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Forming an Innovative Start-Up Ecosystem to Increase the Entrepreneurial Activity of Companies (As Exemplified by Asian Countries)

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ABSTRACT: This study assesses the development of start-up ecosystems and the effectiveness of government initiatives, determines issues, and proposes measures to support entrepreneurial ecosystems. The aim of the study was to examine how innovative start-up ecosystems contribute to sustainable development and increased entrepreneurial activity in Asian countries, focusing on their strategic importance for economic transformation and technological growth. Using quantitative and qualitative research methods, the authors conduct a comparative analysis of the development of entrepreneurial ecosystems in five Asian countries (Kazakhstan, China, India, South Korea, and Japan) for 2018-2021. The empirical analysis relies on panel data from global databases, applying regression modeling to assess the influence of ecosystem variables on sustainable innovation activity across 20 observations. The data obtained indicates a different degree of development of entrepreneurial ecosystems in the countries under study. Japan and South Korea demonstrate consistently high levels of ecosystem development, while Kazakhstan, China, and India show lower levels but with growth trends. According to the study results, the most influential factors for the development of entrepreneurial activity are state support and policies and access to financing. The findings show that access to financing and state support are the most influential factors in boosting green start-ups and sustainable innovation, with a 1-point increase in funding leading to a 12.6 percentage point rise in eco-innovation activity. To increase entrepreneurial activity, develop open innovations, and achieve SDGs, the authors propose several support measures. These support measures contribute to the formation of start-up infrastructure, including business incubators and accelerators, creating a favorable environment for the development of the venture capital market, building a knowledge exchange system through international cooperation in the framework of open innovation, and holding international hackathons and other events aimed at stimulating innovation and activating knowledge dissemination. Article results offer practical insights for policymakers and ecosystem developers to enhance regulatory frameworks, improve financing mechanisms, and foster global partnerships that support innovation-driven entrepreneurship. Its unique contribution lies in presenting a cross-country, data-driven analysis of entrepreneurial ecosystems in Asia with a focus on sustainability, thereby filling an important gap in the literature on green innovation and start-up policy strategies.

Keywords: sustainable development, entrepreneurial ecosystems, open innovation, start-ups.

I. INTRODUCTION

In the pursuit of sustainability, companies become aware of the need to transform and adapt their business activities to the emerging trends and challenges of today's world [1]. Such socio-economic factors as economic growth, demographic changes, urbanization, environmental degradation, and social degradation affect the development of entrepreneurship in different countries and regions [2]. To increase the contribution of entrepreneurship to sustainable development, companies need to implement continuous innovation [3] aimed at improving the following three main areas: environmental, economic, and social.

Continuous innovation is essential to ensure sustainability and drive entrepreneurial growth [4]. In the environmental field, innovation helps organizations reduce their environmental footprint by developing cleaner technologies, adopting sustainable practices, and conserving resources. In the economic sphere, innovation enables organizations to seek new market opportunities and improve productivity. The social aspect of innovation is equally important for sustainable development and entrepreneurship. Through innovation, companies can develop socially responsible initiatives that respond to social needs and promote inclusive growth.

Therefore, to achieve sustainable development through the potential of innovation and entrepreneurial activity, the concept of an innovation ecosystem emerges. According to the experts of the International Development Innovation Alliance [5], for innovative ideas to be effectively generated, tested, and ultimately scaled in terms of their impact on the development of enterprises, they require coordinated joint actions and resources of various actors (governments, civil society, universities, entrepreneurs), which are called the innovation ecosystem. All this contributes to the development of a culture of innovation and entrepreneurship that stimulates economic growth [6], social progress, and environmental sustainability in a supportive institutional environment [7]. The fundamental idea behind the entrepreneurial innovation ecosystem is to create a favorable environment to support innovation, the creation of new firms, and the corresponding sustainable employment growth in each region. Open innovations involve an active search for outside ideas, technologies, and experiences to complement a company's internal capabilities. This approach encourages organizations to engage in strategic collaboration, joint ventures, and open platforms where ideas can be exchanged, improved, and implemented [8]. Thus, the open innovation approach becomes a key tool for a region's innovation ecosystem. Regions should strive to develop their national economies by identifying unique resources such as natural resources, skilled labor, cultural heritage, and geographic location and harmonizing economic activities to take advantage of these benefits [9]. Through open innovation, regions can access external technologies and market information and identify new trends and opportunities to build successful organizations and drive sustainability [10]. Recognizing that economic progress depends on the acquisition of knowledge, innovation, and entrepreneurship, countries and regions are increasingly focusing on developing robust innovation ecosystems.

For the development of the ecosystem, it is necessary to create and implement new business solutions and business approaches [11]. Under an ecosystem approach to innovation, a complete and strong innovation ecosystem includes elements such as knowledge exchange, ideas, inventions, research, education, start-ups, entrepreneurs, angel investors, mentors, consultants, and events and is supported by universities, business incubators, accelerators, investors, co-working spaces, and venture capitals. Since companies are looking for innovative approaches consistent with the principles of environmental sustainability [12], social responsibility, and economic viability, a start-up can be a business solution.

Despite the growing importance of entrepreneurial ecosystems in fostering innovation and sustainable development, there remains a gap in the literature concerning the specific role of start-ups in driving these processes across different Asian regions. While previous studies have acknowledged the influence of open innovation and government support on the entrepreneurial landscape, they have largely overlooked the comprehensive impact of entrepreneurial ecosystems on the development of green technologies and sustainable innovations. But in our opinion, start-ups are the most promising form of enterprise organization since they are characterized by flexibility and adaptability to market changes.

A start-up business is a temporary form of organization that aims at making a reproducible and scalable business model. Start-ups are created to solve the problems that arise in the socio-economic environment and achieve growth and long-term development of the company using innovative technologies. Being innovative enterprises, start-ups embody the principles of entrepreneurship and serve as the driving force behind economic growth, technological progress, and sustainable development [13]. However, these business solutions often face financial constraints that hinder them from investing in the necessary infrastructure, technology, staffing,

marketing, and product development. Limited resources can slow progress, limit scalability and affect a company's competitiveness in the market.

Therefore, the issue of creating a strong and open entrepreneurial ecosystem and assessing its impact on activity in the field of sustainable development and innovation becomes important for the launch of start-ups [14, 15]. Thus, the research question was: How do entrepreneurial ecosystems in Asian countries contribute to sustainable innovation and growth of start-up activity?

To address these authors have set the following sub-questions:

- What are the key factors influencing the development of entrepreneurial ecosystems in these countries?
- How do government policies and access to financing affect the level of innovation activity in start-ups?
- What role do green start-ups play in promoting sustainability, and how are they supported by the ecosystem?
- How do the entrepreneurial ecosystems in these countries compare in terms of fostering sustainable innovation?

The following text of the article is structured as follows: the literature review describes the theoretical background, focusing on entrepreneurial ecosystems, open innovation and their importance for sustainable development. The methodology describes in detail the research methods used by the authors, including the countries studied, data sources and research design. Particular attention is also paid to the panel regression analysis, which identifies the key factors determining the success of entrepreneurial ecosystems in five countries. The results of the analysis are presented systematically, beginning with the descriptive statistics of the data, followed by hypothesis testing to examine the relationships between the key variables. Discussion suggests practical implications for policymakers and provide suggestions for improving the effectiveness of start-up ecosystems. The article concludes with a summary of the main findings and the significance of the study.

II. LITERATURE REVIEW

To clearly indicate the focus of our research, we need to clarify that despite academic interest and entrepreneurial practice in the formation of effective forms of cooperation within the innovation ecosystem, the role of start-ups has not been sufficiently studied. While the entrepreneurial ecosystem approach has gained traction, studies often don't consider the complexity of these systems in fostering sustainable innovation, particularly in emerging markets at the regional and state levels.

