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Innovation Policy in Kazakhstan

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Abstract:

The development of a country's innovation potential is now regarded as an essential condition for economic modernisation and sustainable growth. This paper examines Kazakhstan's state innovation policy over the period 2001–2025. The relevance of the topic lies in the fact that, despite long-standing programme efforts and substantial public funding, systemic issues persist in the country´s innovation policy, such as weak coordination, fragmented implementation and limited business involvement in the innovation process.

The aim of this study is to identify the key factors shaping the effectiveness of Kazakhstan's state innovation policy through the use of both quantitative and qualitative research methods. Innovation policy effectiveness is assessed based on measurable innovation outcomes and stakeholder perceptions of state support mechanisms.

The regression analysis shows that only investment in R&D has a statistically significant impact on the growth of innovation output. In contrast, industrial innovation expenditures and the share of active enterprises show a weaker correlation.

Survey data highlight key barriers such as bureaucracy, lack of transparency, and regional disparities in access. The results of the survey suggest that without a systemic

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transformation of governance institutions, a revision of the grant allocation system and stronger incentives of innovation demand, sustainable progress is unlikely to be achieved. The findings may be of relevance to countries with emerging innovation systems.

Keywords:
effectiveness of innovation policy, innovation measurement, national innovation system, public policy analysis, transition economies

1. Introduction

The development of a country's innovation potential is increasingly recognised not only as a driver of modernisation and sustainable growth, but also as a key factor in national competitiveness, technological sovereignty, and resilience in the face of global disruptions. In a context of accelerating technological change and geopolitical uncertainty, innovation capacity determines a country's ability to adapt and thrive. Governments are responding by adopting transformative policies focused on cross-sectoral coordination, mission-oriented goals, and institutional learning (Edler & Fagerberg, 2017; Mazzucato, 2018; Schot & Steinmueller, 2018).

This is particularly relevant for emerging economies such as Kazakhstan, where innovation policy plays a dual role: not only as a catalyst of economic growth, but also as a strategic tool for reducing dependence on resource-based sectors, enhancing national resilience, and advancing integration into global value chains. In this context, fostering knowledge-intensive industries is not merely desirable — it is essential for long-term stability, technological sovereignty, and sustainable development. Kazakhstan defines the interests of citizens and the quality of institutions as an important strategic direction (Bokayev et al., 2023).

However, in post-socialist contexts such as Kazakhstan, the effectiveness of innovation policy is often undermined by a persistent gap between strategic ambition and institutional capacity. Frequent shifts in priorities, overlapping mandates among government bodies, and a limited tradition of evidence-based governance continue to hinder coordination and consistent implementation (Pisár et al., 2023). Similar issues have been documented in other post-Soviet states. For example, Panikarova (2019) highlights that in Russia, despite the presence of comprehensive innovation strategies, fragmented institutional frameworks, weak accountability, and poor coordination between regional and federal levels significantly reduce policy effectiveness.

Since 2001, Kazakhstan has been launching a series of initiatives aimed at building a national innovation system. Key milestones include the adoption of the Innovation Development Programme (2003), the establishment of the National Agency for

Technological Development (2008) and successive State Programmes for Industrial-Innovative Development. Despite the existence of strategic documents, specialised institutions and dedicated funding mechanisms, innovation activity in the country remains weak. Institutional structures are often fragmented and poorly coordinated, while policy implementation suffers from inconsistent prioritisation, limited human capital and underdeveloped links between science and industry. These persistent gaps underscore the need for a comprehensive assessment of systemic challenges and key effectiveness factors. This is further reflected in Kazakhstan's global standing: according to the Global Innovation Index 2025, the country ranks 81st out of 139 economies, indicating limited international competitiveness in innovation performance (WIPO, 2025).

The aim of this study is to identify the main factors determining the effectiveness of Kazakhstan's state innovation policy by quantitative and qualitative research methods.

The central assumption of this study is that the current system of state support for innovation in Kazakhstan does not facilitate a systemic transition to an innovation-based economy, functioning predominantly as a collection of uncoordinated and loosely connected initiatives. To achieve the research objectives the study will answer three key research questions:

RQ1: What stages and institutional changes have defined the evolution of Kazakhstan's state innovation policy since 2001?

RQ2: Which economic and institutional factors most strongly influence Kazakhstan's innovation output (2004–2024)?

RQ3: How do businesses and academia actors assess current support mechanisms, and what barriers do they identify?

2. Innovation and innovation policy

Contemporary approaches to developing state innovation policy demonstrate an evolution from supporting R&D and addressing market failures to more comprehensive and systemic strategies focused on transformational change.

It is commonly accepted that the concept of "innovation" was introduced by Schumpeter in 1934. Since then, numerous scholars have expanded or redefined the term. Singh and Aggarwal (2022), in their review of 208 definitions, identified "newness" as the most consistent element. They define innovation as the operationalization of creative potential with commercial and/or social motives through adaptive solutions that generate value, apply new technologies, and foster economic growth.

Although innovation is now firmly rooted as an economic category, Bryan and Williams (2021) note that prior to 1960, terms like "invention" or "innovation" were

rarely featured in leading economic journals.

One of the earliest conceptual frameworks to explain the link between science, technology, and the economy was the linear model of innovation. This model, though never formally codified (Godin, 2006), describes innovation as a sequence from basic research to development, production, and diffusion.

Governments play a pivotal role in fostering innovation through general frameworks and targeted tools such as R&D subsidies. However, the effectiveness of these tools varies by sector and type of firm. (Zuo & Lin, 2022).

Emerging from this understanding, place-based innovation policy has gained traction. Calderini et al. (2023) highlight its focus on leveraging local capacities, though in practice outcomes are mixed due to insufficient attention to regional specific.

