may lack enthusiasm for addressing social ills within their regions because the money to deal with social challenges may be appropriated by the government from the businesses operating within the regional boundaries, a position long advocated by the proponents of the Friedman doctrine (1970). Yet, government failure at addressing social ills comes at a cost, and there is growing evidence that private initiative, including social entrepreneurial actions, is increasingly attentive to lifting people out of poverty (Anokhin et al., 2023 in press), thus signifying the shift in the thinking surrounding social challenges. Ultimately, however, the concerted efforts of regional players aimed at lifting people out of poverty increase the spending power of regional consumers (Chistyakova et al., 2023; Petrovic et al., 2017), which should have a positive impact on regional development. As such, we expect that addressing social ills within the region should promote regional development, albeit indirectly.

Finally, efforts to curb emissions are likely to indirectly promote regional development as well. First, reduction in emissions requires adoption of better technologies, and recent technologies often have the benefit of improved effectiveness in addition to reducing the environmental footprint (Swink et al., 2006; van Soest & Bulte, 2001). Second, investment in the development and deployment of better technologies, while constituting a cost to regional firms, results in higher within-region spending, thus growing the regional economy and contributing to development (Masduki et al., 2022). Third, improvements in the ecological situation within the region have a direct positive impact on the health of the population, which translates into higher productivity in the regional workforce (Cole & Neumayer, 2006). Overall, we expect the pursuit of the ecological agenda to positively affect regional development.

The study tests these expectations in a sample of 74 Russian regions over the course of 2013–2018. The Russian economy was going through a crisis caused by Western sanctions during this period, so the context of our study is conservative. Despite the crisis, Russia remains a major player in the global arena (World Bank, 2020), and understanding the factors affecting its development is essential. The paper is organized as follows: In the following section, we provide a brief overview of the relevant literature and formulate testable hypotheses that link the pursuit of economic, social, and ecological goals to regional development. Next, we introduce our data and present the methodology chosen to test the hypotheses. This is followed by the presentation of our results and the discussion of their implications for theory and practice. The paper concludes with an overview of the limitations of the study and suggestions for future research.

Conceptual framework and hypothesis development

Relationship between regional R&D investment and regional development

While different conceptualizations of regional development are possible and used in the literature (Pike et al., 2011), fundamentally, most metrics of development may be reduced to a simple maxim: the ability to do more with less (Higgins & Savoie, 2017). In the economics literature, this

is typically captured with the notion of technical efficiency, with "technology" understood rather broadly as a way to combine certain inputs to produce a particular set of outputs (Mariano et al., 2015; Spitsin et al., 2021). Accordingly, to study the impact of economic, social, and ecological goals' pursuit on regional development, it is essential to consider how these kinds of advancements are likely to affect the technical efficiency observed in the region.

It is logical to expect that the purposeful investment by the regional firms in research and development is likely to bring about improvements in resource allocation efficiency. While the nature of innovation is said to be ill-defined (Aghion & Tirole, 1994), and it may never be possible to guarantee a successful outcome of any given R&D project, taken as a whole, innovative activity is beneficial in terms of improving resource yield (Schulte, 2013), and firms expect to see such improvements when committing to various research and development projects. Indeed, had the positive association between systematic investment in R&D and efficiency improvement not been observed repeatedly, the innovative efforts of most rational firms would have stopped a long time ago. This, by extension, implies that regions with firms actively investing in research and development will necessarily see advancement with respect to resource utilization yield; that is, they will stand to benefit in terms of regional development. Importantly, regional firms initiating innovative projects are not the only recipients of the benefits that newly generated insights provide. As the knowledge spillover theory of entrepreneurship makes abundantly clear (Audretsch & Lehmann, 2005), many innovative ideas fail to be pursued by the corporations responsible for their discovery but will, instead, be acted upon by alert individuals and firms whose expectations of the value of new discoveries exceed those of the companies responsible for their discovery. That is, investment by regional firms in R&D promotes regional development both directly and indirectly. As such, we expect to see a pronounced positive association between regional R&D investment and regional development.

Stated formally, Hypothesis 1: *There is a positive relationship between regional R&D investment and regional development*.

Startup rates and regional development

Apart from relying on innovative ideas that spill over from corporations heavily investing in research and development, startups pursue their own technological insights as well as ideas created by the region's universities (Audretsch & Lehmann, 2005). While some scholars express doubt as to the role of entrepreneurs in promoting the development agenda (Shane, 2009), the extant literature clearly indicates that entrepreneurship and innovation are positively associated (Anokhin & Schulze, 2009). Even if the majority of startups pursue opportunities that are not innovative in nature but rather have to do with arbitrage (Anokhin et al., 2011), it is important to notice that the very presence of arbitrage opportunities within the region indicates substantial inefficiencies in resource utilization. By exhausting arbitrage opportunities prevalent within their regions, young firms help address these inefficiencies and, as such, help close the gap between lagging and leading regions with respect to how resources are utilized.

Adoption of innovative resource combinations by startups along with the pursuit of arbitrage opportunities by regional entrepreneurs necessarily leads to improvements in the overall resource allocation efficiency within the region, thus promoting regional development. Accordingly, we expect startup rates within the region to be positively related to the overall development dynamics.

Stated formally, Hypothesis 2: *There is a positive relationship between startup rates and regional development*.

