

This article explores the role of state support in stimulating technological entrepreneurship and its impact on the innovation process. Through analyzing existing research and using empirical evidence, the article develops a theoretical framework that explains the mechanisms of the impact of government measures on technological entrepreneurship. The article provides an overview of the main measures and tools implemented in the Republic of Kazakhstan over the past 10 years. In particular, the effectiveness of measures of JSC “Entrepreneurship Development Fund “Damu”, which realizes the functions of an agent for accounting and monitoring the use of funds from the state budget, is assessed. The draw a conclusion about the stable growth of the sector, despite the negative factors of the impact of non-stability of the external environment. A quantitative assessment of the macroeconomic impact of financial measures of state support on technological entrepreneurship using the methods of correlation and regression analysis is given. The results of the assessment showed that there are weak and strong influence of state support measures: interest rate subsidies do not show macroeconomic effect, loan guarantees have a weak effect on the opening of new business entities; conditional placement of funds in banks and interest rate guarantees show good influence.

In conclusion, our article presents concrete practical implications and policy recommendations to enhance state support strategies for technology entrepreneurship, aimed at promoting innovation and reinforcing economic competitiveness. The research has revealed a noteworthy surge in innovation activity and growth in economic competitiveness. In particular, comparative assessments indicate that in 2021, the SME sector accounted for 33.3 % of the economy, signifying a substantial increase from the 32.8 % of GDP it constituted in 2020. These numbers underline the success of the current policies and provide a strong rationale for the continued enhancement of state support for technology entrepreneurship. The findings not only reaffirm the significance of continuing this policy but also establish the groundwork for more ambitious targets, such as achieving a 35 % share of SMEs in the economy by 2025

Keywords: innovation ecosystem, innovation entrepreneurship, innovation policy, innovations, government support, start-ups, venture financing

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EVALUATION OF THE EFFECTIVENESS OF GOVERNMENT SUPPORT FOR TECHNOLOGY ENTREPRENEURSHIP

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1. Introduction

Modernization and transfer of any country's economy to the technological path is impossible without the active participation of small and medium-sized enterprises. It is recognized as an indispensable element of the modern economy.

According to the Global Innovation Index, developed by Cornell University, INSEAD Business School and the World Intellectual Property Organization, which reflects the potential for innovation and its outcomes, the leaders in the field of innovation in 2022 are Switzerland, the United States, Sweden, the United Kingdom, the Netherlands, South Korea, Singapore, Germany, Finland and Denmark. The Republic of Kazakhstan ranks 83rd out of 132 countries and territories worldwide (down from 75th place in 2021). This decline in the Global Innovation Index indicates the vulnerability of the country in implementing innovative and technological entrepreneurship projects [1].

The Global Innovation Index encompasses seven analytical sections. Kazakhstan's strongest positions are observed in the sections of «Institutions» and «Infrastructure» (ranking 52nd and 58th, respectively). This section evaluated the political climate, regulatory factors (such as “rule of law”) and the business environment, indicating a noticeable governmental endeavor in our country to develop this sector of the economy.

At present, the world practice has accumulated considerable experience in the formation of national innovation systems and the use of mechanisms of state stimulation of technological entrepreneurship in various functional areas and ways of impact. However, the mechanisms of state support are not always effective.

Moreover, low efficiency is characteristic of technological infrastructure, which to a large extent functions only with the support of the state.

In order to ensure the transition to a new technological mode, the industrial policy of developed countries is aimed at

reforming the principles of organization and mechanisms of state stimulation of technological entrepreneurship, including new forms of functioning of public-private partnership, within which it is possible to concentrate and effectively use national and corporate intellectual, material and financial resources to transform the national industry on the basis of breakthrough technologies. This will make it possible to form competitive advantages in new global markets.

Thus, in connection with the intensification of the modernization process of the economy and transition to the innovative way of its development in the conditions of unstable external environment, the problem of adaptation of measures of state support for innovative small and medium-sized enterprises to the existing conditions requires a systematic study of recent changes.

2. Literature review and problem statement

Technology entrepreneurship is a powerful tool for SMEs to help them meet the challenges and seize the opportunities of today's digital economy. It stimulates innovation, growth and sustainability, making SMEs more competitive and adapted to the requirements of the modern market.

The author of the article [2] defined technological entrepreneurship as investment in a project that brings together and utilizes specialized professionals and heterogeneous assets to create and generate value for the firm. He articulated the differences between technological entrepreneurship and other types of entrepreneurship and highlighted the attributes and characteristics that make it unique, however, the definition of technological entrepreneurship given in the study focuses on investment and value creation, while the relationship with innovation and what types of innovation it fosters remained unexplored.

Thus, [3] proposed an understanding of technological entrepreneurship as a process that combines elements of academic and intellectual entrepreneurship with entrepreneurship of commercial organizations that introduce new technologies and innovative business solutions in the market environment. In this regard, it can be noted that technological entrepreneurship in its essence is based precisely on the cooperation of companies from both the academic sector and the business environment. This study aims to confirm and substantiate the importance of technological entrepreneurship and innovation in the modern world, while the issue of their contribution to economic growth has remained unexplored, as full information on specific innovation projects and their impact on the economy is required for analysis.

Studies [4] have shown that the share of technological entrepreneurship contribution to the overall development of the world economy is 35 % of the world GDP. Undoubtedly, this confirms the importance and influence of the technological entrepreneurship sector in the global economic arena.

The basic concept related to the creation of a full cycle of innovation and commercialization of new technologically advanced products demonstrates the importance of innovation in today's world. This approach emphasizes not only the development of new ideas and technologies, but also their successful introduction to the market, which will contribute to the growth and development of the economy. However, the study did not focus on examining the data to analyze entrepreneurial activity in different countries to compare the conditions of the technological environment

in different countries and the development of technological entrepreneurship.