In parallel, the functional approach to innovation systems has shifted the focus from institutional structures to dynamic processes such as entrepreneurship and knowledge diffusion. Hekkert et al. (2006) stress that mapping these functions is essential for understanding systemic performance.

Rooted in the national innovation systems (NIS) perspective (Lundvall, Freeman, Nelson), this approach views innovation outcomes as contingent on institutional structures and actor interactions. Pavitt (2002) and Markard & Truffer (2008) argue that both micro- and macro-level policies shape the innovation environment, influencing the competitiveness of firms.

Borrás and Edquist (2013) expand on this by advocating policy instruments that are problem-specific and functionally aligned. Since the 2010s, the "policy mix" concept has dominated discourse, emphasizing the interplay between instruments, actors, and institutions (Flanagan et al., 2011). Kern et al. (2019) argue that coherence, adaptability, and institutional learning are core to effective innovation governance.

Countries with post-socialist or transition backgrounds exhibit unique institutional legacies and structural challenges that influence their innovation trajectories. Pisár et al. (2021) emphasize that in such settings, sustainable innovation policy requires institutional coherence and the capacity to align national and regional levels. Tonelli et al. (2019), using Romania and Brazil, illustrate how local actor networks and informal coalitions can circumvent path dependency.

Profiroiu et al. (2019) and Radonić and Milosavljević (2019) focus on Romania and Serbia, respectively, showing that innovation in the public sector depends on HR practices, training, and the cultural acceptance of failure. Mukhitdinov (2024), analysing Uzbekistan, finds that human capital alone is insufficient without policy coordination, highlighting the impact of inter-agency misalignment.

Țigănașu et al. (2019) show that in many Central and Eastern European countries, weak governance capacity correlates with poor innovation outcomes. Șerbănică (2021) further reveals how regional disparities within a single country such as Romania can reflect structural limitations in innovation infrastructure.

Nommik (2024) presents Estonia as a case of successful digital innovation in the public sector, attributing success to legal clarity, stakeholder engagement, and proactive leadership.

These findings are particularly relevant for understanding the specific features of innovation policy in the Republic of Kazakhstan, which shares institutional features with other post-socialist states. However, detailed comparative analyses remain limited and warrant further exploration.

Mission-oriented innovation policy, as advanced by Mazzucato (2018), seeks to direct innovation toward societal goals beyond economic growth. Key components include clearly defined missions, risk-sharing, and institutional agility. Schot and Steinmueller (2018) reinforce this vision, calling for experimental capacity and societal involvement.

De Jong and De Vries (2025) frame innovation as a second-order change, requiring not only new outputs but fundamental shifts in systems and managerial capabilities such as adaptability and uncertainty tolerance.

McLaren and Kattel (2025) further emphasize that mission-oriented approaches demand three types of capabilities: analytical, operational, and political. Deficiencies in any area can compromise even well-resourced programmes.

Innovation outcomes are shaped by both internal and external conditions. Dziallas and Blind (2019) highlight the interplay of organisational resources, market structures, and institutional settings.

Psychological dimensions also play a role. Roberts et al. (2021) identify cognitive, motivational, and organisational factors, such as risk perception and leadership experience, that affect innovation readiness.

Innovation measurement remains contested. Zobel et al. (2017) support patents as robust indicators, while García et al. (2012) propose new product counts for industry-specific relevance. Taques et al. (2020) offer a typology distinguishing inputs (e.g. R&D), throughputs (e.g. patents), and outputs (e.g. sales), including intangible gains.

Zhao et al. (2025) demonstrate that in China, mixed incentives (subsidies and tax breaks) enhance SME innovation differently depending on the context. Knapp et al. (2025) show that regulation can stimulate innovation when firms adopt resilient strategies, using data from 27 OECD countries.

Taken together, the literature shows that innovation policy effectiveness hinges on a multifaceted architecture that integrates:

- clearly defined policy goals and a strategic vision;
- institutional coherence and adaptive governance structures;
- human and organisational capacities, including failure-tolerant cultures;
- regionally sensitive and inclusive implementation mechanisms;
- reliable methods for monitoring and evaluating innovation inputs and

outcomes.

Recent scholarship suggests that policy evaluation must move beyond simple indicators and consider systemic functions, stakeholder interactions, and contextual enablers. This requires developing tools that assess not only economic outcomes but also institutional learning, policy coherence, and capacity for transformation.

Armed with this theoretical foundation, the following sections apply these insights to Kazakhstan's case. We first outline the research design (Section 3), then examine Kazakhstan's innovation policy evolution (Section 4), analyze the quantitative impact of key factors (Section 5), and assess stakeholder perspectives (Section 6), before synthesizing findings. This structure allows us to explore whether the principles identified in the literature manifest in Kazakhstan's innovation system and to identify context-specific challenges.

3. Methodology

3.1. Document Analysis

A content analysis was conducted on strategic and programmatic documents related to innovation development in Kazakhstan from 2001 to 2025 to respond to the RQ1. Based on this analysis, a chronological classification of the stages in the evolution of state innovation policy was developed, indicating key documents, stated objectives and responsible institutions at each stage. In addition, an expert analysis was carried out to assess the risks of recurring shortcomings in public administration.

3.2. Regression Models

To quantitatively assess the impact of various factors on the volume of innovative products in Kazakhstan during the period 2004–2024 (RQ2), two types of regression models were constructed:

1. **Ordinary Least Squares Regression** — a classical model of the form: $Y = \beta_0 + \beta_1 X_1 + \beta 2X2 + \beta 3X3 + \varepsilon$, where:

Y — volume of innovative products (million KZT), which serves as a measurable proxy for the effectiveness of innovation policy;

X_1 — share of innovation-active enterprises (%), reflects the level of innovation engagement across the business sector. It is a key indicator in national development plans and reflects the structural base for innovation-led growth;

X2 — expenditure on R&D (million KZT), represents investment in the generation of new knowledge and scientific capacity. This is a widely recognised input indicator for innovation systems, both nationally and internationally;

X3 — expenditure on industrial innovation (million KZT), captures funding aimed specific at applied innovations within production sectors.