Poverty and regional development

Economic actors invest in the development and adoption of new technologies when they believe there is substantial market demand for their products and services (Zhu & Weyant, 2003). For this demand to manifest, it is essential that the region's population is not afflicted by poverty, which remains one of the main social problems that governments and social entrepreneurs tackle together (Anokhin et al., 2023 in press). Poverty-ridden regions are unlikely to be seen by firms and entrepreneurs serving such markets as providing incentives to invest in better technologies because the probability of recouping such investments is prohibitively low (Mosley & Verschoor, 2005). Besides, poverty begets a host of issues like criminal activity that are detrimental to the economic environment and may lead to the flight of existing firms to other regions rather than entice the regional business population to invest in better resource utilization (Hipp et al., 2019). For this reason, certain regions may deal with a vicious problem where poverty begets poverty, and the intractability of this issue is widely acknowledged by both policymakers and social activists (Kraay & McKenzie, 2014).

On the other hand, poverty alleviation is likely to stimulate the demand for products and services offered by regional firms, which may result in retaining firms within the region and enticing them to invest in better technologies. In other words, regions that have successfully addressed the notion of poverty—to the extent possible—may expect to see improvements in resource allocation efficiency by regional firms as a result. Moreover, inasmuch as poverty alleviation reduces the intensity of the crime-related problems, regional businesses' need to invest in security loses intensity, and the money previously diverted to

safeguarding the operations may instead be funneled to more productive ends. Taken together, this implies that the relationship between poverty and regional development is negative, with regions demonstrating lower poverty rates displaying higher development trajectories.

Stated formally, Hypothesis 3: *There is a negative relationship between prevalence of poverty and regional development*.

Emission intensity and regional development

The ecological part of the triple bottom line agenda is also likely to positively affect regional development. Emission footprints are a side effect of using obsolete technologies. Curbing emissions necessarily requires adopting newer and better technologies, which typically come with improved economic effectiveness (van Soest & Bulte, 2001). That is, even if efforts to curb emissions are driven primarily by ecological considerations and not thoughts of regional development, improvement in resource utilization is likely to accompany the adoption of better technologies. It may be argued that upgrading technologies is costly (Liu et al., 2021). Yet these costs are not wasted. At the very least, investing the resources to reduce emissions contributes to gross regional product regardless of where the technology in question originates. Adopting sophisticated technology also requires access to qualified labor, and growing requirements for specialized labor within a region are likely to contribute to addressing many of the social ills otherwise permeating the regional environment. Besides, environmentally conscious technologies and business models often rely on the so-called circular economy paradigm (Parida et al., 2019), which, in addition to reducing emissions, improves resource yield (Lahti et al., 2018). Together, this implies that resource utilization efficiency improves when ecological goals are pursued.

Finally, as the ecological situation within the region improves, one may expect to see improvements in the health and life expectancy of the regional population. Improvements in health directly translate into higher productivity in the regional workforce (Kirsten, 2010). Reducing the incidence of sickness frees up the resources otherwise tied up in the local healthcare system and allows these resources to be reinvested in regional development. Overall, we expect the pursuit of the ecological agenda to positively affect regional development. By the same token, growing emissions are likely to exert a negative impact on regional development.

Stated formally, Hypothesis 4: *There is a negative relationship between emission intensity and regional development*.

Regions with above-average per capita income

While we believe that the relationships postulated above are true in most circumstances, we acknowledge that they are more likely to manifest in some regions than in others. Specifically, they are more likely to be observed in well-off regions that are already at or close to the technological forefront. Adopting sophisticated technologies requires a particular state of development by the regional firms, and firms that are close to their respective frontiers—and regions that have an abundance of such firms—are more likely to adopt technologies that yield the highest improvement in resource utilization efficiency (Mirvis et al., 1991). Durham et al. (1998) refer to this notion as the "rich get richer" phenomenon. If this line of reasoning is correct, it is likely that regional development is more intense in regions that already do quite well (Vuković & Wei, 2010; Vuković et al., 2022). Typically, this may be characterized by a relatively high per capita income. From an economic standpoint, investments in R&D and the creation of new firms will likely lead to the spread of truly superior technologies, which will generate the highest "bang for the buck" in terms of regional development, whereas similar efforts in less affluent regions will be sub-par (although still present).

We expect an amplifying moderation effect also from the interaction of the poverty level with the incomes of the population. Indeed, the clash of opposites (high poverty and high per capita income) points to strong disparities in the region's economy. This means that there are several large super-successful firms operating in the region and their employees receive very high incomes. However, the rest of the region's economy is poorly developed and the mechanisms for redistributing these incomes for the entire population of the region are not functioning well. Accordingly, this combination of factors will increase the negative impact of poverty on regional development. Such a situation may well be typical for Russian regions that are concentrated in the extractive industries.

Finally, curbing emissions is a very expensive proposition (Gillingham & Stock, 2018), and regions that boast higher per capita income are more likely to successfully adopt eco-friendly technologies that will contribute to regional development. In other words, in all cases, the relationships implied by Hypotheses 1–4 are likely to be more pronounced in regions with above-average per capita income.

As stated formally, hypotheses arise as follows: Hypothesis 5: *The positive relationship between regional R&D investment and regional development is more pronounced in regions with above-average* per capita *income*. Hypothesis 6: *The positive relationship between startup rates and regional development is more pronounced in regions with above-average* per capita *income*. Hypothesis 7: *The negative relationship between the prevalence of poverty and regional development is more pronounced in regions with above-average* per capita *income*. Hypothesis 8: *The*

negative relationship between emission intensity and regional development is more pronounced in regions with above-average per capita *income*.

Data and methods

Data

The study employs a sample of the Russian regions over the period of 2013–2018. Only the regions comprising the Russian Federation as of 2013 were considered for inclusion in the database.

Two of the regions (Moscow and St Petersburg) are excluded because their economies are not representative of the rest of the country and may unduly distort the estimates of regional development. Russian laws formally classify them as regions, but in reality, they are large cities and agglomeration centers, not regions. The difference between these cities and regions is significant in terms of a number of economic, social, and environmental indicators, which can lead to distortions in the study results. A similar approach is used in the works (Kalabikhina et al., 2019; Mikheeva, 2021; Mokrensky, 2020; Solanko, 2008).