Paper [5] presents the results of research on the relationship between the technological environment (measured by the amount of investment in R&D and access to information and communication technology infrastructure) and technological entrepreneurship in 54 countries over a five-year period. Using data from the Global Entrepreneurship Monitor and the World Bank Development Indicators, a significant and stable inverted U-shaped relationship between R&D investment at the country level and the probability of technological entrepreneurship development was found. The focus of the study is on the impact of R&D investment on technological entrepreneurship at the country level, while the problems of technological entrepreneurship development at the level of multinational companies and its relationship with their competitiveness on the global stage have not been studied, as the authors did not conduct an in-depth analysis of specific companies, considering the problem only at the macro level.

The development of technological entrepreneurship at the level of multinational companies is considered in [6], the authors noted that the development and implementation of new technologies contributes to their competitiveness in the global arena. For example, some multinational companies use new technological aspects related to Data Science to improve decision making in several stages of the production process. However, the study has not explored the contribution of technology entrepreneurship to the government's tax revenue as an influence on the financial stability and development of the country.

The study [7] found that from 2010 to 2014, the number of technology enterprises in China increases, their contribution to product value, exports, employment and taxes increases. For example, the value of industrial output of technology entrepreneurship accounted for 41.49 % of the average GDP growth, the total export value of high-tech products was about 22.6 %, and the contribution of technology entrepreneurship to government tax revenue was about 8.49 %. Despite extensive research on this topic, the impact of state support has remained under-researched.

State support for technological entrepreneurship plays an important role in stimulating innovation activity and economic development. Support of technological entrepreneurship contributes to the development of scientific and technological potential of the country, which affects its innovative development in the long term [8]. However, the authors have not emphasized the role of public procurement of innovations as a policy tool to support smart and inclusive development, improve social welfare, stimulate the growth of both entrepreneurship and national competitive advantage.

The authors [9] elucidated the perceived benefits of e-public procurement such as increased transparency, cost savings for both parties involved, simplification and shortening of the procurement process and increased opportunities for SMEs to access public procurement markets. However, the study did not aim to fill the gap in knowledge and understanding of entrepreneurship in the Asian region.

The article [10] notes that Asia differs from the rest of the world with its unique and long-established cultural, social, economic and technological characteristics. However, these characteristics are still understudied by entrepreneurship scholars. This creates a unique entrepreneurial context in the region. But the authors did not consider the

organizations that facilitate their interaction with potential investors.

Researcher [11] emphasizes the dynamism of the business market associated with the emergence of new technologies, so entrepreneurs need to actively adapt their business models to these dynamics. In this situation, organizations that support entrepreneurs come to the rescue. Startup acceleration programs such as Astana HUB and Tech Garden create a platform for interaction between startup founders and investors. The creation of high-tech industries with a focus on innovation contributes to the development of future products and their successful export strategy. May be, the work would be unique if the authors analyzed the effectiveness of government investments in the development of SME technologies.

The study of the effectiveness of state support allows to determine how effectively state resources aimed at supporting technological entrepreneurship are used. Thus, in [12] a system for assessing the effectiveness of strategies of state support for innovative entrepreneurship was presented, and by applying appropriate economic methods [13] it is possible to identify promising ways to develop entrepreneurship in the Republic, including the improvement of innovation legislation in the field of state support.

Despite the extensive coverage in the economic literature on the effectiveness of state support for SMEs, the policy of industrial-innovative development of the economy does not give the desired result, the innovation component of manufactured products still remains at a very low level, the competitiveness of manufactured products is also at a low level [14].

The results of a study [15] on the effectiveness of financing mechanisms and instruments implemented by the Republic through the national institution for the development of small and medium-sized enterprises Entrepreneurship Development Fund indicate that Damu has been able to reduce regional inequality in SME financing, as evidenced by the number of SMEs financed and the number of jobs created, and that many small firms cannot grow into medium-sized enterprises in a competitive environment.

The author of [16] notes the ineffectiveness of increasing the amount of support for small business based on the results of sociological surveys of entrepreneurs.

A study [17] included an economic evaluation of public export support programs for SMEs in Spain. The evaluation was based on indicators such as activity, geographical location, sales volume and number of employees. The results of the analysis showed that companies that participated in the program improved their export performance as a share of total sales by about 10 percentage points.

A panel study on the effectiveness of export promotion programs [18] relies on subjective statistical methods: they estimate the impact of the program on the competencies, strategies and productivity of small firms based on survey data.

However, there are still unresolved issues related to the study of the analysis of the state's position on the priority stimulation of technological development of the economy in order to understand the importance of innovation and entrepreneurship from the point of view of state policy. An option to overcome the relevant difficulties could be to study the analysis of the efficiency assessment of the main institutional instruments – republican state programs aimed at implementation of the state innovation policy. An option to overcome the related difficulties could be a comparative study of different forms of state support, such as guarantees and soft loans, with budget subsidies for technological costs,

contributing to the identification of best practices and methods of entrepreneurship support. All this allows to argue that it is advisable to conduct a study devoted to the development of a methodology for assessing the effectiveness of economic mechanisms of state stimulation of entrepreneurship. Results obtained will contribute to the optimization of government measures to support entrepreneurship and improve outcomes in this area.

3. The aim and objectives of the study

The aim of this study is to quantitatively evaluate the impact of government entrepreneurship support tools in the Republic of Kazakhstan, providing data-driven insights for policymakers, entrepreneurs, and stakeholders to refine existing support programs, foster innovation, and enhance economic competitiveness.