The selection of independent variables is based on both their theoretical relevance and their practical role as official national innovation indicators in Kazakhstan. These metrics are regularly used by public authorities to guide funding decisions, monitor programme outcomes, and assess policy effectiveness. Their inclusion also aligns with international empirical practice, as prior studies confirm that R&D expenditure, the share of innovation-active enterprises, and industrial policy support are strong predictors of innovation performance across various contexts (Lu et al., 2018; Ding et al., 2025; Yang et al., 2024; Yan et al., 2022; Hajek & Henriques, 2017; Shi et al. 2023; Dobrovolska et al., 2023).

The model makes it possible to estimate the change in the outcome variable resulting from a one-unit increase in each factor, holding all other variables constant.

2. **Log-log regression using the same variables:** $\ln(Y) = \beta_0 + \beta_1 \ln(X_1) + \beta 2 \ln(X2) + \beta 3 \ln(X3) + \varepsilon$.

This approach estimates elasticity, i.e. the percentage change in the dependent variable resulting from a 1% change in each independent variable. Logarithmic transformation helps eliminate scale inconsistencies between variables and makes the results more comparable and interpretable.

3.3. Survey Design and Analysis

The empirical basis of the study also included a sociological survey conducted among respondents with experience in interacting with the state innovation support system. The aim was to assess perceptions of grant effectiveness, identify key administrative and institutional barriers, and collect suggestions for improving support mechanisms (RQ3).

The survey covered all applicants for innovation grants since 2020. Out of 2,547 applications (2020–2024), 359 valid responses were collected (≈14%), exceeding the representative sample threshold (95% confidence, ±5%). It was voluntary and disseminated via the grant operator's website and social media. While the sample ensures statistical reliability, some response bias is possible, as applicants with stronger experiences were more likely to participate. Respondents represented academia, business, and industry. The online survey (Google Forms) included closed and open questions, with data processed in Excel and analysed in Python to identify correlations and clusters.

Open-ended responses were subjected to content analysis: answers were coded by key themes (transparency and trust, bureaucratic burden, funding volume, mentoring support, reporting and oversight) and grouped into thematic clusters. This combined quantitative and qualitative approach provides a comprehensive view of how the target audience perceives state innovation support. Overall, the survey reveals how participants assess the effectiveness of support mechanisms, highlighting institutional barriers, procedural inefficiencies, and practical suggestions.

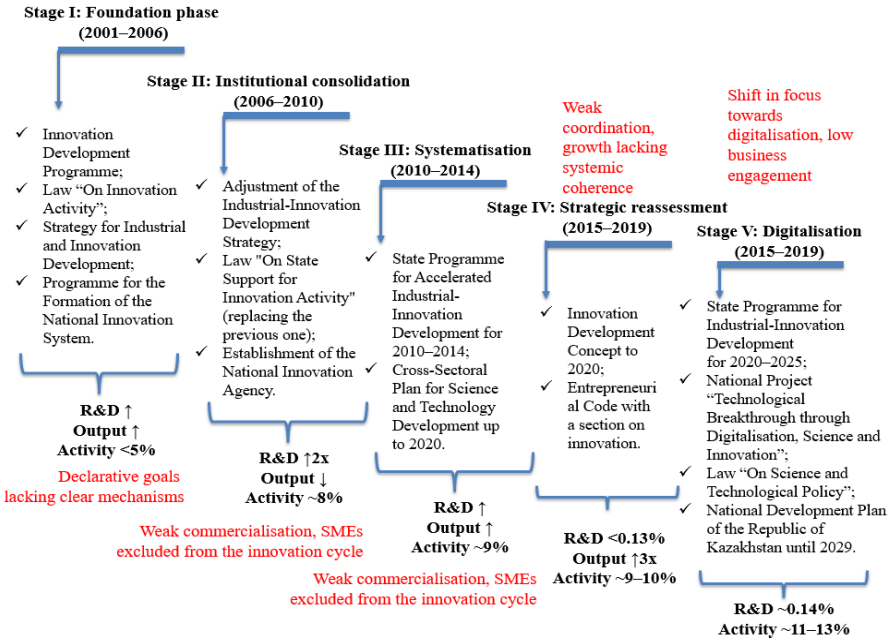
While these findings are valuable, the study has certain limitations: innovation statistics are available only from 2003, restricting the analysis period (2003–2024), and survey results are limited to grant applicants since 2020, with possible self-selection bias. Nevertheless, combining institutional analysis, econometrics, and survey data enhances validity through triangulation.

4. The evolution of Kazakhstan's state innovation policy (RQ1)

Based on the analysis of strategic documents and regulatory acts, five distinct stages in the development of Kazakhstan's state innovation policy can be identified. Their structure, key programme documents and institutional changes are outlined in Figure 1.

Figure 1:

The dynamics of innovation policy in the Republic of Kazakhstan: stages, focus areas, and indicators



Source: constructed by the authors using national legal acts and strategic planning documents

The first stage (2001–2006) marked the foundation of Kazakhstan's innovation policy. During this period, the following were adopted: The innovation development

programme (Government of the Republic of Kazakhstan, 2001), the Law "On Innovation Activity" (Government of the Republic of Kazakhstan, 2002), the Strategy for Industrial and Innovation Development until 2015 (President of the Republic of Kazakhstan, 2003) and the Programme for the Formation of the National Innovation System (Government of the Republic of Kazakhstan, 2005). These documents established the initial legal and institutional framework: they defined key concepts, declared the need to develop innovation infrastructure (such as techno parks and technology transfer centres) and outlined support measures for innovation projects. The programmes were only partially implemented, and several documents were repealed prematurely.