Russia also has a number of so-called autonomous districts that are unique in some important respects and were thus excluded from the analysis. Finally, we excluded the regions with missing values with respect to the key indicators analyzed in this paper. In all, our sample contains 74 regions. The data were sourced from the Russian Statistics Bureau, Rosstat (Federal State Statistics Service (Rosstat), 2022). Our database contains 444 observations (74 regions multiplied by 6 years).

Variables

Dependent variable. To assess *regional development*, we calculated the technical efficiency of the regions vis-à-vis the so-called technological frontier. The frontier has been calculated with the use of Data envelope Analysis (DEA) (Cooper et al., 2011). This approach has been widely used in the economics and development literature (e.g., Charnes et al., 1989; Emrouznejad et al., 2019). Fundamentally, DEA compares the regions with respect to how they combine certain inputs (e.g., labor and capital) to generate a specified output (e.g., gross regional product) to identify the leading regions that define the frontier. These leading regions will have their technical efficiency set to 1. Less efficient regions will find themselves at a distance from the frontier. Their efficiency estimates will vary in the interval from 0 to 1. Efficiency estimates were multiplied by 100% for ease of interpretation. The higher the efficiency estimate, the higher the level of regional development. In this study, we used labor and capital as inputs and gross regional product (calculated as regional sales) as an output. The calculations were performed in the R programming language. In any year, as few as 2 and as many as 4 regions were identified as having frontier efficiency, with the rest being at a distance from the frontier.

Independent and moderator variables. We use the logarithm of *regional R&D investment* as our first independent variable (Chen & Lee, 2020). *Startup rates,* calculated as a ratio of new firms to the region's population, are our second independent variable capturing the impact of economic factors (Nakamura & Magani, 2020;Nakamura & Managi, 2020). The *prevalence of poverty* was assessed as the share of the population with income below the official poverty level (Korosteleva & Stpie-Baig, 2020). This represents the social dimension of the triple bottom line triad. Finally, *emission intensity,* calculated as the ratio of uncaptured air emissions from stationary sources within the region to the value of sales by regional firms (tons of emissions per 1 billion rubles of products sold), was used as a proxy for the ecological dimension of the triad (Dong et al., 2018). *Per capita income* (Behera & Dash, 2017), calculated as the average monthly income per capita in the region in rubles, was used as a moderator.

Control variables. We also controlled for a number of additional factors that may bear on regional development. Specifically, we accounted for the region's *export intensity* (Cheng et al., 2019), defined as the ratio of the export-related revenue of regional firms to their overall sales multiplied by 100%, as this may substantially affect the dynamics of regional processes. We also controlled for *higher education enrollment* (Li et al., 2021), defined as the ratio of the number of students to the population of the region multiplied by 100%, because higher representation of an educated population may promote regional development in non-trivial ways (Faggian et al., 2019). Finally, because regional development may depend on cross-border cooperation (Basboga, 2020), we included a dummy variable *border region* that captures whether or not the region is located at the land border of Russia with foreign countries (Anokhin, 2013). Descriptive statistics and correlations are provided in Table 1.

Models and estimation

Working with the panel data necessitates employing proper econometric techniques. As one of our variables (border

Table 1. Descriptive statistics and correlations between variables.

		Mean	SD	1	2	3	4	5	6	7	8
1	Export intensity	11.6	13.67	1							
2	Higher education enrollment	2.8	.92	−.28***	1						
3	Border region	.45	0.5	−.16***	0	1					
4	Regional R&D investment	14.44	1.55	0	.18***	−.11*	1				
5	Startup rates	0.2	.09	.06	.30***	−.12*	.43***	1			
6	Prevalence of poverty	.14	.05	−.15**	−.15**	.18***	−.51***	−.30***	1		
7	Emission intensity	304.92	265.9	.19***	−.12**	.07	−.27***	−.06	.38***	1	
8	Per capita income	25.41	7.35	.47***	−.23***	−.12*	.39***	.21***	−.44***	−.13**	1
9	Regional development	51.68	23.32	.19***	.09	−.25***	.64***	.39***	−.54***	−.28***	.34***

Note. ***$p < .001$; **$p < .01$; *$p < .05$. Because correlation coefficients are within the conventional limits (below .7), it is possible to employ our variables in regression analysis.

region dummy) is time-invariant, we chose to estimate our models with the help of a random effects estimator. The general expression for a regression model with random effects is as follows

$$Yit = Intercept + X_{it} * \beta + \mu_i + \varepsilon_{it} \quad (1)$$

where *Intercept*- is a constant, X_{it}- variables and β- coefficients for variables, μ_i- is a random error invariant in time for each object, ε_{it}- model regression residual. We report three regression models with random effects. Model 1 is expressed as follows

$$\begin{aligned} Regional\ development = {} & Intercept + \beta 1 * Export\ intensity \\ & + \beta 2 * Higher\ education\ enrollment \\ & + \beta 3 * Border\ region + \mu_i + \varepsilon_{it} \end{aligned} \quad (2)$$