For a broader understanding of the role of start-ups in the innovation ecosystem, we selected the Asian region as the research object, which includes five countries: Kazakhstan, China, India, South Korea, and Japan. Although previous studies have covered the positive impact of open innovation on the economic and innovation performance of companies, there is still a lack of comprehensive research into the role of start-ups in the broader innovation landscape.

To further contextualize the role of start-ups within the innovation ecosystem, recent literature underscores the critical contributions of start-ups to economic development and technological advancement, particularly within the Asian context. Sharma and Bhardwaj [16] explore the influence of AI on the journalism start-up ecosystem in major Asian cities, emphasizing the transformative impact of technology on start-up growth and sustainability in the region. Similarly, Jagačić et al. [17] provide a comprehensive review of metrics used to measure start-up progress, highlighting the importance of monitoring tools in the effective management and scaling of start-ups. These studies, alongside research on corporate engagement with start-ups, as examined by Jha et al. [18], suggest that start-ups play a pivotal role in driving innovation and economic growth through their dynamic interactions with larger corporations and their ability to rapidly adapt to technological changes. However, despite these advances, there remains a lack of consensus regarding the specific impact of start-ups on sustainability and green innovation, particularly in the context of rapidly developing countries of Asian region.

The significant economic growth of the Asian region and its contribution to the global economy explains our interest in start-up ecosystems and their impact on regional and national innovation systems. Based on the data from StartupBlink, which provides insight into the global start-up ecosystem, it becomes clear that the development of start-ups in the Asian region is characterized by an uneven distribution of resources and mechanisms to support an innovative entrepreneurial culture.

Factors such as geographical location and population have a great impact on the development of start-ups. Regions with favorable geographical conditions (for example, Kazakhstan) which have access to natural resources such as oil, gas, and low-cost electricity (as of May 1, 2023, the average cost of 1 kW was 0.02 US cents) can provide a solid foundation for economic growth and investment opportunities to attract and develop start-ups. In addition, regions with large populations such as China and India often have a larger labor force, market opportunity, and consumer base, providing a favorable environment for start-ups to grow.

Recent studies further highlight the advanced start-up ecosystems in South Korea and Japan, attributing their success to a combination of well-established infrastructure, access to significant funding, and supportive regulatory environments. For instance, Jha, Singh, and Basu [18] emphasize the role of corporate engagement in bolstering start-up growth in these countries, where large corporations actively collaborate with start-ups to foster innovation and drive economic expansion. Additionally, research by Pejic-Bach et al. [19] underscores the importance of ecosystem dynamics in these nations, noting that the interplay between government policies, venture capital availability, and technological infrastructure creates a conducive environment for start-ups to thrive. These findings align with the broader narrative that South Korea and Japan's leading positions in the start-up landscape are not merely coincidental but are the result of deliberate strategies and investments in creating sustainable entrepreneurial ecosystems. As a result, both countries continue to set benchmarks for others in the region, further solidifying their roles as innovation leaders.

Despite their potential, there are several problems that prevent the full implementation of the start-up ecosystem in the Asian region. A key issue is access to finance and investment capital [14]. While some countries in Asia, such as China and India, can attract significant investment in their start-up ecosystems, Kazakhstan faces insufficient funding. The development of robust venture capital networks, business angel communities, and crowd-funding platforms can fill the funding gap and provide start-ups with the resources they need to scale and expand their operations.

It is also necessary to pay attention to the legal framework of some countries in the Asian region. However, bureaucratic processes and lengthy approval procedures can hinder the ease of doing business [20]. Such obstacles not only slow down the pace of innovation but also limit the flexibility and agility of start-ups in adapting to market demands and opportunities. Governments that actively promote and support entrepreneurship through policy initiatives and programs can create a favorable environment for start-ups.

An important issue is the protection of the intellectual assets of start-ups. Strengthening intellectual property laws and enforcement mechanisms is critical to creating a favorable environment for start-ups to thrive and protect their intellectual property rights. Another challenge is limited access to high-quality entrepreneurial education and business support services. Entrepreneurship training programs, mentoring initiatives, and incubation centers can train aspiring entrepreneurs with the necessary skills, knowledge, and resources to launch and scale their start-ups. Investments in entrepreneurial education and comprehensive support programs contribute to the development of a skilled workforce [21, 22].

Finally, limited opportunities for collaboration hinder the exchange of ideas, knowledge, and resources between start-ups and other stakeholders. Building dynamic open ecosystems can foster collaboration, develop a culture of open innovation, and create a favorable environment for start-ups to thrive. Collaboration and knowledge sharing between start-ups, academic institutions, and government are key drivers for the growth of the Asian start-up ecosystem. While protecting national interests and resources is critical, it is equally important to create an open collaborative environment that encourages knowledge exchange, partnerships, and cross-border collaboration. Creating dynamic, open ecosystems that foster collaboration of different regions and promoting inter-regional partnerships, integration barriers can be minimized, and the overall innovation potential of the regional ecosystem can be increased to startup development.

Recent studies emphasize the crucial role of collaboration and knowledge sharing in enhancing the growth and sustainability of start-up ecosystems. For example, Máté, Estiyanti, and Novotny [23] highlight the significance of start-up incubation processes that involve close collaboration between start-ups, academic institutions, and governmental bodies, leading to more robust and innovative outcomes. Their research suggests that fostering an open ecosystem where these stakeholders actively engage can significantly enhance the start-up landscape by facilitating the exchange of ideas, resources, and expertise. Additionally, the work of [24] supports the notion that successful innovation ecosystems are often underpinned by strong networks of collaboration that transcend national boundaries, encouraging cross-border partnerships and reducing integration barriers. These findings underscore the importance of creating an environment where open innovation and inter-regional collaboration are prioritized, thus enabling start-ups to leverage regional strengths and contribute to a more dynamic and integrated Asian start-up ecosystem.

Based on the study of limited opportunities in various areas for the development of start-ups, we identified the conditions on which the successful implementation of start-ups depends: the availability of funding for start-ups, state support, the favorable tax policy, entrepreneurial education, the maturity of the R&D transfer system, the openness of the domestic market.

Moreover, as economies become increasingly interconnected, the role of open innovation and inter-regional collaboration becomes paramount in harnessing diverse strengths across different regions. By analyzing these

dynamics, we can better understand how to build robust ecosystems that foster knowledge exchange, cross-border partnerships, and ultimately, a more integrated and competitive global economy.

III. MATERIAL AND METHOD

The Materials and Methods section encapsulates the blueprint of the research endeavor, meticulously delineating the tools, procedures, and approaches employed to explore the research questions or hypotheses. This section serves as a detailed roadmap, elucidating the systematic methodology adopted to gather, analyze, and interpret data with precision and integrity. Beginning with a comprehensive description of the participants or sample selection, it presents a detailed portrait of the individuals or entities involved in the study, outlining the demographic characteristics and selection criteria. Subsequently, the research design is explicated, illuminating the overarching structure guiding the study, whether it be qualitative, quantitative, experimental, or employing mixed methodologies. This section meticulously details the materials or instruments utilized, delving into the specifics of the tools, surveys, or equipment harnessed to collect data. The procedure or data collection segment elaborates on the step-by-step process undertaken during the research, providing transparency regarding the protocols followed. Moreover, the section addresses the approach to data analysis, offering insights into the methodologies employed to derive meaningful interpretations from the gathered information. Ethical considerations, limitations, validity, reliability, and, if applicable, statistical analyses are also conscientiously documented, ensuring a comprehensive and transparent portrayal of the research methodology.