The second stage (2006–2010) focused on the establishment of support institutions and instruments. This period saw the adoption of several key measures: The Industrial-Innovation Development Strategy was revised (2006); the National Agency for Technological Development was established as a joint stock company to manage grant funding and innovation projects; a new Law "On State Support for Innovation Activity" (Government of the Republic of Kazakhstan, 2006) replaced the 2002 Law and the National holding company "Samruk-Kazyna" was created (2008), incorporating development funds tasked with advancing industrial and innovation policy. This phase marked a shift from general declarations to efforts at systemic implementation: core institutions for innovation development were established, direct support tools were introduced and innovation infrastructure was expanded.

The third stage (2010–2014) was characterized by accelerated industrial-innovation development. This period coincided with the implementation of the large-scale State Programme for Accelerated Industrial and Innovation Development (SPIID) for 2010–2014 (President of the Republic of Kazakhstan, 2010). The SPIID marked a new phase by integrating innovation policy into broader industrial modernisation efforts. Accompanying documents included the "30 Corporate Leaders of Kazakhstan" initiative (2007), the programme was discontinued in 2012 without achieving its objectives), the Cross-sectoral plan for science and technology development to 2020 (2010) and the Innovation development concept to 2020 (President of the Republic of Kazakhstan, 2013). The results were mixed. The SPIID 2010–2014 was completed on time and largely achieved its targets, with approximately 83% of the 104 performance indicators being met (Press Service of the Accounts Committee, 2020). However, documents such as the S&T Development Plan and the 2020 Concept formally remained in force until their end dates but lacked proper auditing or performance evaluation, making it difficult to assess their impact.

The fourth stage (2015–2019) was marked by efforts to integrate innovation with entrepreneurship and to stimulate private sector involvement. The main framework documents of this period included the State Programme for Industrial and Innovation Development for 2015–2019 (the second SPIID) and the State Programme for Business Support and Development "Business Roadmap 2025" (adopted in 2018 with an innovation component). In addition, in 2015, a dedicated chapter on state innovation

policy was added to Kazakhstan's Entrepreneurial Code. This period also saw the launch of university-based programmes for the commercialisation of scientific research and the initial formation of a venture capital fund under the Astana International Financial Centre (AIFC). However, implementation was once again hindered by institutional challenges such as mid-course budget cuts and the achievement of only about half of the intended performance indicators.

The fifth stage (2020–2025) is characterised by a relaunch of priorities and institutional reforms. During this period, several new strategic documents were adopted: the State Programme for Industrial and Innovation Development for 2020–2025 (the third SPIID), the National Project "Technological Breakthrough through Digitalisation, Science and Innovation" (2021), the new Law of the Republic of Kazakhstan "On Science and Technological Policy" (Government of the Republic of Kazakhstan, 2024) and the National Development Plan of Kazakhstan until 2029 (President of the Republic of Kazakhstan, 2024). These initiatives aim to update the goals and instruments of innovation development in response to modern challenges (e.g. digitalisation and Industry 4.0.). However, inconsistency re-emerged: the 2020–2025 SPIID was discontinued prematurely in 2022 and effectively replaced by the National Project, which itself was also terminated early by the end of 2023. This frequent reformatting of policy hampers the achievement of long-term objectives. On a more positive note, the 2024 Law is expected to strengthen institutional links between science, technology and innovation, while the National Plan to 2029 sets concrete targets (e.g. increasing R&D expenditure to 1% of GDP). Nevertheless, common features persist across all five stages: a disconnect between ambitious goals and practical measures, frequent shifts in priorities and the failure to fully implement most programmes. As a result, many of the issues identified at the early stages of policy development continue to be reproduced to this day.

Thus, each stage is characterized by the introduction of new support instruments and institutions, as well as persistent challenges related to continuity, institutional stability and strategic coherence.

5. Factors determining innovation development in 2004–2024 (RQ2)

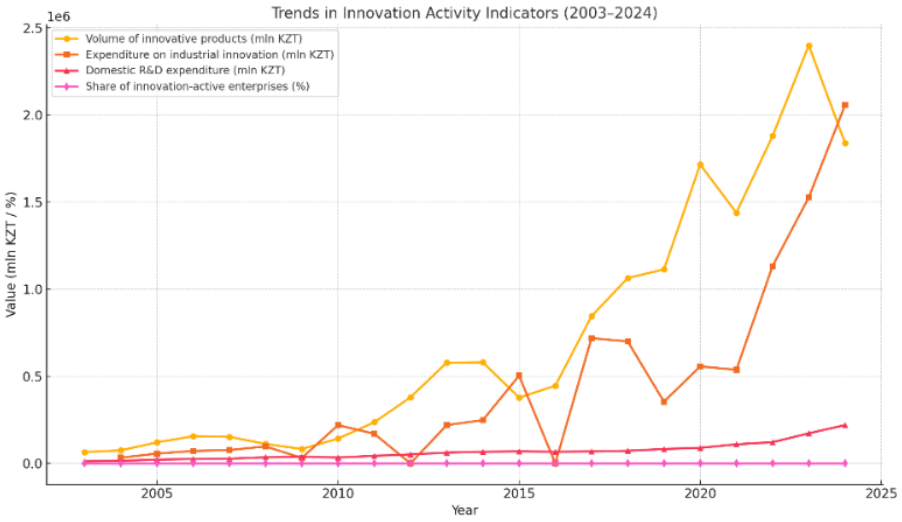
We hypothesized that R&D expenditure, industrial innovation investment, and share of innovation-active enterprises were the key drivers of national innovation output. This proposition was tested using correlation and regression analysis based on Kazakhstan's data for 2004–2024, drawn from official statistics of the Bureau of National Statistics of Kazakhstan (n.d.).