Models 2 and 3 are expressed as follows

$$\begin{aligned} Regional\ development = {} & Intercept + \beta 1 * Export\ intensity \\ & + \beta 2 * Higher\ education\ enrollment \\ & + \beta 3 * Border\ region \\ & + \beta 4 * \text{Regional R\&D investment} \\ & + \beta 5 * \text{Startup rates} \\ & + \beta 6 * \text{Prevalence of poverty} \\ & + \beta 7 * \text{Emission intensity} + \mu_i + \varepsilon_{it} \end{aligned} \quad (3)$$

$$\begin{aligned} Regional\ development = {} & Intercept + \beta 1 * Export\ intensity \\ & + \beta 2 * Higher\ education\ enrollment \\ & + \beta 3 * Border\ region \\ & + \beta 4 * \text{Regional R\&D investment} \\ & + \beta 5 * \text{Startup rates} \\ & + \beta 6 * \text{Prevalence of poverty} \\ & + \beta 7 * \text{Emission intensity} \\ & + \beta 8 * \text{Per capita income} \\ & + \beta 9 * \text{Regional R\&D investment} \\ & * \text{Per capita income} \\ & + \beta 10 * \text{Startup rates} \\ & * \text{Per capita income} \\ & + \beta 11 * \text{Prevalence of poverty} \\ & * \text{Per capita income} \\ & + \beta 12 * \text{Emission intensity} \\ & * \text{Per capita income} + \mu_i + \varepsilon_{it} \end{aligned} \quad (4)$$

Model 1 is a comparison model that only includes control variables. Model 2 adds a set of independent variables to the set of predictors to test Hypotheses 1–4. Model 3 adds the moderator variable and its interactions with the independent variables and serves to test Hypotheses 5–8. To avoid non-essential ill-conditioning, predictor variables are standardized (Marquardt, 1980). Calculations were performed using

the R programming language. All models are highly significant as indicated by the chi-squared statistics.

Results

The results of our calculations are presented in Table 2.

Based on the calculations (Table 2), Model 1 is described by the following expression

$$\begin{aligned} Regional\,development = {} & 51.68 + 3.19 * Export\,intensity \\ & + 2.36 * Higher\,education\,enrollment \\ & - 5.42 * Border region + \mu_i + \varepsilon_{it} \end{aligned} \quad (5)$$

Expressions for models 2, 3, and 4 are constructed similarly according to the data in Table 2. Model 1 is highly significant and explains about 5.4% of the variance in the dependent variable. Both export intensity and higher education enrollment have a positive impact on regional development. At the same time, being located at the border with other countries exerts a negative impact on the level of regional development. While explaining this finding is beyond the scope of this paper, we suggest that the countries bordering Russian regions (mostly former Soviet Union republics) are less developed than Russia proper, such that sharing borders with those is less likely to result in positive spillovers to Russian regions.

Model 2, which adds the set of independent variables to Model 1, demonstrates a marked improvement in R^2 and explains 21.8% of the variance in the dependent variable. All direct effect hypotheses 1–4 are supported. R&D investments exert a significant positive impact on regional development (b = 5.08, $p < .001$) as do regional startup rates (b = 2.60, *p.001).* This lends support to hypotheses 1 and 2. The prevalence of poverty in the region negatively affects regional development (b = −2.78, *p.01),* thus lending support to Hypothesis 3. Regional development necessitates poverty alleviation. Emission intensity negatively affects regional development (b = −4.72, $p < .001$) thus providing support for Hypothesis 4. A reduction in emission intensity is likely to lead to regional development. Model 3 further improves the predictive power of our regression by bringing the R^2 to 23.1%, yet this improvement is fairly minor. Of the four interaction effects, only one attains statistical significance at the conventional level.

To ease the interpretation of the interaction effects, we plot the significant moderated relationship between the independent variable Emission intensity and the variable Per capita income in Figure 1. To plot the graph, we use the following technique: Figure 1 shows the effect of Emission intensity on regional development with the moderator of per capita income. The rest of the variables in Model 3 have average values. Because all variables except the dependent variable are standardized, their average values are equal to zero. We get the following function

$$\begin{aligned} Regional\,development = {} & 51.69 - 6.42 * Emission\,intensity \\ & - 0.34 * Per\,capita\,income \\ & - 1.48 * Emission\,intensity \\ & * Per\,capita\,income \end{aligned} \quad (6)$$

Since Per capita income is a moderator, we plot the resultant functions at one standard deviation above and

Table 2. Regression results.

	Model 1	Model 2	Model 3
Intercept	51.68*** (2.56)	51.68*** (1.91)	51.69*** (1.91)
Export intensity	3.19*** (.96)	2.44** (.89)	2.37** (.89)
Higher education enrollment	2.36*** (.60)	2.58*** (.72)	3.02** (1.04)
Border region	−5.42* (2.57)	−3.87* (1.93)	−3.82* (1.90)
Regional R&D investment		5.08*** (1.47)	5.10*** (1.52)
Startup rates		2.60*** (.68)	2.98*** (.70)
Prevalence of poverty		−2.78** (1.05)	−2.40* (1.15)
Emission intensity		−4.72*** (.62)	−6.42*** (.99)
Per capita income			−.34 (1.27)
Regional R&D investment * per capita income			−.37 (.68)
Startup rates * per capita income			−1.12 (.62)
Prevalence of poverty * per capita income			−.37 (.72)
Emission intensity * per capita income			−1.48* (.74)
R^2	.054	.218	.231
ΔR^2	-	.164	.013
Fit statistic	$\chi^2_{(3)}$ = 28.22	$\chi^2_{(7)}$ = 130.22	$\chi^2_{(12)}$ = 144.95
p	<.001	<.001	<.001

Note. Dependent variable: Regional development. Standard errors in parentheses. ***$p < .001$; **$p < .01$; *$p < .05$.