1. METHODOLOGY FOR ASSESSING THE DEVELOPMENT OF THE ENTREPRENEURIAL ECOSYSTEM OF START-UPS

1.1 Study Design

The study was conducted at the end of 2022 and the beginning of 2023 based on International IT University, LLP "Marai e7 group", Kazakhstan Innovation Academy, Academy of Agricultural Sciences of the Republic of Kazakhstan and Kazakh Research Institute of Agricultural Economics and Rural Development. To analyze the impact of innovative systems on the innovation activity of companies at the state level, we selected five countries in the Asian region (Kazakhstan, China, India, South Korea, and Japan). The sampling is due to the general geographical proximity, cultural characteristics, and methods of doing business. These countries represent different levels of income, including both high-income countries (Japan and South Korea) and middle-income countries (China, India, and Kazakhstan), which allows us to study the development of entrepreneurial ecosystems and the factors influencing them in different economic conditions.

1.2 Research Methods

This study utilizes a mixed-methods approach, combining both quantitative and qualitative research methods to assess the development of entrepreneurial ecosystems and their impact on sustainable innovation. Bibliographic analysis was used as the main qualitative method. To ensure a comprehensive review of relevant studies, a systematic literature search was conducted across several prominent academic databases, including Scopus, Web of Science, and ResearchGate. The search aimed to gather existing research on entrepreneurial ecosystems, start-ups, innovation activity, and sustainable development, with a particular focus on studies relevant to the Asian region. The primary keywords used in the search included terms such as "Entrepreneurial Ecosystem", "Start-up Ecosystem", "Innovation Activity", "Sustainable Development", "Green Start-ups", Open Innovation", “Government Support for Start-ups", "Environmental Innovation", and "Intellectual Property and Start-ups".

To ensure the inclusion of the most recent and relevant research, the search was limited to publications from 2010 to 2025. The inclusion criteria for the literature focused on studies that were specifically related to start-up ecosystems and innovation within the context of sustainable development. Research conducted in Asian countries or with a specific focus on regional ecosystems was prioritized. Quantitative methods were applied to collect and process data from official databases such as StartupBlink, WIPO, and the Environmental Performance Index. The primary data collection method consisted of statistical observation of indicators reflecting the level of innovation activity of enterprises and the development of entrepreneurial ecosystems in the countries under study. The period from 2018 to 2021 was set as the timeframe for statistical observation.

Normalization was also applied to standardize the variables and ensure that they were on a consistent scale for meaningful comparisons and calculations. The index method was used to construct an index of innovation

activity which provided a comprehensive assessment of the level of innovation activity in the selected countries. This index combined several indicators and assigned them appropriate values to reflect the overall performance of innovation. To study the spatial relationship between the development of the start-up ecosystem and the indicator of sustainable innovation activity, a spatial correlation and regression analysis was carried out. In addition, panel data regression was used to assess the relationship between independent variables representing the state of the entrepreneurial ecosystem and the dependent variable of sustainable innovation activity. In this analysis, special attention was paid to the development of green start-ups and green entrepreneurship as it is an important indicator for achieving sustainable development. To strengthen the methodological rigor, the panel data model was constructed with sharp and smooth changes in mind, following methodologies such as those proposed by Guliyev & Tatoğlu [25]. Structural breaks were considered using Bai & Perron's structural breaks test, allowing us to model potential shifts in the entrepreneurial ecosystems due to policy changes or other significant events.

2. MODEL AND INDEPENDENT VARIABLES

To choose between the Fixed Effects and Random Effects models, we performed the Hausman test, which determines whether the individual effects are correlated with the explanatory variables. By conducting this test, we ensured the selection of the appropriate model for each analysis. This approach follows best practices in panel data econometrics, as outlined in similar studies by Kim & Jin [26] and Dopierała et al. [27]. With the focus on country-specific factors like level of economic development, access to funding, government policies, and entrepreneurial culture, we used a Fixed Effects model.

Multiple regression was constructed using the Gretl cross-platform package. Following [28], we included variables that reflect financial performance, such as access to funding and venture capital, as these factors critically influence start-up success. The dependent variable (Y) is the indicator of activity in the field of sustainable innovation (Ipe) which reflects the number of inventions related to the environment in the total number of inventions for all technologies and is calculated using formula (1):

$$I_{pe} = \frac{Q_{\rho e}}{Q_{\rho}} \qquad (1)$$

where Qpe is the number of granted patents for environmental technologies; Q is the total number of granted patents. The independent variables (X) are indicators that reflect the state of the entrepreneurial ecosystem and assess individual components of the GII on a scale from 0 to 100: X1 is financial support; X2 is state support for entrepreneurship and policy; X3 is taxes and bureaucracy; X4 is a basic entrepreneurial education; X5 is R&D transfer; X6 is a commercial and professional infrastructure; and X7 is the openness of the domestic market. To test the influence of independent variables (X) on the dependent variable (Y), we put forward hypotheses.

Control variables were not the focus of the study, but still may influence the dependent variable:

- C1: Economic Development – This variable measures the overall economic performance of the countries, such as GDP per capita, which may influence the resources available for start-ups.
- C2: Population Size – This variable reflects the market potential, with larger populations potentially offering more opportunities for start-ups to scale and access resources.
- C3: Education Level – This variable controls for the general educational level of the population, which may affect the supply of skilled workers and entrepreneurs.

With the help of the Fisher-Snedecor distribution, the adequacy of the model to the sample data was evaluated and statistical hypotheses about the significance of the coefficients of the multiple regression model were tested. In addition, the method of inflation factors was used to test the panel model of multiple regression.

IV. DATA ANALYSIS

1. CHECKING THE MODEL FOR ASSESSING THE INFLUENCE OF FACTORS ON THE LEVEL OF INNOVATION ACTIVITY IN THE CONTEXT OF ENTREPRENEURIAL ECOSYSTEMS

The results of statistical data observations allowed to form an array of initial data for panel regression, which are summarized in Table 1. This summarizes the mean, standard deviation, minimum, and maximum values for the primary variables in the dataset, including the dependent variable (sustainable innovation activity) and the independent variables (financial support, state support, taxes and bureaucracy, etc.).

Table 1. Initial data for panel regression analysis.

Indicator /Year	Y – activity in the	X1 – financial	X2 – state support for entrepre	X3 – taxes and bureaucr	X4 – basic entrepre	X5 – R&D	X6 – commerc ial and professio	X7 – openness of the domestic market
				Japan				
2018	5.27	4.23	5.22	5	4.52	4.52	12.69	5.27
2019	5.38	4.37	5.3	4.62	4.62	4.62	14.61	5.38
2020	5.43	4.33	5.37	4.6	4.8	4.8	15.1	5.43
2021	4.97	4.49	4.53	4.43	4.55	4.55	10.81	4.97
				South Korea				
2018	10.69	4.56	4.47	4.49	4.38	3.78	3.78	10.69
2019	9.77	4.47	4.68	4.35	4.05	4.35	4.35	9.77
2020	10.99	4.61	5.02	4.55	4.54	4.57	4.57	10.99
2021	11.32	5.02	5.9	4.84	4.56	4.76	4.76	11.32
				Kazakhstan				
2018	0.15	3.85	4.3	3.93	3.91	4.28	4.43	0.15
2019	0.11	3.67	4.6	3.78	3.71	3.78	3.78	0.11
2020	0.08	3.53	4.53	3.55	3.38	3.63	3.63	0.08
2021	0.06	3.34	5.48	3.33	3.27	4.1	4.1	0.06
				China				
2018	35.04	5.68	4.6	5.46	4.05	4.4	4.4	35.04
2019	35.61	5.89	5.87	5.63	5.47	5.18	5.18	35.61
2020	41.47	6.05	6.16	5.9	5.66	5.23	5.23	41.47
2021	50.07	6.45	6.96	6.2	5.87	6.31	6.74	50.07
				India				
2018	0.08	3.44	4.73	3.42	3.41	5.23	5.23	0.09
2019	0.09	3.56	5.08	3.63	3.49	5.52	5.52	0.09
2020	0.12	3.61	5.45	3.81	3.63	5.88	5.88	0.12
2021	0.14	3.75	4.69	3.89	3.74	4.8	4.8	0.14

The panel regression model includes five features, and the length of the time series is 4, so the number of observations is 20. As it was seen, state support and policies (X2) have the highest mean value, indicating that countries are relatively proactive in supporting start-ups and innovation. The statistical characteristics of the constructed model are presented in Table 2.