To achieve this aim, the following objectives are accomplished:

- to study the development of entrepreneurship and infrastructure for its state support;
- to analyze the development of technological entrepreneurship and its efficiency;
- to provide an analytical assessment of changes in financial and non-financial measures of state support for technological entrepreneurship in the country;
- to develop a regression model, assess its reliability, and make its interpretation.

4. Materials and methods of the study

The object of this study is the system of state initiatives to support entrepreneurship in the Republic of Kazakhstan. The main hypothesis of this study is that the effectiveness of state entrepreneurship support programs has a significant impact on the growth of technological entrepreneurship, innovation and competitiveness of the economy of Kazakhstan.

The main assumption of our study was that the amount of state financial support (soft loans, guarantees and subsidies) provided by the Damu Fund has an impact on the following outcome variables: the number of SMEs, tax revenues, the number of employees employed in SMEs, the production output of SMEs and the level of innovation activity among enterprises.

Historical, dialectical, monographic and graphical methods of research have been used in the study. As a major economic-mathematical method, correlation-regression analysis was used. The initial data were sourced from indicators provided by JSC «Entrepreneurship Development Fund «Damu»», the National Bank of the Republic of Kazakhstan and the Bureau of National Statistics ASPR RK for the period from 2011 to 2022. Data processing was carried out using the Statistica 13 software package.

5. Results of investigating the effectiveness of state support for technological entrepreneurship

5.1. Study of entrepreneurship development and state support Infrastructure

World experience shows that small and medium-sized enterprises are one of the main engines of the technical prog-

ress, and their innovative activity is confirmed by the fact that the number of innovations per researcher in these enterprises is four times higher than in large organizations. As calculated by experts, at least 46 out of 58 largest inventions of the 20th century made in America and Western Europe belong to individuals and small firms [19]. The share of small businesses among knowledge-intensive companies in technologically developed countries is up to 90 %. For instance, in China small and medium enterprises accounted for 65 % of all patents and 75 % of all created technical innovations and 80 % of the country's new products [20].

The analysis of statistical sources allows to state that the entrepreneurial sector in the country is growing. Thus, over the last five years there has been an increase in the number of small and medium-sized enterprises. The number of small and medium-sized entities compared with the corresponding date of 2018 increased by 46.5 % and amounted to 1,818,764 units to up to the end of 2022. According to statistics, 67.9 % of all small and medium-sized enterprises are individual entrepreneurs, 18.7 % are legal entities of small business, 13.2 % are peasant or farming households and 0.2 % are legal entities of medium-sized business (Table 1).

The structure of SME entities shows the outstripping growth of the number of individual entrepreneurs (IEs) and small enterprises. The number of individual entrepreneurs (IEs) compared with the 2018 year increased by 425,000 (+52.6 %), and currently their total number has reached 1.2 million. The number of small enterprises has increased by 109,000 (+47.2 %). The growth in the number of the small business entities is clearly attainable due to the growth of the economy itself and substantial state support for businesses. Stimulation of the agricultural industry along with the growing demand for locally produced agri-food products have been factors resulting in the continuous increase in the number of peasant and farming households since 2016.

The number of active SME entities in the Republic of Kazakhstan

Types of enterprises	2018	2019	2020	2021	2022	2022. in % by 2018
Small business enterprises	231,325	258,365	280,200	299,737	340,584	147.2
Middle business enterprises	2,620	2,502	2,486	2,754	2,924	111.6
Individual entrepreneurs	809,115	855,920	857,910	907,722	1,234,536	152.6
Peasant or farm enterprises	198,268	213,457	216,715	221,434	240,720	121.4
Total	1,241,328	1,330,244	1,357,311	1,431,647	1,818,764	146.5
Including those in manufacturing	45,505	51,600	57,173	64,749	101,576	223.2
Of them in the manufacturing industry	39,283	44,491	49,142	55,862	91,628	233.3

The number of small business entities has demonstrated a favorable trend – these are registered enterprises with the formation of legal entities, their number has increased by almost 1.5 times over the last five years. This allows to draw conclusions about significant institutional shifts manifested in the growth of newly established small enterprises and the re-registration of individual entrepreneurs as a limited liability partnership (LLP). The least change has occurred in the dynamics and structure of medium-sized enterprise legal entities.

In an industry breakdown, the majority of small and medium-sized enterprises operate in the construction, trade

and transportation sectors. Industrial and agricultural sectors account for only 3–5 % of all SME entities.

A similar practice is discernible in many countries where the service sector traditionally is more attractive to SME entities. In our view, this is attributed to the following factors:

- the risk level in the service sector is lower than that of the production sector;
- specialized equipment characterized by high costs is not required;
- return on invested capital is faster;
- the service sector quickly adapts to market conditions.

The state support of small and medium-sized entrepreneurship entities has traditionally been an important factor to stimulate their functioning. For a number of years, support of small and medium-sized enterprises in the country has been a state priority and is carried out in a comprehensive manner. The Development Program for Small and Medium-Sized Entrepreneurship of the Republic of Kazakhstan until 2030 posed a series of objectives most of which have been achieved, and this has necessitated the adoption of new policy documents. Today the country is facing new challenges for economic recovery in the post-pandemic period and accelerated technological development.

State programs have been developed and implemented; special tax regimes have been introduced for SME entities; State institutions for providing organizational and financial support as well as advisory services have been established and they are functioning successfully. In most commercial banks, special programs aimed at providing loans to SME entities under more favorable terms have been developed and implemented.

Analysis of program documents, normative acts and other sources has shown that the following types of financial support are available in the republic: loans, guarantees, financing of leasing operations, subsidizing loan interest rates, grant financing and mezzanine financing. These forms of support are implemented by 23 entities, of whom the Eurasian Development Bank (EDB) and the Asian Development Bank (ADB) currently practice an indirect form of financing through second-tier Kazakhstani banks and development institutions (Damu Fund, «KazAgro» JSC).

