

IRSTI 06.56.25

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## FINANCING, INNOVATION, AND EXPORT UPGRADING IN KAZAKHSTANI SMES

Small and medium-sized enterprises (SMEs) in Kazakhstan play a key role in economic diversification and job creation, but their innovation and export potential are limited by insufficient access to long-term financial resources. This study aims to analyze the “financing → innovation → export” nexus and identify principles for tailoring a support portfolio that facilitates the transition from simple financing to developing competencies and improving the quality of export products. The empirical framework is built on panel data on SMEs in Kazakhstan for 2015–2024; fixed-effects models and the instrumental variable method (2SLS/IV) are used to account for endogeneity. The results show that attracting external financing statistically significantly increases innovation activity (including R&D intensity and the likelihood of innovation), with a significant portion of the impact of financing on exports mediated through innovation (approximately 40%). The impact varies depending on the type of instrument: grants and venture/co-financing are more associated with product innovation, while guarantees and concessional loans are primarily associated with the modernization of production processes. The greatest effectiveness is observed among medium-sized enterprises in tradable sectors and catching-up regions when combining financial measures with support for standards, certification, and management competencies. The practical implication is the development of recommendations for a modular program architecture that links financial instruments with competency development and a performance management system.

**Keywords:** financing, small business, innovation, export potential, development.

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### Қазақстан шағын және орта бизнестегі қаржыландыру, инновациялар және экспортты жаңғырту

Қазақстандағы шағын және орта кәсіпорындар (ШОБ) экономиканы әртараптандыруда және жұмыс орындарын құруда маңызды рөл атқарады, бірақ олардың инновациялық және экспорттық әлеуеті ұзақ мерзімді қаржылық ресурстарға қолжеткізудің жеткіліксіздігімен шектеледі. Бұл зерттеу «қаржыландыру → инновация → экспорт» байланысын талдауға және қарапайым қаржыландырудан құзыреттіліктерді дамытуға және экспорттық өнімдердің сапасын жақсартуға көшуді жеңілдететін қолдау портфолиосын бейімдеу қағидаттарын анықтауға бағытталған. Эмпирикалық негіз 2015–2024 жылдарға арналған Қазақстандағы ШОБ бойынша панельдік деректерге негізделген; эндогенділікті есепке алу үшін бекітілген әсерлі модельдер және аспаптық айнымалы әдіс (2SLS/IV) қолданылады. Нәтижелер сыртқы қаржыландыруды тарту инновациялық белсенділікті статистикалық тұрғыдан айтарлықтай арттыратынын (ғылыми-зерттеу және тәжірибелік-конструкторлық жұмыстардың қарқындылығымен инновацияның ықтималдығын қоса алғанда), қаржыландырудың экспортқа әсерінің айтарлықтай бөлігі инновация арқылы жүзеге асырылатынын көрсетеді (шамамен 40%). Әсер құрал түріне байланысты өзгереді: гранттар мен венчурлық/бірлескен қаржыландыру өнім инновациясымен көбірек байланысты, ал кепілдіктермен жеңілдік несиелері негізінен өндірістік процестерді жаңғырту мен байланысты. Қаржылық шараларды стандарттарды, сертификаттауды және басқару құзыреттіліктерін қолдаумен біріктірген кезде сауда салаларындағы және қуып жететін аймақтардағы орта кәсіпорындар арасында ең жоғары тиімділік байқалады. Практикалық салдары – қаржы құралдарын құзыреттілікті дамыту мен және өнімділікті басқару жүйесімен байланыстыратын модульдік бағдарлама архитектурасы бойынша ұсыныстар әзірлеу.