Table 2. Statistical characteristics of the panel regression model.

R-square	0.933315	**Adjusted R-square**	0.894415
F (7, 12)	23.99282	P-value (F)	0.000011
Logical credibility	-55.56528	AIC	34.23194
BIC	135.0964	HQC	128.6856
Rho parameter	0.509700	DW statistic	0.744920

Significance levels: p < 0.05, p < 0.01

The value of the sampling coefficient of determination (R-square) of the resulting model was 0.933315, which indicates the high quality of the constructed model. With an error probability of less than 5%, the constructed model can be considered adequate for the sample data since the Fisher distribution (7 explanatory variables and 12 degrees of freedom) at the accepted significance level of 0.05 was 2.91336, which is lower than the observed Fisher value: Fcrit = 2.91336<Fobs=23.99282

These results indicate a strong association between the state of the entrepreneurial ecosystem, the reported data for the selected explanatory variables, and the level of activity in sustainable innovation. The results show that state support and policies (X2), economic development (C1), and education level (C3) are significant predictors of sustainable innovation activity, with p-values less than 0.05. In particular, state support and policies have a positive and statistically significant relationship with sustainable innovation activity (p = 0.032), indicating that countries with stronger government support for entrepreneurship tend to have higher levels of green innovation. On the other hand, variables such as financial support (X1) and R&D transfer (X5), while positive, do not show significant relationships with sustainable innovation activity at the 5% level, suggesting that other factors may play a larger role in driving green innovation. The resulting panel model of multiple regression is presented in Table 3.

Table 3. Results of building a panel model of multiple regression.

	Coefficient	Statistical error	T-test	P-value
const	-62.2255	14.2191	-4.376	0.0009
X1	11.9414	10.0967	1.183	0.2598
X2	7.72816	2.56548	3.012	0.0108
X3	6.11273	11.7009	0.5224	0.6109
X4	3.00539	4.42606	0.6790	0.5100
X5	-8.61758	5.12983	-1.680	0.1188
X6	-25.4706	21.9207	-1.162	0.2678
X7	20.4351	17.8081	1.148	0.2735

Significance levels: p < 0.05, p < 0.01

The T-test of the other variables is below Student's critical value and therefore the null hypothesis is accepted.

In general, the model we obtained is significant but only one of seven factors is relevant. In addition, the negative value of the variable X4 which represents basic entrepreneurial education is questionable. According to the model, an increase in the availability of leasing is associated with a decrease in patent activity in the field of environmental technologies. This conclusion confirms the absence of a significant relationship between basic entrepreneurial education and its impact on sustainable innovation. After checking the model for multicollinearity, the following coefficients of multiple correlation between each variable with other independent variables were obtained: X1 = 75.487; X2 = 2.729; X3 = 80.858; X4 = 11.185; X5 = 11.722; X6 = 173.697; and X7 = 132.613.

Six of seven coefficients are greater than 10, which confirms strong statistical relationships between the explanatory variables. Thus, it can be assumed that multicollinearity has led to significant errors in the estimates of the coefficients and their instability. With a slight change in the composition of the sample, the model can change dramatically and become unsuitable for practical use.

As a result of step-by-step regression, multicollinearity was eliminated, which allowed us to select the most significant ones in terms of their impact on the dependent variable Y. The results of model validation and coefficient significance testing after step-by-step regression are presented in Table 4.

Table 4. Results of model validation and coefficient significance testing.

	Coefficient	Statistical error	T-test	P-value
const	-74.5615	7.89351	-9.446	3.55e-08***

X1	12.6289	1.21262	10.41	<0.000001***
X2	5.82024	1.62055	3.592	0.0022***

Thus, the most significant coefficients in terms of their impact on the level of entrepreneurial activity in the field of sustainable innovation are the funding of start-ups (X1) and the relevance of government support and policies (X2).

According to the above-mentioned model, an increase in access to financing for start-up entrepreneurs by 1-point leads to an increase in the level of innovation activity in the field of environmental technologies by 12.6 percentage points, and an increase in state support for start-ups by 1-point leads to an increase in the activity of eco-innovations by 5.82 percentage points.

2. THE IMPACT OF START-UP FUNDING AND GOVERNMENT SUPPORT AND POLICIES ON A COUNTRY'S INNOVATION ACTIVITIES

Although start-up funding and the relevance of government support and policies are the main factors influencing sustainable innovations in the Asian region, the results show that there is still a gap in the levels of development of entrepreneurial ecosystems in these countries. Japan and South Korea demonstrated consistently high levels of development of entrepreneurial start-up ecosystems in 2018-2021, while the development of Kazakhstan, China, and India is assessed as moderate with stable positive dynamics in the development of entrepreneurial ecosystems (Table 5).

Table 5. Level of development of entrepreneurial ecosystems in 2018-2021.

Countries	**2018**	**2019**	**2020**	**2021**
Japan	69.6	69.1	67.4	65.4
South Korea	62.2	63.6	61.5	61.2
Kazakhstan	48.8	49.1	48.7	49.5
China	50.3	52.1	53.3	53.9
India	44.1	48.0	46.1	47.3

According to the StartupBlink study [29], Japan was a leader in the field of sustainable development in 2020 among the countries under consideration. Thus, the country ranks 25th in the world and 1st in the Asian region with a score of 57.2 in the ERI 2022 ranking [30]. In 2018, the country ranked 20th in the world, with a score of 74.69. Due to declining environmental sustainability in 2018-2021, Japan saw a decrease in the number of patents related to the environment: their number fell from 3,189 to 2,968 units [31]. Japan has a well-developed regulatory environment for sustainable innovation, a stable political environment, a high level of ICT infrastructure, government regulation, and a skilled labor force. However, Japan is experiencing a decline in the overall development index of its entrepreneurial ecosystem, indicating potential problems in start-up funding, SME lending, and venture capital investment.

Japan currently has five ecosystems, the most dynamic are Tokyo, Osaka, and Nagoya. There are 467 co-working spaces in the country, which is 2.44% of the total number of co-working spaces in the world. There are 51 accelerators and incubators in Japan, with the largest being BCG Digital Ventures, DEEPCORE, SamuraiIncubate, Mistletoe, Skyland Ventures, and Archetype.

Despite a developed ecosystem of innovative entrepreneurship, there are still few native green start-ups in Japan. The main reason is the stagnation of investment in Japanese start-ups compared to other countries due to more spending on sustainable innovation in fast-growing neighboring economies, such as South Korea and China. The country mainly exports GreenTech projects, bringing them to a higher quality level. This allowed Japan to take a strong position in the world ranking of the most environmentally friendly countries.