The work of JSC «Development Bank of Kazakhstan» contributes to the sustainable development of the national economy through investments in the non-commodity sector of the country. The bank engages in investments primarily in large enterprises and, less frequently, in medium-sized entities focused on infrastructural and industrial domains. It has a large set of tools of financial support instruments; however, regrettably, it does not cater to small businesses.

The Damu Fund acts as the main operator of financial support for small and medium-sized businesses in the republic. It collaborates with various financial organizations to attract investments into SMEs. The fund provides both indirect and direct financial assistance to SMEs. Indirect support is achieved through credit intermediation via second-tier banks, while direct assistance is offered through grant financing, interest rate subsidies on loans and project guarantees.

The Joint-Stock Company «National Agency for Technological Development» (JSC «NATD») conducts grant fi-

nancing of innovative SMEs. JSC «KazAgro», possessing numerous affiliated organizations and a range of tools, provides financial support to SMEs within the agricultural sector.

The Joint-Stock Company «Kazakhstan Investment Fund» participated directly in projects of innovative SMEs.

JSC «Kazakhstan Industry Development Institute» promotes the development of priority sectors of the economy through cost reimbursement for the following activities aimed at supporting SMEs:

- developing and/or examining a comprehensive plan for an industrial-innovation project to obtain leasing financing and techno-economic justification for the projects under the industrialization map;

- enhancing enterprise competence (training and/or re-training of personnel, introducing best production practices by involving experts);

- improving technological processes and the efficiency of the organization of production.

JSC “National Company “Kazakh Invest” provides direct financial support to domestic SMEs by reimbursing a part of expenses incurred in promoting their products to international markets (advertising activities, participation in roadshows, etc.).

JSC “Kazyna Capital Management,” commonly referred to as a fund of funds, is engaged in investing in investment funds that provide support to SMEs.

The industrial sector was chosen as a case study to analyze the entrepreneurship support infrastructure. A matrix of links between the actors providing financial support to SMEs for industrial enterprises in the country was drawn up (Fig. 1).

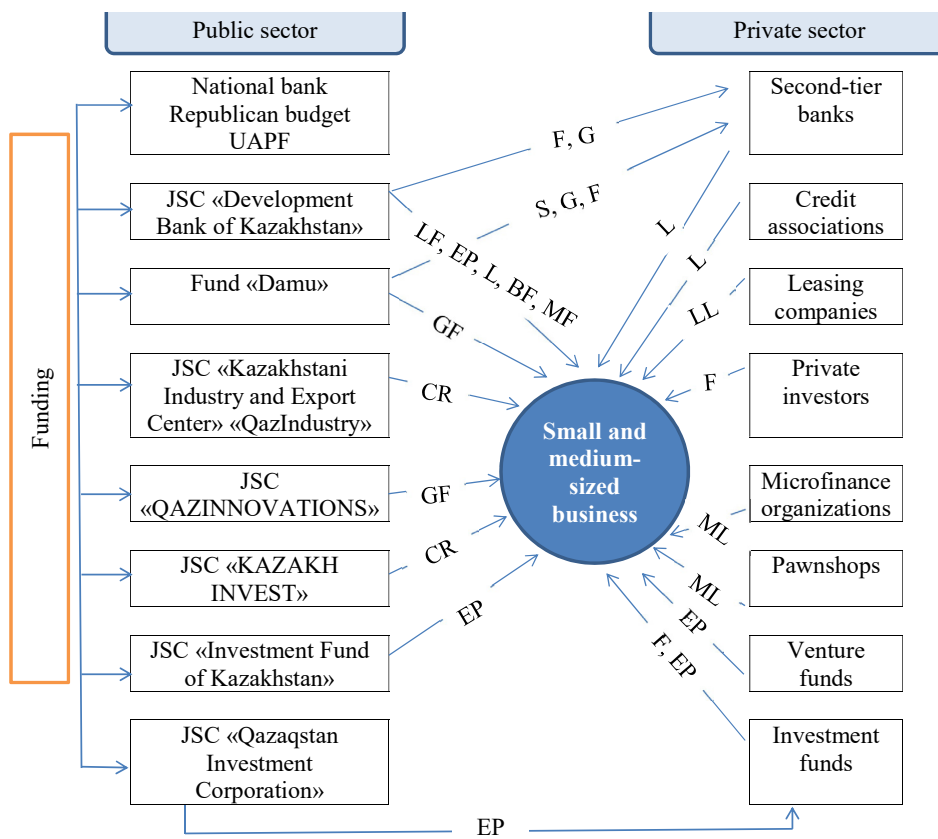


Fig. 1. Opportunities for financial support of SMEs operating in the manufacturing sector: F – funding; G – guarantee; S – subsidizing; GF – grant funding; LF – lease financing; L – lending; BF – bridge financing; MF – mezzanine financing; CR – cost recovery; EP – equity participation; LL – leasing lending

It can be seen that the financial instruments offered by the state to support SMEs in the industrial sector of the Republic include a wide range of measures aimed at facilitating access to additional resources and reducing financial risks. There are at least 16 support entities operating in this sector.

5. 2. Analyzing the development of technological entrepreneurship and its effectiveness

Important components of the innovation infrastructure include technology parks, business incubators, technology transfer centers, business and technology incubators, technoparks, virtual incubators and others.

In the republic, with the involvement of JSC «National Agency for Technological Development» a series of technoparks has been established. Their primary activities encompass technology business incubation, material-technical and advisory support. During the initial stages of creating entities in the realm of innovative small entrepreneurship, these technoparks provide facilities, equipment, offer accounting and tax consultations, engage in informational support, facilitate project management and aid in investment attraction [21].