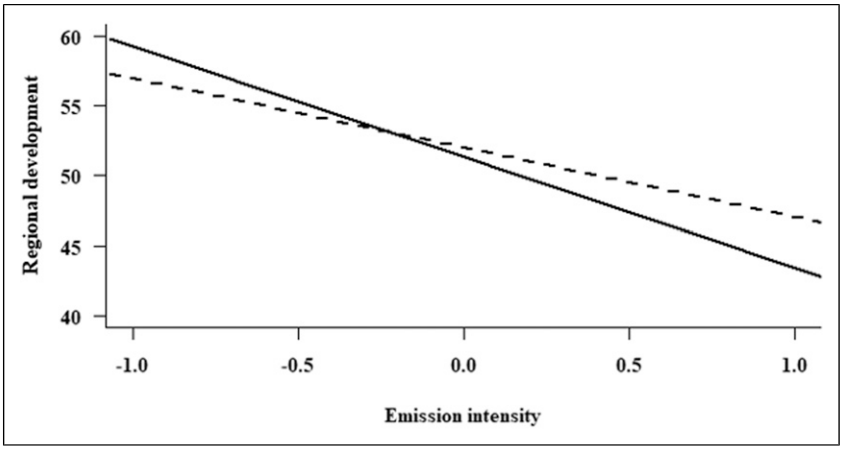

Figure 1. Emission intensity and regional development in high- and low-income regions.
Note: solid line indicates regions with above-average per capita income; dotted line indicates regions with below-average per capita income.

below the mean for Per capita income, the graphical visualization of which is shown in Figure 1.

Specifically, the effect of emission intensity on regional development is more pronounced in regions with above-average per capita income. That is, our calculations confirmed Hypothesis 8: that the negative relationship between emission intensity and regional development is more pronounced in regions with above-average per capita income. At the same time, hypotheses 5, 6, and 7 do not receive support. Fundamentally, it implies that well-off regions are more likely to benefit from reducing emissions in terms of regional development than their less affluent counterparts. This makes the task of regional development particularly daunting for the relatively disadvantaged regions and necessitates careful consideration of ecological policies by their policymakers. At the same time, the fact that relative wealth does not moderate the effect of other independent variables indicates that both economic and social aspects of sustainable development are truly universal in their effectiveness and may be pursued by rich and poor regions alike with similar outcomes in terms of regional development improvements.

Discussion

Our results indicate that, in line with our conceptual development, the economic, social, and ecological goals of sustainable development may be well aligned and naturally lead to a noticeable improvement in regional resource allocation efficiency. Unlike prior literature that at times questioned whether all three facets of development goals may in fact reinforce one another, we demonstrate that indeed all the developmental dimensions may be seen as beneficial from a regional development standpoint, such that regional policy makers are fully justified in emphasizing all three simultaneously.

The positive effects of economic factors—investments in R&D and regional startup rates—are hardly surprising. Existing literature has long postulated these links, and the key role of these factors in bringing about regional advancement was expected. Perhaps less expected is the magnitude of these effects. The impact of a proportionate increase in R&D spending by established firms is almost twice as large as the impact of a similar growth in startup rates, based on the standardized regression coefficients. This dovetails with a more skeptical view of the role that entrepreneurs play in economic development found in Shane (2009). Still, in line with the voluminous literature on entrepreneurship and development dynamics, we confirm the overall positive impact of startup rates on regional development. Regarding hypothesis No. 2, the study tests without using temporal lags. The creation of new firms may not immediately affect the gross regional product or the technological frontier. However, the fact of higher entrepreneurial activity is rather important here. Indeed, newer firms are based on new technologies and are more efficient than older firms. We assume that the ranking of regions by entrepreneurial activity is stable and that it is acceptable to use its current values. On the other hand, the remaining variables do not imply temporal lags, and introducing them for this one variable seems inappropriate and will lead to the loss of one of the years of the study period.

The positive role of poverty alleviation and emission reduction in regional development is a welcome finding that is particularly important given the growing attention to sustainable development espoused by the United Nations and national and regional policymakers around the world. Far from being a "cost" for regional businesses, efforts at addressing social ills and curbing emissions are clearly beneficial from a regional development standpoint. Because regional development further perpetuates the development

cycle, it is essential to communicate these results to not only policymakers but to decision-makers at the firm level. Through the concerted efforts of business owners, managers, and regional policymakers, it is possible to set regional development on a sustainable trajectory, which is a worthy goal in its own right.

It should be acknowledged, however, that without proper direction and attention, efforts by regional firms to improve efficiency may come at a cost to the environment. Care should be taken to ensure that businesses do not "cut corners" as they invest in their own research and development and that they keep the overall goal of sustainable development in mind when committing their funds to new products and services. Ultimately, all regional players stand to gain from concerted efforts aimed at sustainable development.

While the effects of economic and social agenda pursuit appear to be universal, attention to reducing emissions is more likely to bring about a pronounced improvement in regional development in wealthier regions. This suggests that less affluent regions would be wise to emphasize economic and social goals before turning their attention to addressing ecological challenges. Once per capita income increases, however, discerning policymakers should incorporate ecological considerations into their developmental agenda. In other words, sustainable development is subject to sequence and timing, and regional policymakers should focus their attention accordingly. At the same time, three hypotheses that are related to the moderation of the tested variables and the level of income have not been confirmed (hypotheses 5, 6, and 7). We associate this result with the fact that the "rich get richer" phenomenon (Durham et al., 1998) encounters active state regulation, which is aimed at smoothing out disparities between regions. Government regulation is aimed at equalizing, first of all, social and economic indicators. Environmental aspects have not yet received sufficient attention. Therefore, hypotheses 5, 6, and 7, which are associated with social and economic indicators, were not confirmed, but hypothesis 8, which is associated with the environmental factor, was successfully confirmed. Accordingly, this study emphasizes that sustainable development implies smoothing out regional disparities not only in terms of social and economic indicators but also in terms of environmental indicators. The Russian government needs to pay attention to this problem.