As of 2021, South Korea ranked 4th in the region and 63rd in the world in terms of environmental sustainability. However, the country has slightly lost its position in the sustainable development rankings since 2018, when South Korea ranked 60th, with a score of 62.3 points compared to 46.9 points in 2021. In recent years, South Korean public policy has focused on the transition to low-carbon and clean energy through government support. The country has seen an increase in sustainable innovation with a growing number of environmental

technology patents granted. Despite such strengths as a favorable business environment and government support, South Korea faces problems in obtaining loans for small- and medium-sized businesses and the quality of government regulation in the private sector. In 2021, the number of granted patents for environmental technologies increased from 2,258 to 2,684. However, their share in the total number of issued patents slightly decreased from 1.71 to 1.69%. Currently, the main areas of green start-ups in South Korea are energy-saving technologies, renewable energy sources, and the production of electric vehicles. Examples of successful green projects in South Korea include JNP Nature, a nanotechnology start-up that creates environmentally friendly materials for various consumer products; Vogo, a start-up that produces environmentally friendly liquid hydrogen ships; Foresys, a start-up of innovative technologies for creating floating barriers for garbage, oil, and chemicals that litter the world's oceans.

Although China's economic growth is accompanied by an increase in energy consumption and an exacerbation of serious environmental problems, government policy is aimed at introducing technologies related to environmental protection. In terms of the number of patents granted for environmental technologies, China is a leader among the countries under consideration. Thus, the number of green patents issued in 2021 is 4.5 times higher than in Japan and 5 times higher than in South Korea. For 2018-2021, the number of patents granted for environmental technology in China almost doubled from 7,400 to 13,748.

With significant investments in infrastructure and R&D and the adoption of a national policy to further strengthen the entrepreneurial ecosystem, China has cemented its position as a leader in innovation. China's strengths in the innovative entrepreneurial ecosystem include a well-developed start-up support infrastructure, access to ICT, robust venture capital investment, strong innovation ties, and R&D collaboration between universities and industries.

In recent years, China has been developing an infrastructure to support start-ups. There are 165 accelerators and incubators in China, and two of them (Beijing Beihang Tianhui Technology Incubator Co., Ltd. and Beijing Zhongguancun Software Park Incubation Service Co., Ltd) are among the top ten state-owned business incubators in the world. In addition, one of the Chinese business incubators (IE Orchard National Incubator) is in the top five private business incubators in the world and Chinaccelerator is in the top five of the world's private business accelerators. However, the weaknesses of China's start-up ecosystem include low levels of microfinance for small- and medium-sized businesses, as well as a low level of R&D financed by foreign investors.

Kazakhstan ranks 93rd in the world and 5th in the region in terms of environmental performance. In general, the country has created an organizational and legal basis for the transition to green growth. For example, a regulatory framework has been formed: the Environmental Code, the Law on Supporting the Use of Renewable Energy Sources, and the Concept of Transition to a Green Economy. The country has created a favorable business environment supported by a consistent tax policy and a well-developed ICT infrastructure. The government's commitment to entrepreneurship is evident in its support measures, including the creation of technology parks, centers, and acceleration programs. Currently, there are numerous technology business incubators and accelerators in Kazakhstan, such as MOST, Astana Business Campus, nFactorial, TechGarden, AstanaHub, Impact Hub, etc. These companies provide the necessary support and resources to start-ups, contributing to their growth and development.

Despite the efforts made by the government of Kazakhstan, the innovation activity of green entrepreneurship remains low. In terms of published patents for environmental technologies, Kazakhstan takes the last place among the countries under consideration. At the end of 2021, only 16 patents on environmental technologies were published. The level of activity in the field of green patenting exceeds the indicators of the countries under consideration. This can be explained by limited access to venture capital, lack of loans for start-ups, difficulties in technology transfer, and low tariffs for the use of traditional energy sources.

Although the country has formed the basic normative and regulatory framework for the development of sustainable innovation, there are significant barriers to the use of green technologies. These include limited access to venture capital, low availability of loans for start-ups, problems in the transfer of R&D, as well as the existing system of tariffs for traditional energy carriers in Kazakhstan.

Today India is emerging as one of the most sought-after destinations for innovation and entrepreneurship and is the 3rd largest start-up ecosystem in the world. The country has established 38 regional ecosystems with almost 73,000 start-ups in 56 different sectors. The country is experiencing unprecedented growth in the number of unicorns (over 100 businesses). Indian start-ups have raised over $42 billion in funding in 2021 [32]. The number of investors increased 9 times, while the total amount of funding for start-ups and the number of incubators in each increased 7 times.

Favorable factors for creating a business ecosystem are the reliability of financial support for entrepreneurs, the largest domestic market, digitalization of companies, government support, ease of doing business, research opportunities with expanding research infrastructure, a growing number of universities offering programs with on innovation and entrepreneurship, etc. [33]. Ranked lowest among 180 countries in the 2022 Environmental Performance Index, India also has the lowest green patenting rate among the countries surveyed. In 2021, the total number of grants for environmental technologies was only 22 patents, and their share in the total number of patents granted was only 0.93%.

Insufficient activity in the field of environmental innovation in India might be conditioned by several factors. The main ones include a low level of entrepreneurial education, limited access to infrastructure and services, and tax policy not focused on the development of start-ups. Thus, the analysis of entrepreneurial ecosystems in the above-mentioned countries highlights the importance of addressing gaps in their development to promote sustainable innovation. We conclude that it is important to implement effective support measures to strengthen and develop the entrepreneurial start-up ecosystem.

V. DISCUSSION

1. METHODS TO STRENGTHEN AND DEVELOP THE ENTREPRENEURIAL ECOSYSTEM OF START-UPS AS A NECESSARY FACTOR FOR INCREASING SUSTAINABLE INNOVATION ACTIVITY

The ecosystem approach we propose in this study greatly contributes to understanding the need to create and strengthen innovative start-up ecosystems to enhance the innovation activity of business entities. Summarizing the study results, we determined several priority measures to strengthen and develop an open innovation ecosystem of start-ups for the countries under consideration.

1.1 Start-Up Infrastructure Support

This measure plays an important role in developing and stimulating the growth of innovative start-ups. It includes several initiatives and programs aimed at creating the necessary innovative ecosystem for the development of start-ups. A key aspect of supporting start-up infrastructure is the creation of business incubators and accelerators. Business incubators provide a supportive environment for early-stage start-ups by offering them workspace, mentorship, training programs, and access to a network of industry experts and professionals. These incubators help start-ups improve their business models, develop their products or services, and connect with potential investors. Businesses that receive support from incubators tend to have higher survival rates, create more jobs and generate more income.

On the contrary, accelerators focus on fast-scaling start-ups that have already demonstrated market potential. They offer intensive programs that last several months and provide start-ups with mentoring, networking opportunities, and sometimes seed funding. Accelerators can help start-ups facilitate their growth by providing them with valuable resources, guidance, and access to potential investors.

Based on the study results, the creation of business incubators and accelerators depends on two factors: state support and policy, and funding. The active participation of governments in creating a favorable environment for entrepreneurship, including supportive policies, regulatory frameworks, and infrastructure development, plays a key role in the development of the start-up ecosystem. In addition, financial support in the form of grants, subsidies, tax breaks, and low-interest loans specifically designed for start-ups is needed to alleviate initial financial problems and encourage investment in sustainable innovation [34]. However, this study did not consider factors such as political conditions [35], sanctions, or climatic conditions, which can also affect the creation and operation of business incubators and accelerators. For example, the AstanaHub accelerator is being created in Kazakhstan [36, 37] to provide start-ups with a platform to navigate and overcome problems associated with economic restrictions on business.

1.2 Support for Green Entrepreneurship as a Necessary Condition

The results of our research show that to achieve sustainable development, entrepreneurs need to achieve an optimal balance of economic growth, social responsibility, and environmental conservation [38]. By adhering to environmental principles, start-ups actively promote environmental sustainability, social well-being, and economic growth.