The implementation and operation of technoparks in the country are carried out using a contemporary European model, characterized by the following features: the presence of a facility capable of accommodating dozens of small companies, which in turn contributes to the formation of a large number of new small and medium-sized innovative enterprises, benefiting from all the advantages of a collective service system; and a system of services provided by companies, encompassing both complex and simple services

that are in demand within the existing structure of innovative enterprises in the service sector. During the period from 2004 to 2016, ten regional technoparks were established with state participation; however, five of them were closed by 2017. The primary activity of technoparks is business incubation in areas such as IT, mining industry, geology, engineering, metallurgy, oil and gas sector, petrochemicals and agriculture.

National technology parks are focused on establishing new high-tech industries in the Republic of Kazakhstan. Among the most well-known regional technoparks are the Almaty Regional Technopark, the «Algorithm» Technopark (Uralsk), and the «UniScienTech» Technopark (Karaganda), all of them were created to facilitate the development of the innovative potential of their respective regions. Two other key features of technoparks are cooperation with large regional enterprises, as well as partnership with leading universities and research institutes.

In addition, specialized economic zones have been established as critical elements of the country’s innovation infrastructure. These zones offer the following support measures: tax incentives (at a rate of 0 % for corporate income tax, land tax, property tax); exemption from customs duties on imports; provision of land plots on a gratuitous basis; priority rights for land acquisition; simplified procedures for hiring foreign labor.

Presently, In the republic hosts 13 special economic zones («Astana – the New City», Astana-Technopolis», «Turkistan», Aktau Seaport, Park of Innovation Technologies, «Ontustik», National Industrial Petrochemical Technopark, «Saryarka», «Pavlodar», «Khorghos – Eastern Gates», «Chemical Park Taraz», International Border Cooperation Center «Khorghos», «Kyzylzhar») and 31 industrial zones.

To implement startup projects, hopes are placed on enhancing the institutional environment, particularly through the establishment of financial institutions and innovation technoparks (AIFC Fintech Hub, Astana Hub, Tech Garden, QazTech Ventures). Additionally, startups addressing pressing technological challenges are offered innovation grants under the condition of mandatory co-financing from businesses. This stands as a positive example of Kazakhstan’s business engagement in technology commercialization and the technological advancement of industries and enterprises [22].

It can be stated that the country has a well-developed ecosystem of technological entrepreneurship. It is expected that through the joint efforts of the public sector, the scientific community and the business sector, the level of innovation activity in small and medium-sized enterprises in the Republic will grow steadily. However, it can be argued that the indicators of innovation activity in SMEs as a primary criterion for technological entrepreneurship development, do not strongly correlate with the scale of state support. Thus, the overall level of enterprise innovation activity in the country is was estimated at 11 % in 2022. Despite a positive trend in the proportion of innovation-active enterprises during the years 2011–2022, the current level is unable to maintain a high rate of innovation and technological advancement in the country. For instance, OECD data for

2020 indicated that the average number of companies implementing new innovative products or business processes in developed countries is was 53 % [23].

The highest values are observed for large businesses at 33.1 %, followed by medium-sized businesses at 20.6 % and small enterprises at 8.5 % (Fig. 2).

Large enterprises demonstrate higher innovation activity not only in comparison to small enterprises but also in relation to medium-sized enterprises. Large businesses are better provided with their own financial resources, higher scientific and technical potential, research infrastructure and more skilled workforce.

Small enterprises as compared to large ones are characterized by the lack of financial resources, the lack of skilled personnel and greater sensitivity to the impact of a factor such as a reduction of solvent market demand in the market because of their focus on consumer service delivery. Kazakh enterprises prefer to acquire ready-made technologies, software and equipment and spend up to 72 % of the amount spent on innovation investment.

The volume of produced innovative goods almost doubled between 2018 and 2022 (Fig. 3) and has demonstrated robust growth rates over the last 20 years. Nevertheless, despite active state regulation of technological development within the real sector of the economy during first decade of industrialization, the proportion of innovative output in relation to the country’s GDP increased marginally from 1.27 % to 1.83 %.

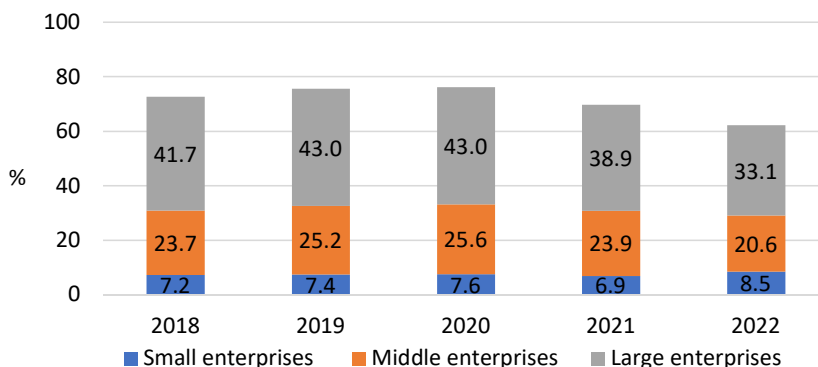


Fig. 2. Level of innovation activity of enterprises depending on size, % Resource: [24]