The regression analysis revealed several important patterns, which are examined in detail below. Figure 2 illustrates that the volume of innovative products increased more

than 28 times, R&D expenditure rose nearly 19-fold, and industrial innovation spending expanded over 62 times. The share of innovation-active enterprises grew from 2.1% to 11.9%.

Figure 2:

Trends in innovation indicators of the Republic of Kazakhstan



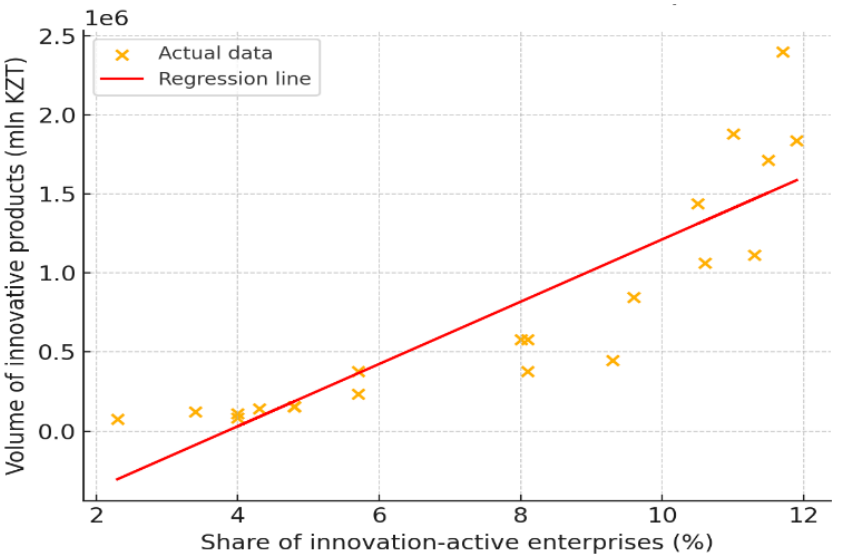
Source: constructed by the authors based on national statistical data

To explore the interrelationships among variables, a correlation analysis was conducted. The results showed that the volume of innovative products had a very strong positive correlation with R&D expenditure (Pearson's $r \approx 0.95$), a strong positive correlation with the share of innovation-active enterprises ($r \approx 0.87$) and a moderate positive correlation with industrial innovation expenditure ($r \approx 0.74$). All correlations were positive, indicating that an increase in each factor was individually associated with an increase in innovation output.

A multiple linear regression model was constructed, with the volume of innovative products as the dependent variable and the three aforementioned factors: the share of innovation-active enterprises, R&D expenditure, and industrial innovation expenditure as independent variables. Figures 3, 4, and 5 illustrate the regression models for each of the three indicators.

Figure 3:

Linear regression for the first pair of indicators

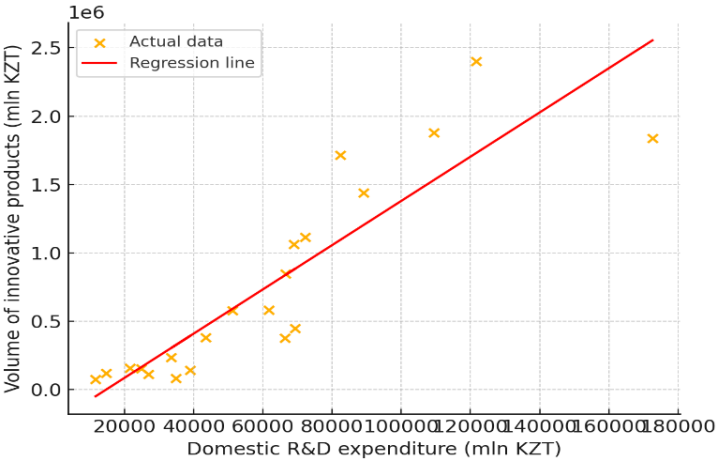


Source: constructed by the authors based on national statistical data

Figure 3 illustrates the results of the linear regression model constructed to assess the impact of the share of innovation-active enterprises on the volume of innovative product output in Kazakhstan. The regression line showed a positive slope, indicating a consistent relationship: as the share of innovation-active enterprises increased, the overall volume of innovative products also tends to rise. However, the data revealed noticeable dispersion beyond the 10% range, indicating low predictive accuracy and limited explanatory power. This may have reflected a formalistic definition of "innovation activity", low commercialisation, especially among SMEs, —and the influence of other unaccounted-for factors.

Figure 4:

Linear regression for the second pair of indicators

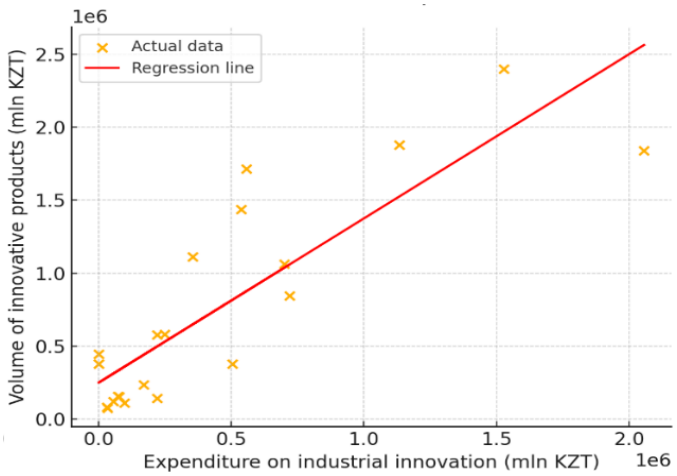


Source: constructed by the authors based on national statistical data

Figure 4 illustrates the results of a regression analysis conducted to assess the relationship between domestic expenditure on R&D and the volume of innovative product output in Kazakhstan. The observations were closely along the regression line, with minimal dispersion.