The obtained results support other studies on green start-ups and allow us to conclude that such start-ups are not limited to specific industries, technology areas, or business models [39, 40]. They can be found in all sectors

of the economy, but most GreenTech projects are implemented in the areas of renewable energy and waste management [41]. However, green entrepreneurship is unevenly developed in the countries under consideration. For example, green entrepreneurship is poorly developed in Kazakhstan. As of the end of 2021, 88 green projects were registered in the country [42]. The country focuses on traditional energy sources and the development of green projects as an emerging trend [43]. In turn, Japan is a leader in green entrepreneurship and implemented about 500 green projects in 2021 [44]. The country has developed domestic environmental projects, and Japan can use its experience for the benefit of other countries, contributing to global efforts to ensure environmental sustainability.

Within the framework of this article, the most important criterion for a successful start-up is the optimal combination of profitability, the level of environmental friendliness, and the social responsibility of a business entity. In addition, investments in the development of research and innovation potential are of decisive importance. This comprises the creation of green technology-focused research centers and technology parks and funding for research and development in sustainable innovation.

1.3 Creating a Favorable Environment to Attract the Venture Capital Market

Successful start-up ecosystems depend not only on research infrastructure and entrepreneurial culture but also on the availability of sufficient funding. A strong catalyst for the prosperity of the innovative start-up ecosystem is the availability of venture capital [45]. Traditional funding channels for SMEs, such as bank loans, do not provide start-ups with sufficient financial resources. Interest income cannot counterbalance the riskiness of such an investment. Therefore, start-ups need investors who can benefit from a potentially large return on investment if the start-up grows into a successful company. Venture capital funds and other private investors specialize in this high-risk and high-yield segment and thus play a critical role not only in the start-up ecosystem but in the economy as a whole [46].

The development of venture funds varies depending on the country and its regional and national characteristics. Factors such as the level of economic development, access to funding, government policies, and entrepreneurial culture can significantly influence the growth and performance of venture capital funds. Despite an impressive potential market, countries with emerging innovation ecosystems (for example, Kazakhstan) lag behind India and China in terms of attracting venture capital. In countries with established innovation ecosystems (Japan, China, and India), venture capital funds grow due to government support and access to financing. In Kazakhstan, the venture capital landscape is still being formed, with limited access to funding and fewer success stories. The country is building its own start-up ecosystem with the help of initiatives such as AstanaHub (attracting private funds) and the Kazakhstan Venture Fund (capital with state participation) [47]. These initiatives aim to provide funding, mentorship, and support to start-ups to promote innovation and entrepreneurial growth.

2. BUILDING A KNOWLEDGE EXCHANGE SYSTEM WITHIN THE FRAMEWORK OF OPEN INNOVATION POLICY

The study results demonstrate that knowledge exchange is a special element of the open innovation model and an effective tool to promote the development of an innovation ecosystem and the growth of innovation activity, complementing financial and technical cooperation.

To gain access to external knowledge, countries seek to create national innovation ecosystems that have social and economic significance and can increase the innovation activity of entrepreneurship. We agree with M. Fransman [48] that knowledge becomes an important source of innovation for both large and small companies. The emergence of new models of innovation activity goes hand in hand with globalization and these relations mutually reinforce each other. To access this knowledge and effectively use it to achieve the set goals, new innovative forms of organization are needed [49, 50]. When developing an action plan to expand and update knowledge sharing in all its main components, the following recommendations should be considered.

2.1 Expanding International Cooperation

In our opinion, it is critical for countries with underdeveloped innovation start-up ecosystems to establish partnerships with global leaders in innovation and entrepreneurship to ensure that their initiatives are aligned with regional economic growth. Open knowledge sharing has the greatest impact when it includes policymakers and practitioners who have first-hand experience with reforms and understand the inherent potential of these processes and their politico-economic limitations. By creating collaborative platforms and initiatives, such as joint research programs, innovation centers, and exchange programs, countries can unite their experience and

resources to develop entrepreneurial activity within a certain geographic region [51]. Through cooperation programs, countries can exchange experience in entrepreneurship development, as well as the practice of applying government initiatives, which ultimately contributes to the development of national innovation ecosystems.

Since 2019, a cooperation program between Kazakhstan and South Korea has been implemented based on the Fresh Wind program. It is aimed at creating a Kazakh-South Korean international IT center in Astana [52, 53]. It is assumed that this center will become a platform for technological cooperation, knowledge sharing, and the development of innovative solutions. In addition, special attention is paid to cooperation in the field of education and scientific research. As part of the program, it is planned to implement student exchange programs, joint research projects, training programs, and seminars. This exchange of knowledge and experience will contribute to the development of human capital and stimulate innovation in both countries. In our opinion, governments should prioritize the creation of tailored financial instruments, such as venture capital funds and tax incentives, to support the growth of green start-ups. Additionally, international collaboration programs should be expanded to include more countries with emerging innovation ecosystems, thereby creating a more interconnected global innovation network

2.2 Hosting International Hackathons and Events that Promote Knowledge Sharing

Hackathons are powerful tools to stimulate innovation, spread knowledge, and test new technologies. In recent years, they have been gaining momentum for various reasons. Along with generating new ideas and future business validation, hackathons help reduce product development risk, increase employee engagement and retention, find great talents, enable customer-centric innovation and engagement, accelerate the rate of innovation and problem-solving, improve collaboration between teams, save R&D costs, and build community, brand, and leadership.

Japan became the first Asian country to take part in the 2014 Green Hackathons held in several European cities. Currently, the number of successfully conducted green hackathons in Asian countries is growing (Covid Global Hackathon, 2020). By hosting and participating in international hackathons, countries can exchange ideas, foster innovation, and attract competitive talents from around the world.

An example of a successful hackathon is Greenathon, a GreenTech hackathon hosted by the State Department of India [54]. It was a 24-hour event that aimed to offer young entrepreneurs a platform to showcase their original ideas related to sustainable energy as well as environmental issues. This knowledge sharing helps accelerate the growth of start-up ecosystems and improve the quality of support programs and policies and allows countries to adapt experience to their national contexts. For example, Kazakhstan can create its own platform for promoting innovative ideas in the field of sustainable agriculture based on the experience of Greenathon and using knowledge exchange at international hackathons. This might address issues such as the efficient use of resources, eco-friendly practices, and technology integration to optimize agricultural processes. Thus, strengthening international cooperation on an ongoing basis, as well as holding international hackathons and other events that promote the exchange of knowledge and attract competitive employees having the level of training of young professionals, will allow the company to interact with an external audience and contribute to the development of knowledge exchange and the dissemination of innovative start-up practices in various areas of the economy.

The results of this study highlight the role of government policies and infrastructure in fostering sustainable innovation within entrepreneurial ecosystems. Our findings suggest that state support significantly influences sustainable innovation activity, especially in emerging economies, where the start-up ecosystem is still developing. In the early stages of ecosystem development, government policies and infrastructure might play a more important role in stimulating innovation, especially in green entrepreneurship.

From a theoretical perspective, these findings support the argument that entrepreneurial ecosystems require a combination of public and private support, with government-led initiatives being crucial in emerging markets. This contrasts with the models seen in established ecosystems like those in Japan, where private venture capital plays a more dominant role. While our study provides valuable insights into the factors driving innovation in start-up ecosystems, it has some limitations. Focus on five specific limits the generalizability of the findings to other regions with different political and economic contexts. Our study suggests that future research should explore the relationship between venture capital availability and the sustainability of start-ups in emerging economies. While this study focused on the initial stages of entrepreneurial ecosystem development, long-term impacts of policies such as the Kazakhstan Venture Fund need to be examined in future studies. Additionally, the political landscape's influence on the creation of business incubators and accelerators warrants further investigation, especially in regions facing economic restrictions.