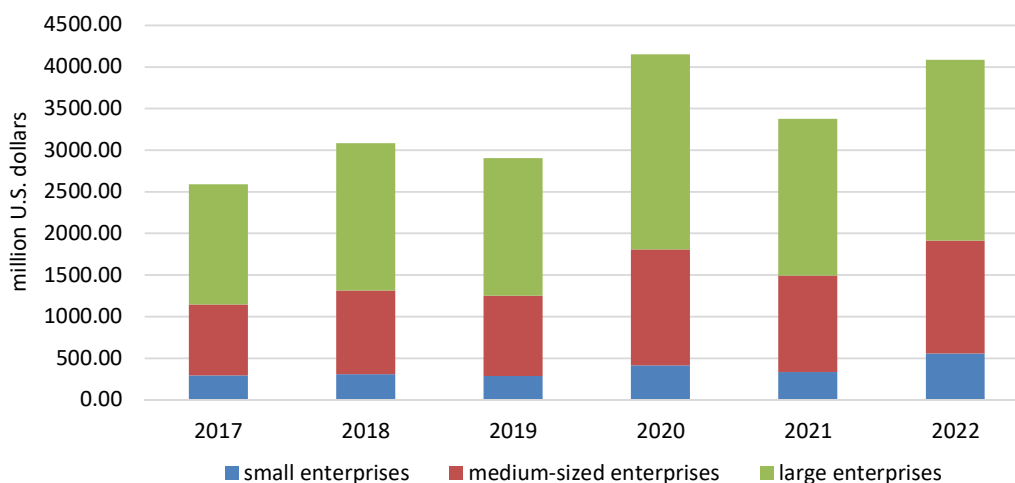


Fig. 3. Volume of innovative products depending on the size of enterprises, mln. tenges Resource: [24]

In 2022, SMEs in the Republic accounted for 37 % of GDP, and the share of active enterprises within this sector accounted for 99.5 %. However, the proportion of innovative product output attributed to this sector is only 18.1 %. Nonetheless, the overall volume of innovative product manufacturing in the country shows growth, though unstable. A positive trend is observed across all business sectors, encompassing both large enterprises and small to medium-sized businesses.

A survey of entrepreneurs conducted by the National Statistical Bureau has shown that among the factors impeding the implementation of innovative activities in enterprises of the Republic of Kazakhstan, the most significant is the lack of financial resources, accounting for approximately 83 % of the total answers. The lack of financial resources from external sources as a barrier was pointed out only by 2.5 % of all respondents. Other reasons are ranked in the following order: excessive innovation-related expenditures (7.5 %), insufficiently skilled personnel (5.1 %), lack of information about technologies (2.0 %).

The potential for a more in-depth analysis of the innovation activity of entrepreneurial entities is limited by the absence of more detailed information in official statistical reports regarding numerous indicators of innovation development, in the context of types of activities, forms of ownership and enterprise sizes. However, the analysis carried out in this study allows to draw a fairly objective picture of the position of entrepreneurship among other branches of activity and its contribution to the process of innovative development within the state economy. It is obvious that the level of development of entrepreneurship in terms of its innovative activity does not meet the requirements of the time and global challenges posed to the country's economy.

5. 3. Analytical assessment of changes in financial and non-financial measures of state support for technological entrepreneurship in the country

As mentioned above, the republic pays great attention to the development of the entrepreneurial sector of the economy. The main areas of state support for SMEs in the country are financial support, including interest rate subsidies, credit guarantees and targeted placement of funds for SME financing. The Government through the “Damu” Fund over the past five years has provided levels of preferential financing for SMEs comparable to those of OECD countries. The budget for SME support programs over a five-year period amounted to 1.677 billion U.S. dollars. These measures made it possible to finance 148,200 SME projects (Table 2).

The budget for the 5-year period for SME support programs amounted to 1.68 billion U.S. dollars:

- 0.96 billion U.S. dollars from state programs such as “Business Roadmap 2025,” “Economy of Simple Things,” “Enbek,” and “Nurly Zher” (subsidies and guarantees);
- 0.71 billion U.S. dollars from international financial institutions (Asian Development Bank, European Bank for

Reconstruction and Development, United Nations Development Programme), revolving funds within the framework of the National Fund of the Republic of Kazakhstan, local executive bodies and other sources of preferential financing.

The indicators presented in the Table 3 were selected as effective factors of the impact of government support measures for small and medium-sized businesses. An important growth resource for small and medium entrepreneurship in the Republic of Kazakhstan is the mobilization of financial resources, particularly loans. Therefore, a primary emphasis within the framework of government programs was placed on expanding SMEs' access to credit resources. The increase in the number of small and medium-sized business entities and new enterprises is a consequence of entrepreneurs' active investment activities; in turn, these new enterprises create new work places, contributing to a reduction in the country's unemployment rate. Additionally, the growth of entrepreneurial tax contributions and the volume of production serve as direct resulting indicators of macroeconomic impact.

Table 2

Indicators of state support for SMEs in the republic

Indicators	2018	2019	2020	2021	2022	2022 in % by 2018
Volume of allocated funds for SMEs, mln. U.S. dollars, total	225.9	277.8	286.6	346.0	540.3	312.5
Conditional investment	123.0	148.2	176.4	136.7	148.6	157.9
Subsidies	93.9	118.2	93.3	156.6	301.4	419.5
Guarantee	9.1	11.4	17.0	52.7	90.3	1303.6
Number of supported projects	11,826	21,810	24,041	33,161	57,357	485.0
Share of manufacturing projects, %	15.7	8.8	10.2	8.4	8.1	51.6

Note: Compiled from the sources [25, 26].

Table 3

Indicators of small and medium-sized enterprises in the RK for 2011–2020*

Indicators	2018	2019	2020	2021	2022	2022 in % by 2018
Number of SMEs (thousand units)	1,146	1,241	1,330	1,357	1,432	125.0
Taxes paid by participants of the SP “DKB 2025” (bln. U.S. dollars)	0.83	0.92	0.97	1.39	1.35	213.0
Number of employed in SMEs (thousand people)	3,190	3,313	3,449	3,370	3,512	110.1
SME output (bln. U.S. dollars)	71.3	76.7	84.6	79.2	98.5	180.5
Production volume of innovative products (mln. U.S. dollars)	2591.2	3084.3	2907.5	4153.8	3377.3	170.3
Share of innovative products in GDP, (%)	1.6	1.7	1.6	2.4	1.7	110.3

Note: Compiled from the sources [25, 26].