Finally, scholars propose to assess development at the level of countries and regions in three areas (economic, social, and ecological agendas) (Elkington, 2018). There are a large number of indicators that are proposed as criteria for assessing each of these areas (Gini coefficient, Belyavskiy (2023), human capital, environmental pollution, etc.). At the same time, the problem of developing a single criterion for evaluating all three areas has not yet been resolved, although attempts are made in the literature to form a complex criterion (e.g., the index method or the DEA method), but they can be distorted by the influence of the subjective factor. For this reason, it seems more appropriate to study the impact of economic, social, and environmental indicators on each of the triple development goals separately. In this paper, we have chosen the resulting indicator (dependent variable) to reflect the economic aspect of regional development. In further work, we plan to consider the impact of economic, social, and environmental indicators on two other development goals (social and ecological agendas), choosing the appropriate dependent variables.

Limitations, conclusions, and future research

Like any research, this study has certain limitations. The fact that the data come from a single country may limit the generalizability of our findings. Nevertheless, given the sheer size of the Russian territory, the role that Russia's economy plays in the global arena, and the pronounced diversity in the level of development of the Russian regions analyzed in this study, we are confident that the results are relevant to a great number of other contexts.

The period under study has been characterized by a systemic crisis due to the imposition by Western countries of sanctions against Russia. We suggest that this provides for a conservative setting where regional development is harder to ensure. In this sense, the fact that we find support for our key hypotheses is noteworthy. Still, it will be important to replicate our study in different contexts not plagued by the economic or political crisis.

It may also be questioned whether the way we capture regional development with the help of Data envelope Analysis is sufficiently well-suited to make inferences with respect to sustainable development. We maintain that this technique is uniquely qualified to capture development regardless of the specific trajectories pursued and thus fits the goals of the study. Nevertheless, one may consider employing alternative indicators of sustainable development, including those offered by the United Nations, as an alternative dependent variable. Future research would be wise to consider such alternative indicators.

Overall, this study makes an important step in uncovering the interrelationship between economic, social, and ecological goals in the context of sustainable development. It is our hope that it initiates dialog among scholars and policymakers interested in promoting a sustainable development agenda.

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Data availability statement

The data that support the findings of this study are available from the corresponding author upon request (Federal State Statistics Service (Rosstat), 2022).

References

Aghion, P., & Tirole, J. (1994). The management of innovation. *Quarterly Journal of Economics*, *109*(4), 1185–1209.

Anokhin, S. (2013). Venture migration: A quest for a low-hanging fruit? *Entrepreneurship and Regional Development*, *25*(5-6), 423–445. https://doi.org/10.1080/08985626.2012.758316

Anokhin, S., Morgan, T., Jones Christensen, L., & Schulze, W. (2023). Local context and post-crisis social venture creation. *Strategic Entrepreneurship Journal*, *17*(1), 40–60. https://doi.org/10.1002/sej.1448

Anokhin, S., & Schulze, W. S. (2009). Entrepreneurship, innovation, and corruption. *Journal of Business Venturing*, *24*(5), 465–476. https://doi.org/10.1016/j.jbusvent.2008.06.001

Anokhin, S., Wincent, J., & Autio, E. (2011). Operationalizing opportunities in entrepreneurship research: Use of data envelopment analysis. *Small Business Economics*, *37*(1), 39–57. https://doi.org/10.1007/s11187-009-9227-1

Audretsch, D. B., & Lehmann, E. E. (2005). Does the knowledge spillover theory of entrepreneurship hold for regions? *Research Policy*, *34*(8), 1191–1202. https://doi.org/10.1016/j.respol.2005.03.012

Basboga, K. (2020). The role of open borders and cross-border cooperation in regional growth across Europe. *Regional Studies, Regional Science*, *7*(1), 532–549. https://doi.org/10.1080/21681376.2020.1842800

Behera, S. R., & Dash, D. P. (2017). The effect of urbanization, energy consumption, and foreign direct investment on the carbon dioxide emission in the SSEA (South and Southeast Asian) region. *Renewable and Sustainable Energy Reviews*, *70*, 96–106. https://doi.org/10.1016/j.rser.2016.11.201

Belyavskiy, B. (2023). Power symmetry in global value chains: Evidence from the Russian retail market. *Journal of Eurasian Studies*, 18793665221150658. https://doi.org/10.1177/18793665221150658

Cainelli, G., D'Amato, A., & Mazzanti, M. (2020). Resource efficient eco-innovations for a circular economy: Evidence from EU firms. *Research Policy*, *49*(1), 103827. https://doi.org/10.1016/j.respol.2019.103827

Carayannis, E. G., & Campbell, D. F. (2018). *Smart quintuple helix innovation systems: How social ecology and environmental protection are driving innovation, sustainable development and economic growth*. Springer.

Charnes, A., Cooper, W. W., & Li, S. (1989). Using data envelopment analysis to evaluate efficiency in the economic performance of Chinese cities. *Socio-Economic Planning Sciences*, *23*(6), 325–344. https://doi.org/10.1016/0038-0121(89)90001-3

Chen, Y., & Lee, C. C. (2020). Does technological innovation reduce CO2 emissions?Cross-country evidence. *Journal of Cleaner Production*, *263*, 121550. https://doi.org/10.1016/j.jclepro.2020.121550

Cheng, X., Chen, L., & Sun, R. (2019). Modeling the non-point source pollution risks by combing pollutant sources, precipitation, and landscape structure. *Environmental Science and Pollution Research*, *26*(12), 11856–11863. https://doi.org/10.1007/s11356-019-04384-y

Chistyakova, N., Mikhalchuk, A., Bocharova, Y., Akerman, E., & Tatarnikova, V. (2023). Catching-up regional strategy as a tool to reduce spatial inequality. *Journal of the Geographical Institute Jovan Cvijic, SASA*, *73*(1), 33–48. https://doi.org/10.2298/IJGI2301033C

Cole, M. A., & Neumayer, E. (2006). The impact of poor health on total factor productivity. *Journal of Development Studies*, *42*(6), 918–938.https://doi.org/10.1080/00220380600774681

Cooper, W. W., Seiford, L. M., & Zhu, J. (Eds), (2011). *Handbook on data envelopment analysis*. Springer Science & Business Media.