Figure 5:

Linear regression for the third pair of indicators



Source: constructed by the authors based on national statistical data

Figure 5 illustrates the linear regression results assessing the impact of industrial innovation expenditure on innovation output. The wide dispersion of data points, especially beyond 1 trillion KZT, suggested that increased spending does not proportionally raise output. This indicated that direct subsidies or investments in technological upgrades did not clearly impact innovation results during the period. Possible reasons included inefficient use of funds, insufficient scale, or returns appearing in forms not reflected in output data.

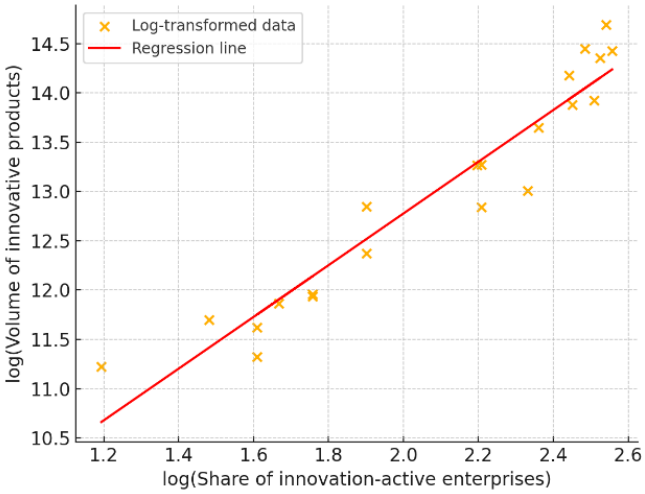
Overall, the linear regression model explained approximately 90% of the variance in innovation output ($R^2 \approx 0.90$). However, notably only the R&D coefficient was statistically significant at conventional levels ($p < 0.01$), whereas the coefficients on enterprise share and industrial expenditure were not significant ($p > 0.1$). The 95% confidence interval for the R&D effect was well above zero, underscoring its robustness.

To test the robustness of the findings, a second model — a log-log regression was constructed. Logarithmic transformation helped mitigate nonlinearity and allowed for the estimation of elasticity in the relationship between variables.

Figure 6 illustrates the graph of the log-log regression illustrating the relationship between the logarithms of the share of innovation-active enterprises and the volume of innovative products for the same period.

Figure 6:

Log-log regression for the first pair of indicators



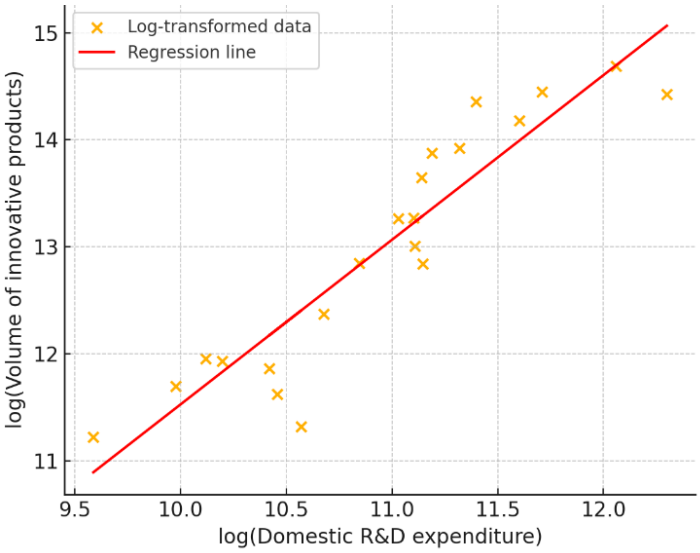
Source: constructed by the authors based on national statistical data

Unlike the linear model, in which the impact of the share of enterprises was statistically insignificant, the logarithmic regression revealed a strong non-linear effect: as the base of innovation-active enterprises expanded, output increased at an accelerated rate. In the log-log model, the coefficient on the share of enterprises became significant ($p < 0.05$), indicating that once a critical mass of innovative firms was present, their impact on output grew markedly.

Figure 7 illustrates the results between R&D expenditure and the volume of innovative products.

Figure 7:

Log-log regression for the second pair of indicators



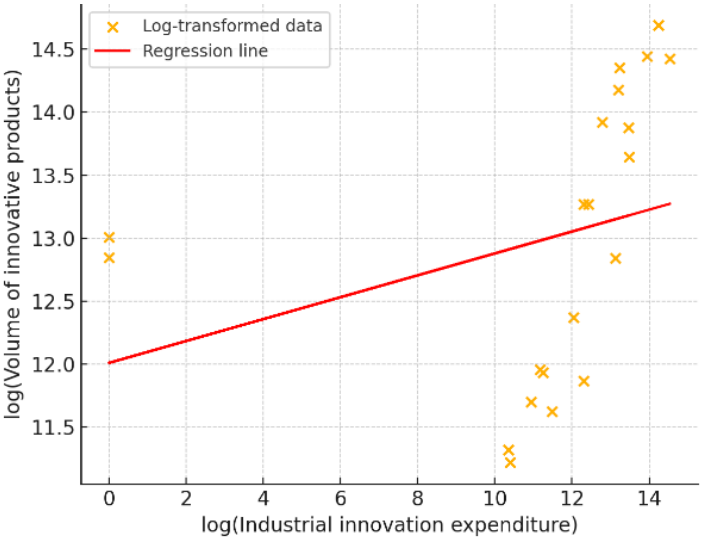
Source: constructed by the authors based on national statistical data

The graph shows a linear relationship on a logarithmic scale. R&D expenditure demonstrated a stable, statistically significant, and elastic association with innovation output. For example, the estimated elasticity of R&D (~1.6) suggested that a 1% increase in domestic R&D spending was associated with approximately a 1.6% increase in innovation output, all else being equal.