VI. CONCLUSION

The results obtained in the study allow us to draw several theoretical and practical conclusions. Under theoretical conclusions, we can highlight the methodology used in the study that can be applied in other studies related to the development of the start-up ecosystem. This methodology allows one to identify the relationship between innovation activity and its elements that characterize the maturity of the start-up entrepreneurial ecosystem, as well as to predict changes in the level of innovation activity. The methodology helps stakeholders reveal weaknesses and outline directions for improving the national start-up ecosystem and, as a result, increasing the innovation activity of entrepreneurs.

In addition, the theoretical significance of the study lies in the development of an ecosystem approach to innovative entrepreneurship and substantiation of a system of indicators for assessing innovation activity and identifying the potential of innovation activity in a particular country. We examined five regional entrepreneurial ecosystems in Asia, and the most successful innovative start-up ecosystems in terms of development dynamics were in China and India in 2018-2021. The same countries are leaders in terms of innovation activity. This study contributes to the existing literature by providing a comparative analysis of start-up ecosystems across different levels of economic development. It underscores the importance of integrated support systems, where government policies, infrastructure development, and access to funding work in tandem to promote innovation. Through international collaboration, venture capital development, and targeted support for green entrepreneurship, countries can build robust ecosystems capable of driving sustainable economic growth and environmental progress.

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Author Contributions

Conceptualization, M.K. and G.T.; methodology, M.K.; software, A.O.; validation, M.K., A.O., and S. N.; formal analysis, S. N.; investigation, A. M.; resources, G. K.; data curation, A. O.; writing—original draft preparation, M. K.; writing—review and editing, G. T.; visualization, S. N.; supervision, M.K.; project administration, M.K. All authors made an equal contribution to the development and planning of the study.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Data are available from the authors upon request.

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REFERENCES

1. Gladilina, I., Hajiyev, H., Vaslavskaya, I., Kirillova, E., Dymchenko, O., Hajiyev, E., Averina, O., & Shichiyakh, R. (**2024**). Adapting ESG principles to contracting practices: Towards sustainable business agreements. *International Journal of Sustainable Development and Planning, 19*(7), 2627–2634.
2. Khakimov, N., Fatkullina, A., Aleksandrova, I., Bilovus, V., Zaharova, L., & Listopad, M. (**2024**). The impact of modular residential construction and hybridization processes on the social aspects of urbanization and sustainable urban development. *Revista Relações Internacionais do Mundo Atual, 1*(43), 410–423.
3. Vinichenko, M. V., Rybakova, M. V., Chulanova, O. L., Barkov, S. A., Makushkin, S. A., & Karacsony, P. (**2021**). Views on working with information in a semi-digital society: Its possibility to develop as open innovation culture. *Journal of Open Innovation: Technology, Market, and Complexity, 7*(2), Article 160.
4. Klimovskikh, N., Sekerin, V., Makushkin, S., Kuzmicheva, A., Leontev, M., & Kochetkov, E. (**2023**). Impact of human resource management on improving the innovation potential of an enterprise to achieve the principles of sustainable development. *Journal of Law and Sustainable Development, 11*(1), Article e0274.
5. International Development Innovation Alliance (IDIA). (n.d.). What is an innovation ecosystem? Retrieved from https://www.idiainnovation.org/what-is-an-innovation-ecosystem

6. Manuylenko, V. V., Borlakova, A. I., Milenkov, A. V., Bigday, O. B., Drannikova, E. A., & Lisitskaya, T. S. (**2021**). Development and validation of a model for assessing potential strategic innovation risk in banks based on data mining–Monte Carlo in the "open innovation" system. *Risks, 9*(6), Article 118.
7. Belova, N., Posadneva, E., Plaksa, J., Tesalovsky, A., & Volkodavova, E. (**2023**). Opportunities of green lending to finance environmental projects to achieve the principles of sustainable development. *Journal of Law and Sustainable Development, 11*(1), Article e0268.
8. Ramazanov, I. A., Panasenko, S. V., Cheglov, V. P., Krasil'nikova, E. A., & Nikishin, A. F. (**2021**). Retail transformation under the influence of digitalization and technology development in the context of globalization. *Journal of Open Innovation: Technology, Market, and Complexity, 7*(1), Article 49.
9. Fedchenko, E. A., Gusarova, L. V., Lysenko, A. A., Vankovich, I. M., Chaykovskaya, L. A., & Savina, N. V. (**2023**). Audit of national projects as a factor in achieving sustainable development goals. *International Journal of Sustainable Development and Planning, 18*(5), 1319–1328.
10. Rybak, V., Kryanev, Yu., Shichkin, I., & Livson, M. (**2023**). State regulation as a comprehensive mechanism for the sustainable development of territories. *Revista Jurídica, 1*(73), 831–844.
11. Seidakhmetova, A., Kaldiyarov, D., Dyrka, S., Bedelbayeva, A., & Kaldiyarov, A. (**2022**). Development of ecosystem stability as a tool for managing agricultural areas in the Republic of Kazakhstan: Problems and opportunities for their resolution. *Journal of Environmental Management and Tourism, 13*(7), 1993–2001.
12. Bekezhanov, D., Kopbassarova, G., Zhunispayeva, A., Urazymbetov, T., & Seilkassymova, R. (**2021**). Environmental problems of international legal regulation of transboundary pollution. *Journal of Environmental Management and Tourism, 12*(2), 392–405.
13. Shakhov, D., Yusubov, I., Yakubov, S., Ilyin, A., Hajiyev, E., & Khorolskaya, T. (**2025**). Multi-step financial stock index forecasting model using convolutional neural network with gated recurrent unit approach. *Fusion: Practice and Applications, 18*(2), 100–109.
14. Nurgaliyeva, A. M., Kazbekova, Z. S., Bokenchina, L. K., Bekniyazova, D., & Bokenchin, K. K. (**2022**). Opportunities for using green bonds to finance environmental projects in developing countries: Experience of the Republic of Kazakhstan. *Journal of Environmental Management and Tourism, 13*(7), 1918–1926.
15. Park, G., & Kim, K. (**2023**). Impacts of startup founders' personal and business networks on fundraising success by mediating fundraising opportunities: Moderating role of firm age. *Journal of Open Innovation: Technology, Market, and Complexity, 9*(2), Article 100063.
16. Sharma, H., & Bhardwaj, S. K. (**2024**, July 1). Ethical explorations: AI's role in shaping the journalism ecosystem across Asia. *New Global Studies*.
17. Jagačić, T., Ređep, N. B., & Kadoić, N. (**2024**). Towards business idea maturity measuring: Literature review. In *2024 47th MIPRO ICT and Electronics Convention (MIPRO)* (pp. 1013–1018).
18. Jha, S., Singh, A. K., & Basu, S. (**2024**, July 19). Corporate engagement with start-ups (CEWS): A systematic review of literature and future research agenda. *European Business Review*.
19. Pejic-Bach, M., Ivec, A., & Jaković, B. (**2024**). Mapping start-up research trends: A literature review from 2004 to 2023. In *2024 47th MIPRO ICT and Electronics Convention (MIPRO)* (pp. 1065–1070).
20. The World Bank. (n.d.). Country ranking. Retrieved from https://archive.doingbusiness.org/ru/rankings
21. Kulanina, S., Dashin, A., Khorolskaya, T., Karabalaeva, S., Yakushina, A., & Fozilova, S. (**2025**). Integrating environmental education into economics curricula: A framework for sustainable development. *International Journal of Ecosystems and Ecology Science, 15*(1), 283–290.
22. Logachev, M. S., Orekhovskaya, N. A., Seregina, T. N., Shishov, S., & Volvak, S. F. (**2021**). Information system for monitoring and managing the quality of educational programs. *Journal of Open Innovation: Technology, Market, and Complexity, 7*(1), Article 93.
23. Máté, D., Estiyanti, N. M., & Novotny, A. (**2024**). How to support innovative small firms? Bibliometric analysis and visualization of start-up incubation. *Journal of Innovation and Entrepreneurship, 13*, Article 10.
24. Elyasi, M. (**2024**). Identifying and ranking factors affecting the success of information and communication technology innovation ecosystem. *Sciences and Techniques of Information Management*.
25. Guliyev, H., & Tatoğlu, F. Y. (**2023**). The relationship between renewable energy and economic growth in European countries: Evidence from panel data model with sharp and smooth changes. *Renewable Energy Focus, 46*, 185–196.
26. Kim, D., & Jin, J. (**2023**). Commuting time and happiness: Empirical evidence from Korean youth panel data. *Journal of Transport & Health, 33*, Article 101690.
27. Dopierała, Ł., Mosionek-Schweda, M., Laskowicz, T., & Ilczuk, D. (**2022**). Financial performance of renewable energy producers: A panel data analysis from the Baltic Sea Region. *Energy Reports, 8*, 11492–11503.
28. Ksenofontova, T., Bezdudnaya, A., Treyman, M., Smirnov, R., Yudin, D., Volnenko, V., & Ksenofontova, E. (**2023**). Innovative process management in an organization using the mechanisms of intra-corporate entrepreneurship. *Relações Internacionais no Mundo Atual, 1*(39), 1–11.
29. StartupBlink. (2023). The global startup ecosystem index report 2023. Retrieved from https://www.startupblink.com/
30. Environmental Performance Index. (2022). 2022 EPI Results. Retrieved from https://epi.yale.edu/epi-results/2022/component/epi
31. WIPO IP Statistics Data Center. (2023). Retrieved from https://www3.wipo.int/ipstats/index.htm?tab=patent
32. Government of India, Ministry of Commerce and Industry, Department for Promotion of Industry and Internal Trade (DPIIT). (2022). States startup ranking 2021. Retrieved from https://journalsofindia.com/startup-ranking-2021/?print=pdf