Over the previous decade, the indicators pertaining to entrepreneurial development in the Republic of Kazakhstan have demonstrated a consistent and noteworthy advancement. Notably, the growth rates within the Small and Medium-sized Enterprises (SME) sector have exhibited substantial vigor since 2019, surpassing the

overall Gross Domestic Product (GDP) growth rates for the nation, denoting an increase of approximately 4.6 % year-on-year (Y/Y). This conspicuous surge in economic activity within the SME sector has subsequently engendered a proportional augmentation of its share within the national economy. In 2021, this share stood at 33.3 %, representing a noticeable increase from the 32.8 % of the GDP it comprised in 2020. In accordance with the strategic development plan of the Republic, it is aspired that the contribution of SMEs to the country’s economic landscape will reach 35 % by the year 2025. The present indicators indicate a high probability of this goal being achieved earlier than the scheduled target. Concurrently, and against the backdrop of the economic convalescence observed in 2021, along with its continued growth in the early part of the ensuing year, the quantity of enterprises operating within the SME sector has experienced a substantial surge. By the culmination of 2021, the cumulative number of SME entities exceeded 1.4 million, marking a noteworthy increment of 5.5 % from the figure observed in 2020, which had recorded a 2 % augmentation in the same context.

However, in 2020 both in the Republic of Kazakhstan and worldwide, a series of restrictions were introduced due to the COVID-19 pandemic, which had a negative impact on the economy, resulting in a slowdown in the growth rates of production output, new enterprises and businesses, as well as a reduction in tax revenues to the budget. The number of individuals engaged in entrepreneurship also experienced a decrease of 2.29 % in 2020 compared to 2019, which can also be attributed to the implementation of detailed restrictions affecting small and medium-sized business entities. SMEs accounted for approximately 40 % of the total employment in the country’s economy. The employment structure within the SME sector was comprised of 43 % small enterprises, 38 % individual entrepreneurs (IPs), 10 % medium-sized enterprises and 8 % family farms (FEs).

Hence, state support for businesses along with accessible credit resources aided small and medium-sized enterprises (SMEs) in weathering the crisis of 2020 and resuming growth in 2021. The primary indicators of small business activity improved against the backdrop of favorable conditions in external markets and the normalization of the epidemiological situation within the country. In April 2022, the government approved the Concept for the Development of SMEs until 2030. As outlined by government bodies, the implementation of this Concept aims to increase the share of SMEs in the GDP to 40 % by 2030 from the current value of 33 %.

5. 4. Regression model construction, reliability assessment and interpretation

Thus, assessing the activities of entrepreneurship support institutions in the country, it is possible to state the positive effect of investment in this sector, with return indicators showing significant growth, exceeding in some parameters the growth rate of state funding. The objective of the current study is to provide a quantitative assessment of the macroeconomic impact of state support measures on this sector of the economy based on data regarding the operations of the «Damu» Entrepreneurship Development Fund and statistical information on the functioning of entrepreneurship in the Republic.

In order to investigate the impact of state financial support measures, a parallel inquiry was conducted into the influence of state financial assistance volumes. This influence is attributed to the allocation of funds, guarantees and subsidies through the primary operator, the «Damu» Fund on quantitative indicators. These indicators encompass the number of small and medium-sized enterprises, tax contributions, the workforce engaged in SMEs, SME production output and the level of innovative activity among enterprises within the timeframe spanning from 2011 to 2021. The outcomes of regression models are presented in Table 4.

As a result of regression model building, 8 paired regression equations were obtained, meeting the statistical criteria of reliability and validity, for 2 models the relationship was weak, which excluded the possibility of using its results for further analysis and forecasting.

Table 4

Regression analysis of the impact of measures of state support for entrepreneurship on the economy

Factor-attribute (X)	Outcome factor (Y)	Brief description of the dependency model
Conditional investment	Number of SMEs	$y=0.00229x+630.637$, $R^2=88.56\%$
	Taxes paid by the participants of the SP “DKB 2020”	$y=163515.8612\ln(x)-1809297.37$, $R^2=69.53\%$
	Number of employed in SMEs	$y=564.683x^{0.146}$, $R^2=53.29\%$
	SME output (billion tg)	$y=4.126x^{0.572}$, $R^2=50.96\%$
	Level of innovation activity of enterprises	$y=-3.6e^{-10} \cdot x^2+0.000103x+3.421$, $R^2=64.87\%$
Subsidies	Number of SMEs	A weak correlation has been identified in both linear and nonlinear forms. The coefficient of determination (R^2) falls within the range of 515 %
	Taxes paid by the participants of the SP “DKB 2020”	
	Number of employed in SMEs	
	SME output	
	Level of innovation activity of enterprises	
	Number of SMEs	
Guarantees (tenge million)	Number of SMEs	An adequate correlation between the factors has not been established, both in linear and nonlinear formulations. The coefficient of determination (R^2) remains within the range of 20–30 %
	Taxes paid by the participants of the SP “DKB 2020”	$y=105664.8317\ln(x)-879925.0699$, $R^2=83.04\%$
	SME output (billion tg)	$y=709.498x^{0.405}$, $R^2=78.44\%$
	Level of innovation activity of enterprises	$y=2.662x^{0.149}$, $R^2=62.86\%$

6. Discussion of results of the effectiveness evaluation of state support for technological entrepreneurship

The analysis reveals a substantial increase in the number of SMEs in the Republic of Kazakhstan over the past five years, driven by substantial state support and economic growth. It is noted that small businesses in the service sector predominate, underpinned by lower risk, less specialized equipment, and faster capital return (Table 1).