Finally, Figure 8 illustrates the results between the logarithm of industrial innovation expenditure and the logarithm of the volume of innovative products in Kazakhstan.

Figure 8:

Log-log regression for the third pair of indicators



Source: constructed by the authors based on national statistical data

The graph showed an upward trend. Although industrial innovation expenditure appeared statistically significant in the logarithmic model, its impact was less pronounced and more sensitive to external conditions. In practical terms, this suggested that while additional spending on industrial innovation can contribute to higher output, the effect was neither stable nor proportional: results depended heavily on how funds were allocated and whether enterprises were prepared to absorb and implement new technologies effectively.

6. The perceived quality of the current public support for innovations in the Republic of Kazakhstan (RQ3)

Despite the existence of formal innovation support instruments in Kazakhstan, including grant programmes, little is known about how they are perceived by actual users. To address this gap, a sociological survey was conducted among applicants and recipients of innovation grants to assess their experience, identify barriers, and collect suggestions for reform.

The survey highlights five main challenges: inadequate financial support,

bureaucratic and transparency issues, skills and mentoring deficits, institutional fragmentation, and weak systemic impact — revealing a persistent gap between policy design and execution.

The data also show distinct respondent profiles based on grant outcomes. Recipients are younger (median 33), with about 7 years of experience and mostly based in Astana or Almaty, while non-recipients are older (median 38), more often hold a master's degree, and are more likely to live in regional areas. These differences suggest the system may favour applicants from major cities, a pattern also noted in countries such as the Czech Republic and Slovakia (Šipikal et al., 2017). These profile differences also shape perceptions of access to finance, one of the most pressing obstacles. OECD data show that 38% of Kazakhstani firms cite lack of funding as the primary barrier to innovation (OECD, 2017, p. 91). While state grants aim to close this gap, over 60% of respondents report insufficient funding, and 36% identify the co-financing requirement as an additional barrier, particularly for young teams and SMEs.

Procedural clarity and transparency are also critical. Over 40% of respondents rate grant administration poorly (average 2.8 out of 5), citing excessive bureaucracy, unclear criteria, and limited guidance. One participant noted that applications were often rejected without justification, reinforcing perceptions of opacity. Others questioned the integrity of selection, suggesting that automated tools such as AI could reduce perceived bias. Although expressed in strong terms, these remarks reflect a broader trust deficit and concerns about fairness.

Beyond procedural issues, respondents also point to gaps in skills and advisory support. The survey confirms these needs: 37% of respondents prioritize training, 36% want expert guidance, while others mention consultations (11%) and sample applications (9%). Many highlight the absence of institutionalized support, forcing them to rely on paid intermediaries, thereby creating information gaps and fostering informal practices. These shortcomings are compounded by institutional fragmentation: multiple agencies provide uncoordinated grants, and 29% of respondents favour consolidating all programmes under a single agency to reduce duplication and confusion.

Despite these challenges, grants can deliver positive results at the firm level: 72% of recipients consider the use of funds effective, reporting market expansion (38%), new products (28%), and additional investment (24%). However, overall effectiveness remains limited — only 24% consider the system highly effective, with an average score of 3.5 out of 5. As the OECD (2017) notes, dispersing limited resources across many projects weakens systemic impact and risks overburdening institutions. These findings confirm that targeted funding alone is not enough; sustainable progress requires coordinated, reform-oriented innovation policy.

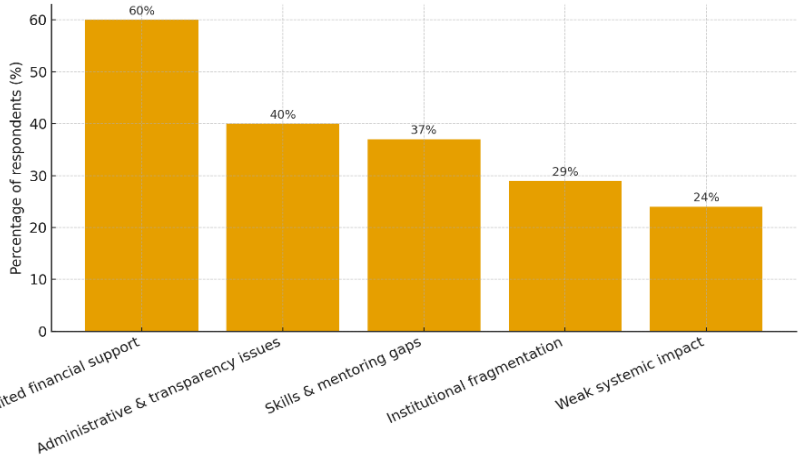
Importantly, this view is shared by innovation actors themselves. Survey respondents propose concrete improvements: 41% call for new grant formats, 38% urge relaxing co-financing requirements, and 35% support unifying programmes into a single "one-stop" platform — either structurally or digitally. In addition, 33% emphasize the

need for post-grant support such as investment attraction, commercialization advice, and mentoring. Transparency also emerges as a key concern: 30% demand clearer criteria, expert justifications, and feedback. Further suggestions include simplifying reporting, introducing digital monitoring tools, and offering tax incentives.

Overall, the survey responses demonstrate that these challenges are systemic rather than isolated, reflecting structural weaknesses in the current innovation support framework. To illustrate their relative prevalence and impact, the five categories are summarized in the diagram (Figure 9), which provides a visual overview of how respondents experience the key barriers.

Figure 9:

Survey results: Key challenges in innovation grant system



Source: compiled by the authors from survey data

7. Discussion

The analysis confirms the fragmentation and lack of systemic coherence in Kazakhstan's innovation policy over 2001–2025. Despite five successive phases, none succeeded in establishing a stable framework for sustained innovation-led growth. Each stage introduced ambitious strategies and new institutions, yet recurring problems — prematurely terminated programs, shifting priorities, and weak coordination, undermined continuity. These institutional shortcomings closely mirror the challenges identified by survey respondents.