Dong, F., Yu, B., Hadachin, T., Dai, Y., Wang, Y., Zhang, S., & Long, R. (2018). Drivers of carbon emission intensity change in China. *Resources, Conservation and Recycling*, *129*, 187–201. https://doi.org/10.1016/j.resconrec.2017.10.035

Durham, Y., Hirshleifer, J., & Smith, V. L. (1998). Do the rich get richer and the poor poorer? Experimental tests of a model of power. *The American Economic Review*, *88*(4), 970–983. https://www.jstor.org/stable/117014

Eisenmenger, N., Pichler, M., Krenmayr, N., Noll, D., Plank, B., Schalmann, E., Wandl, M. T., & Gingrich, S. (2020). The sustainable development goals prioritize economic growth over sustainable resource use: A critical reflection on the SDGs from a socio-ecological perspective. *Sustainability Science*, *15*(4), 1101–1110. https://doi.org/10.1007/s11625-020-00813-x

Elkington, J. (2018). 25 years ago I coined the phrase "triple bottom line." Here's why it's time to rethink it. *Harvard Business Review*, *25*, 2–5.

Emrouznejad, A., Banker, R. D., & Neralić, L. (2019). Advances in data envelopment analysis: Celebrating the 40th anniversary of DEA and the 100th anniversary of Professor Abraham Charnes' birthday. *European Journal of Operational Research*, *278*(2), 365–367.

Faggian, A., Modrego, F., & McCann, P. (2019). Human capital and regional development. In *Handbook of regional growth and development theories*.

Federal State Statistics Service (Rosstat). (2022). EMISS. https://eng.rosstat.gov.ru/ (Data collected on October 2022).

Friedman, M. (1970). A Friedman doctrine: The social responsibility of business is to increase its profits. *New York Times Magazine*, *13*, 32–33.

Gillingham, K., & Stock, J. H. (2018). The cost of reducing greenhouse gas emissions. *The Journal of Economic Perspectives*, *32*(4), 53–72. https://doi.org/10.1257/jep.32.4.53

Gordon, I. R., & McCann, P. (2005). Innovation, agglomeration, and regional development. *Journal of Economic Geography*, *5*(5), 523–543. https://doi.org/10.1093/jeg/lbh072

Higgins, B., & Savoie, D. J. (2017). *Regional development theories and their application*. Routledge.

Hipp, J. R., Williams, S. A., Kim, Y. A., & Kim, J. H. (2019). Fight or flight? Crime as a driving force in business failure and business mobility. *Social Science Research*, *82*(August 219), 164–180. https://doi.org/10.1016/j.ssresearch.2019.04.010

Kalabikhina, I. E., Mokrensky, D. N., & Panin, A. N. (2019). Demographic, economic, geospatial data for municipalities of the Central Federal District in Russia (excluding the city of Moscow and the Moscow oblast) in 2010-2016. *Population and Economics*, *3*(4), 121–134. https://doi.org/10.3897/popecon.3.e39152

Kirsten, W. (2010). Making the link between health and productivity at the workplace —A global perspective. *Industrial Health*, *48*(3), 251–255. https://doi.org/10.2486/indhealth.48.251

Korosteleva, J., & Stępień-Baig, P. (2020). Climbing the poverty ladder: The role of entrepreneurship and gender in alleviating poverty in transition economies. *Entrepreneurship and Regional Development*, *32*(1-2), 197–220. https://doi.org/10.1080/08985626.2019.1640482

Kraay, A., & McKenzie, D. (2014). Do poverty traps exist? Assessing the evidence. *The Journal of Economic Perspectives*, *28*(3), 127–148. https://doi.org/10.1257/jep.28.3.127

Lahti, T., Wincent, J., & Parida, V. (2018). A definition and theoretical review of the circular economy, value creation, and sustainable business models: Where are we now and where should research move in the future? *Sustainability*, *10*(8), 2799. https://doi.org/10.3390/su10082799

Leal Filho, W., Tripathi, S. K., Andrade Guerra, J. B. S. O. D., Giné-Garriga, R., Orlovic Lovren, V., & Willats, J. (2019). Using the sustainable development goals towards a better understanding of sustainability challenges. *The International Journal of Sustainable Development and World Ecology*, *26*(2), 179–190. https://doi.org/10.1080/13504509.2018.1505674

Lenzi, C., & Perucca, G. (2020). The nexus between innovation and wellbeing across the EU space: What role for urbanisation? *Urban Studies*, *57*(2), 323–349. https://doi.org/10.1177/0042098018818947

Li, H., Khattak, S. I., & Ahmad, M. (2021). Measuring the impact of higher education on environmental pollution: New evidence from thirty provinces in China. *Environmental and Ecological Statistics*, *28*(1), 187–217. https://doi.org/10.1007/s10651-020-00480-2

Liu, M., Tan, R., & Zhang, B. (2021). The costs of "blue sky": Environmental regulation, technology upgrading, and labor demand in China. *Journal of Development Economics*, *150*, 102610. https://doi.org/10.1016/j.jdeveco.2020.102610

Mariano, E. B., Sobreiro, V. A., & Rebelatto, D. A. (2015). Human development and data envelopment analysis: A structured literature review. *Omega*, *54*(July 2015), 33–49. https://doi.org/10.1016/j.omega.2015.01.002

Marquardt, D. W. (1980). Comment. *Journal of the American Statistical Association*, *75*(369), 87–91.