The research underscores the significance of state support for SMEs, which has been a consistent priority, with the Development Program for Small and Medium-Sized Entrepreneurship until 2030 yielding successful results. The state has established financial support mechanisms, including loans, guarantees, and grants, delivered through various entities and institutions. The key actors in this landscape include the Eurasian Development Bank, Asian Development Bank, Development Bank of Kazakhstan, Damu Fund, National Agency for Technological Development, KazAgro, Kazakhstan Investment Fund, Kazakhstan Industry Development Institute, National Company “Kazakh Invest,” and Kazyna Capital Management. Each entity plays a specific role in providing financial assistance, investment, and support to SMEs. In the industrial sector, a comprehensive matrix of links between these entities outlines the various financial instruments available to support SMEs in Kazakhstan, aiming to improve access to resources and mitigate financial risks. A total of 16 support entities operate in this sector, contributing to the growth and development of SMEs in the country (Fig. 1).

The country has established a robust ecosystem, including technology parks, business incubators, and specialized economic zones, promoting innovation. Financial institutions and innovation hubs further enhance the startup environment.

However, there exists a gap between state support and SMEs' innovation activity. Despite some progress, only 11 % of enterprises demonstrate innovation. Financial constraints are the primary barrier, with 83 % of entrepreneurs citing this challenge. While the volume of innovative products has grown, their share of the GDP has seen marginal increase. Large enterprises outperform small ones due to better resources. Small businesses, facing financial constraints, struggle to innovate (Fig. 2).

The Republic of Kazakhstan has made significant strides in supporting small and medium-sized enterprises (SMEs). State initiatives have focused on preferential financing, credit guarantees, and subsidies, resulting in substantial financial support for SME projects. Over five years, these measures have enabled the financing of 148,200 projects, amounting to 1.677 billion USD. The growth of SMEs has been accompanied by increased employment, tax contributions, and production volume, all contributing to macroeconomic progress. These indicators demonstrate the effectiveness of government support, despite temporary setbacks due to the COVID-19 pandemic. The SME sector's robust performance aligns with Kazakhstan's goal to achieve a 35 % contribution to the national economy by 2025, which appears feasible given the current growth trajectory (Tables 3, 4).

Through regression analysis, it was revealed that various factors such as conditional investment, subsidies, and guarantees significantly influence key economic indicators. These factors exhibit both linear and nonlinear correlations with the number of SMEs, taxes paid by program partic-

ipants, the SME workforce, production output, and innovation activity of enterprises. Several strong correlations were identified, indicating the effectiveness of state support measures.

However, not all factors showed equally strong correlations, with a few exhibiting weak relationships. These results provide valuable insights for further analysis and forecasting, allowing for informed decision-making regarding state support for entrepreneurship in Republic of Kazakhstan (Table 4).

Despite a number of the above implications, our study has some limitations. Firstly, there may be bias arising from the estimation since our analysis was based on data for a limited period of time. Alternative methods can be used to evaluate the effectiveness of technology entrepreneurship. Second, the results obtained may reflect some characteristics of one country, as only domestic firms were included in the sample. A cross-country comparative analysis is planned as a future study.

7. Conclusions

1. The development of entrepreneurship and the infrastructure for its state support is of strategic importance for economic growth and diversity in the country. The government is actively working to create an environment that favors the development of small and medium-sized businesses and innovative start-ups.

If to consider the issue of conducting a policy to support small and medium-sized businesses, including technological businesses, the state is taking all necessary steps: legislative and organizational measures are being created, and the necessary infrastructure is being developed. It has been established that in the country financial support of SMEs is realized by 23 entities of the state, quasi-state and private sectors. Support is provided through various instruments, the number of which is commensurate with the number of such instruments in developed countries.

2. The research indicates that there is a fully-fledged ecosystem of technological entrepreneurship in the country. For example, in 2022 the share of innovative companies in the country will be 11 %. However, even though there has been a favorable trend in the share of forward-thinking enterprises from 2011 to 2022, the current level does not match the steady tempo required for innovation and technological progression.

3. The budget of SME support programmes over the last 5 years was KZT 652.4 billion, which is comparable to the amount of funding in OECD countries. The country has seen the emergence of technology startups in various fields including information technology, finance, healthcare and education. These startups often received support from incubators and accelerators, which facilitated their development. The country has invested in the development of infrastructure to support technology startups, such as technology parks and innovation centres.

4. The development of technological entrepreneurship had a significant macroeconomic effect in terms of increased taxes paid, employment, increased production and innovation activity. The authors have developed a methodological approach to the effectiveness of state programmes to support small business, based on a system of regression models. A number of financial instruments to support technological

entrepreneurship have been considered, of which the least impact was made by state subsidies, and the greatest – the discussed placement of funds in second-tier banks.

It was determined that an increase in the volume of state-guaranteed loans by 1 % gives an increase in the innovation activity of enterprises by 0.15 % and output growth by 0.41 %. In addition, it was proved that not all financial measures of state support have an effect – the results of econometric modelling showed that subsidies to SMEs do not have macroeconomic returns, the assessment of which would be statistically reliable. Further effective development of SMEs can be ensured with the help of instruments that have a real macroeconomic effect – development of microfinance, regional guarantee funds, preferential lending through banks and credit organizations, preferential rates on leasing contracts, expansion of venture business.

Conflict of interest

We, the authors of this study, declare that we have no conflict of interest that could influence the conduct of this study and the results presented in this paper, whether financial, personal, author or otherwise.

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Data Availability

Data will be made available upon reasonable request.

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