Quantitative findings reinforce this conclusion. R&D expenditure consistently emerges as the strongest driver of innovation output, while industrial innovation

spending, despite being prioritized in state programs, shows only weak correlation with results. The share of innovation-active firms has little effect in linear models but becomes significant in logarithmic ones, suggesting that critical mass is needed before firm-level innovation translates into systemic outcomes. This resonates with international studies that stress the importance of absorptive capacity and demand-side mechanisms, rather than infrastructure spending alone.

Survey evidence adds a practical dimension. Respondents pointed to fragmented mandates, low trust in institutions, limited post-grant support, and the concentration of funding in major cities as systemic weaknesses. These concerns align with institutional analysis and international critiques of transition economies. Stakeholders proposed reforms consistent with global best practice: transparent and flexible grant design, mentoring and advisory networks, reduced co-financing requirements, continuity of support beyond the grant period, and stronger alignment between national priorities and practical implementation. Such suggestions emphasize that gaps in policy execution, rather than the absence of ideas or resources, remain the main barrier.

Comparative evidence reinforces these insights. Mukhitdinov (2024), analyzing Uzbekistan, found similar deficiencies — fragmented institutions, poor inter-agency communication, and limited science-industry linkages—despite growing budgets and reforms. His regression analysis also highlighted the primacy of institutional quality and human capital over purely infrastructural or regulatory measures. Broader studies of transition economies (Radosevic & Yoruk, 2013; Edler & Fagerberg, 2017) likewise show that innovation policy failures usually stem not from resource shortages but from weak coordination, low administrative capacity, and insufficient feedback mechanisms.

The literature emphasizes that successful innovation systems require a multifaceted architecture: clear strategic vision, adaptive governance, human and organizational capacity, regionally sensitive implementation, and robust monitoring and learning. Kazakhstan's case illustrates the absence of such architecture. While strategies regularly declare innovation a priority, their implementation is undermined by weak follow-up, poor institutional memory, and a lack of adaptive coordination platforms. As a result, project-level successes rarely scale, and policy impact remains fragmented.

Addressing these shortcomings requires shifting evaluation beyond linear input–output metrics toward dynamic system monitoring that captures institutional and behavioral dimensions. Reform should begin with a comprehensive review of all innovation-related institutions to clarify mandates, reduce overlap, and strengthen coordination. Funding models need to become more adaptive and outcome-driven, emphasizing trust, risk tolerance, and collaboration across public bodies, businesses, and research actors. Institutionalized post-grant support and knowledge-sharing platforms are essential for sustaining impact and enabling long-term system learning.

The key lesson emerging from this study is that fragmented, short-term efforts cannot deliver lasting outcomes. Evidence from strategies, statistical trends, and stakeholder feedback all point to the same conclusion: without institutional coherence,

long-term vision, and supportive mechanisms, policies remain largely declarative. Kazakhstan must move from a top-down, input-driven model toward a systemic, learning-oriented approach. Stakeholders' calls for unified coordination, transparency, mentoring, post-award continuity, and alignment with national priorities reinforce this direction. Only through such an integrated shift can the innovation system become responsive, inclusive, and capable of driving sustained technological and economic transformation.

8. Conclusion

RQ1 (policy evolution): Since 2001, Kazakhstan's innovation policy has gone through five phases, from institution-building to digitalisation, but none created a functional ecosystem. Frequent policy shifts, weak coordination, and fragmented governance undermined continuity and systemic learning.

RQ2 (factors influencing innovation): Regression analysis shows that R&D investment is the only consistent driver of innovation output. The share of innovation-active firms becomes significant only beyond a critical mass, while industrial innovation spending shows weak correlation. This indicates that performance depends more on knowledge-generation inputs and absorptive capacity than on top-down subsidies.

RQ3 (stakeholder perceptions): Survey results reveal five systemic shortcomings: insufficient funding, bureaucratic and opaque procedures, deficits in skills and mentorship, institutional fragmentation, and weak systemic impact. Respondents proposed reforms such as new grant formats, reduced co-financing, consolidation of programmes under a single platform, post-grant support, and clearer evaluation feedback.

Theoretical and practical contributions:

Theoretically, the findings reinforce existing work on innovation policy by confirming the importance of institutional coordination, adaptive governance, and learning-oriented approaches in a post-Soviet context that remains underrepresented in the literature.

Practically, the study provides policymakers with concrete evidence of where Kazakhstan's innovation policy falls short and why, linking weaknesses with targeted reforms and international best practice. The added value lies in combining econometric analysis with original survey evidence from grant applicants, integrating measurable outcomes with stakeholder perceptions. This mixed-methods design offers a more comprehensive and context-specific assessment than prior studies, and situates Kazakhstan within the broader framework of post-socialist economies, where similar institutional weaknesses and declarative strategies are often observed.

Policy recommendations: To move from declaration to implementation, Kazakh institutions should:

- consolidate innovation programmes under a unified coordination body to eliminate duplication;
- expand funding scale and ease access by reducing co-financing barriers, especially for SMEs and young teams;
- institutionalize mentoring, training, and advisory services as part of grant schemes;
- improve transparency in evaluation through clear criteria, feedback, and possibly algorithm-assisted reviews;
- ensure continuity and learning by introducing post-grant follow-up, commercialization support, and knowledge-sharing platforms.

Limitations and future research: The study is constrained by data availability (statistics since 2003) and a survey limited to applicants since 2020, which may introduce self-selection bias. Its findings are context-specific and cannot be directly generalized. Future research should broaden comparisons to other Central Asian and post-socialist countries, explore regional and sectoral dynamics within Kazakhstan, and assess the role of international actors and donors. Such extensions would test the robustness of the findings and contribute to understanding innovation systems in transition economies more broadly.

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