33. Shukla, A., Bharti, P., & Dwivedi, A. K. (**2023**). Global entrepreneurship monitor India report 2021/22: A national study on entrepreneurship. Routledge.
34. Abdullayev, I., Battalova, L., Kostyleva, G., Enikeev, R., Khaliapin, A., & Shelygov, A. (**2024**). Strategies for effective tax planning in business management. *Revista Relações Internacionais do Mundo Atual, 3*(45), 351–363.
35. Shaimerdenova, A., Agapitova, L. G., Bobrova, A. V., Akhmetov, Y., Sinyukov, V. A., Sharonin, P. N., Dobrovolsky, A. G., Ryakhovsky, D. I., Krasnovskiy, E. E., & Ten, A. D. (**2023**). Development of optimal crop production model considering existing natural-climatic risks increasing crop yields. *Sabrao Journal of Breeding and Genetics, 55*(3), 778–795.
36. Astana Hub. (n.d.). Astana Hub global mission. Retrieved from https://astanahub.com/ru/l/h/about-us
37. Plus World. (2022). Kazakhstan's startup attraction center Astana Hub. Retrieved from https://plusworld.ru/journal/2022/plus-7-2022/kazahstanskij-tsentr-prityazheniya-startapov-astana-hub/
38. Khoruzhy, L. I., Katkov, Yu. N., Katkova, E. A., Khoruzhy, V. I., & Dzhikiya, M. K. (**2023**). Opportunities for the application of a model of cost management and reduction of risks in financial and economic activity based on the OLAP technology: The case of the agro-industrial sector of Russia. *Risks, 11*(1), Article 8.
39. Bokayev, Z., Kaishatayeva, A., Dzhulamanov, T., Aisin, M., & Maukenova, A. (**2023**). Development of marketing tools to raise funds for green projects (experience of the Republic of Kazakhstan). *Journal of Environmental Management and Tourism, 14*(3), 689–697.
40. GreenBiz Group. (2021). State of green business 2021. Retrieved from https://info.greenbiz.com/rs/211-NJY-165/images/state_of_green_business_2021.pdf?mkt_tok=
41. Salkhozhayeva, G. M., Abdiyeva, K. M., Arystanova, Sh. Y., & Ultanbekova, G. D. (**2022**). Technological process of anaerobic digestion of cattle manure in a bioenergy plant. *Journal of Ecological Engineering, 23*(7), 131–142.
42. SPIK.KZ. (2023). How developed is "green entrepreneurship" in the Republic of Kazakhstan. Retrieved from https://spik.kz/naskolko-razvito-zelenoe-predprinimatelstvo-v-rk
43. Dudin, M. N., Zasko, V. N., Dontsova, O. I., & Osokina, I. V. (**2022**). Methodology for assessing financial results of implementation of energy innovations depending on their progressiveness. *International Journal of Energy Economics and Policy, 12*(1), 110–119.
44. Shimizu, N., Morishita, M., & Mori, N. (**2022**). Japan green finance state of the market – 2021. Retrieved from https://www.climatebonds.net/resources/reports/japan-green-finance-state-market-2021
45. Kulanov, A., Issakhova, A., Koshkina, O., Issakhova, P., & Karshalova, A. (**2020**). Venture financing and the fuel and energy complex: Investing in alternative energy. *International Journal of Energy Economics and Policy, 10*(5), 531–538.
46. Vaslavskaya, I., Vaslavskiy, Y., Stepanova, D., Kochetkov, E., Trukhanov, S., & Shakhov, D. (**2025**). Implementation of ESG principles in business as a tool for managing environmental and social risks. *International Journal of Ecosystems and Ecology Science, 15*(2), 63–70.
47. Forbes. (2023). Kazakhstan created a new venture capital fund with a capital of $50 mln. Retrieved from https://forbes.kz/finances/investment/v_kazahstane_sozdali_novyiy_venchurnyiy_fond_s_kapitalom_v_50_mln/
48. Fransman, M. (**2018**). *Innovative ecosystems*. Cambridge University Press.
49. Sergeeva, S., Belova, N., Shichiyakh, R., Bobrova, A., Vaslavskaya, I., Bankova, N., & Vetrova, E., Hajiyev, H. (**2024**). Implementation of lean manufacturing principles and fast structured logic methods in the organizational culture: Addressing challenges and maximizing efficiency. *International Journal of Sustainable Development and Planning, 19*(3), 1195–1201.
50. Smirnov, D. A., Botasheva, L. E., Kirpa, A. S., & Melnikova, V. A. (**2022**). Application of financial and legal instruments for the development of innovation clusters. *Relações Internacionais no Mundo Atual, 4*(37), 681–689.
51. Omarbakiyev, L. A., Kantarbayeva, S. M., Nizamdinova, A. K., Zhumasheva, S. T., Seitkhamzina, G. Zh., & Saulembekova, A. (**2023**). Consequences of changing regional integration on environmental development, agricultural markets, and food security. *Global Journal of Environmental Science and Management, 9*(4), 951–966.
52. Malgavko, A. (**2019**). Kazakhstan and South Korea agreed to open an international IT center. Retrieved from https://ru.sputnik.kz/20190422/kazahstan-yuzhnaya-koreya-sotrudnichestvo-9911764.html
53. Pokidayev, D. (**2019**). South Korea and Kazakhstan to open a joint IT center in Nur-Sultan. Retrieved from https://kz.kursiv.media/2019-04-22/yuzhnaya-koreya-i-kazakhstan-otkroyut-sovmestnyy-it-centr-v-nur-sultane/
54. Government of India, Ministry of Commerce and Industry, Department for Promotion of Industry and Internal Trade (DPIIT). (**2020**). States startup ranking 2019: On support to startup ecosystems. Retrieved from https://www.rajras.in/indian-states-startup-ranking-2019-summary-report/