Masduki, U., Rindayati, W., & Mulatsih, S. (2022). How can quality regional spending reduce poverty and improve human development index? *Journal of Asian Economics*, *82*(October 2022), 101515. https://doi.org/10.1016/j.asieco.2022.101515

Mikheeva, N. N. (2021). Resilience of Russian regions to economic shocks. *Studies on Russian Economic Development*, *32*, 68–77. https://doi.org/10.1134/S107570072101010X

Mirvis, P. H., Sales, A. L., & Hackett, E. J. (1991). The implementation and adoption of new technology in organizations: The impact on work, people, and culture. *Human Resource Management*, *30*(1), 113–139. https://doi.org/10.1002/hrm.3930300107

Mokrensky, D. N. (2020). Migrationally attractive municipalities in the regions of the Central Federal District (excluding regional centers). *Population and Economics*, *4*(1), 51–59. https://doi.org/10.3897/popecon.4.e50403

Mosley, P., & Verschoor, A. (2005). Risk attitudes and the 'vicious circle of poverty'. *European Journal of Development Research*, *17*(1), 59–88. https://doi.org/10.1080/09578810500066548

Nakamura, H., & Managi, S. (2020). Entrepreneurship and marginal cost of CO2 emissions in economic development. *Economic Analysis and Policy*, *67*(September 2020), 1–14. https://doi.org/10.1016/j.eap.2020.05.004

Parida, V., Burström, T., Visnjic, I., & Wincent, J. (2019). Orchestrating industrial ecosystem in circular economy: A two-stage transformation model for large manufacturing companies. *Journal of Business Research*, *101*(August 2019), 715–725. https://doi.org/10.1016/j.jbusres.2019.01.006

Petrovic, M. D., Gelbman, A., Demirovic, D., Gagic, S., & Vukovic, D. B. (2017). The examination of the residents' activities and dedication to the local community - an agritourism access to the subject. *Journal of the Geographical Institute Jovan Cvijic, SASA*, *67*(1), 37–52. https://doi.org/10.2298/IJGI1701037P

Pike, A., Rodríguez-Pose, A., & Tomaney, J. (Eds), (2011). *Handbook of local and regional development*: Routledge.

Radjou, N., & Prabhu, J. (2015). *Frugal Innovation: How to do more with less*. Hachette.

Schulte, U. G. (2013). New business models for a radical change in resource efficiency. *Environmental Innovation and Societal Transitions*, *9*(December 2013), 43–47. https://doi.org/10.1016/j.eist.2013.09.006

Shane, S. (2009). Why encouraging more people to become entrepreneurs is bad public policy. *Small Business Economics*, *33*(2), 141–149. https://doi.org/10.1007/s11187-009-9215-5

Shefer, D., & Frenkel, A. (2005). R&D, firm size and innovation: An empirical analysis. *Technovation*, *25*(1), 25–32. https://doi.org/10.1016/S0166-4972(03)00152-4

Solanko, L. (2008). Unequal fortunes: A note on income convergence across Russian regions. *Post-communist Economies*, *20*(3), 287–301. https://doi.org/10.1080/14631370802281399

Spitsin, V., Vukovic, D., Anokhin, S., & Spitsina, L. (2021). Company performance and optimal capital structure: Evidence of transition economy (Russia). *Journal of Economics Studies*, *48*(2), 313–332. https://doi.org/10.1108/JES-09-2019-0444

Swink, M., Talluri, S., & Pandejpong, T. (2006). Faster, better, cheaper: A study of npd project efficiency and performance tradeoffs. *Journal of Operations Management*, *24*(5), 542–562. https://doi.org/10.1016/j.jom.2005.09.004

United Nations. (2016). The sustainable development goals report. https://unstats.un.org/sdgs/report/2016/

van Soest, D. P., & Bulte, E. H. (2001). Does the energy-efficiency paradox exist? Technological progress and uncertainty. *Environmental and Resource Economics*, *18*(1), 101–112. https://doi.org/10.1023/A:1011112406964

van Stel, A., & Suddle, K. (2008). The impact of new firm formation on regional development in The Netherlands. *Small Business Economics*, *30*(1), 31–47.

Vukovic, D., Jovanovic, A., & Djukic, M. (2012). Defining competitiveness through the theories of new economic geography and regional economy. *Journal of the Geographical Institute Jovan Cvijic, SASA*, *62*(3), 49–64. https://doi.org/10.2298/IJGI1203049V

Vuković, D., & Wei, L. (2010). Regional competitiveness: The case of western China. *Journal of the Geographical Institute" Jovan Cvijic", SASA*, *60*(1), 107–124. https://doi.org/10.2298/IJGI1001107V

Vukovic, D. B., Zobov, A. M., & Degtereva, E. A. (2022). The nexus between tourism and regional real growth: Dynamic panel threshold testing. *Journal of the Geographical Institute Jovan Cvijic, SASA*, *72*(1), 111–116. https://doi.org/10.2298/IJGI2201111V

World Bank. (2020). *Russia integrates: Deepening the country's integration in the global economy.* World Bank.

York, R., Rosa, E. A., & Dietz, T. (2004). The ecological footprint intensity of national economies. *Journal of Industrial Ecology*, *8*(4), 139–154. https://doi.org/10.1162/1088198043630487

Zhu, K., & Weyant, J. P. (2003). Strategic decisions of new technology adoption under asymmetric information: A game-theoretic model*. *Decision Sciences*, *34*(4), 643–675. https://doi.org/10.1111/j.1540-5414.2003.02460.x

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