**Түйін сөздер:** қаржыландыру, шағын бизнес, инновация, экспорттық әлеует, даму.

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### **Финансирование, инновации и модернизация экспорта в малых и средних предприятиях Казахстана**

Малые и средние предприятия (МСП) Казахстана играют ключевую роль в диверсификации экономики и создании рабочих мест, однако их инновационный и экспортный потенциал ограничен недостаточным доступом к долгосрочным финансовым ресурсам. Цель исследования состоит в том, чтобы проанализировать связку «финансирование → инновации → экспорт» и определить принципы настройки портфеля мер поддержки, которые обеспечивают переход от простого предоставления финансов к развитию компетенций и повышению качества экспортной продукции. Эмпирическая база построена на панельных данных по МСП Казахстана за 2015–2024 гг.; для учёта эндогенности применяются модели с фиксированными эффектами и метод инструментальных переменных (2SLS/IV). Результаты показывают, что привлечение внешнего финансирования статистически значимо усиливает инновационную активность (включая интенсивность НИОКР и вероятность внедрения инноваций), при этом значимая часть влияния финансирования на экспорт опосредуется через инновации (около 40%). Воздействие варьирует в зависимости от типа инструментов: гранты и венчурное/софинансирование в большей степени ассоциируются с продуктовыми инновациями, тогда как гарантии и льготные кредиты преимущественно связаны с модернизацией производственных процессов. Наибольшая эффективность наблюдается у средних предприятий в торгуемых секторах и в регионах-догоняющих при комбинации финансовых мер с поддержкой стандартов, сертификации и управленческих компетенций. Практический вывод заключается в разработке рекомендаций по модульной архитектуре программ, увязывающей финансовые инструменты с развитием компетенций и системой управления результативностью.

**Ключевые слова:** финансирование, малый бизнес, инновации, экспортный потенциал, развитие.

## **Introduction**

Small and medium-sized enterprises (SMEs) are an important source of economic diversification, employment, and strengthening regional resilience. However, in Kazakhstan, as in a number of other middle-income countries, SME expansion in innovation- and export-oriented niches is limited by persistent financial barriers. These barriers are particularly significant for projects based on intangible assets (R&D, design, implementation of standards, and certification): a lack of collateral, high risk, and information asymmetry lead to credit rationing and a shortage of long-term financing. International studies emphasize that financial constraints disproportionately affect SMEs and hinder their innovative development, and that effective innovation support requires a combination of instruments that take into account the risk and specific features of investments in intangible assets (Beck & Demirgüç-Kunt, 2006; Hall & Lerner, 2010; Kerr & Nanda, 2015).

In these circumstances, the question of how financial resources are transformed into innovative activity, and subsequently into expanded exports and improved quality of exported goods and services, is becoming increasingly important, both practi-

cally and theoretically. This is particularly relevant for Kazakhstan, as entrepreneurship support policies are built on a combination of credit and guarantee instruments, subsidies, grant and co-financing programs, as well as export measures and services to enhance companies' readiness to enter foreign markets. However, the mere presence of such instruments does not guarantee high performance: an analysis of the channels of influence and the conditions under which financial measures ensure maximum additionality and contribute to the development of the competencies necessary for export upgrades becomes crucial.

Despite the extensive international literature on SME finance, innovation, and export performance, several important gaps remain. First, most empirical studies consider these relationships separately: access to finance is commonly examined in connection with firm growth or innovation, whereas export performance is more often analyzed through productivity and trade-related factors. Far less attention has been given to the integrated finance–innovation–export mechanism at the firm level, particularly in emerging economies. Second, in the case of Kazakhstan, the available literature and policy reports mainly describe support instruments and aggregate

SME outcomes, but offer limited causal evidence at the micro level on how different forms of financing are transformed into innovation inputs and outputs, and to what extent innovation mediates export upgrading. Third, existing studies rarely differentiate between types of instruments, such as grants, guarantees, subsidized loans, and venture or co-investment mechanisms, and therefore do not show which of them are more strongly associated with product innovation, process modernization, or improvements in export quality. This study addresses these gaps by providing firm-level panel evidence for Kazakhstan, applying fixed-effects and instrumental variable methods to identify causal relationships, assessing the mediating role of innovation, and comparing heterogeneous effects across instruments, sectors, firm groups, and regional contexts.

The purpose of this study is to assess the “financing → innovation → export” relationship at the micro level for SMEs in Kazakhstan and to formulate principles for adjusting the portfolio of public instruments that enable access to financial resources to be converted into the development of technological and qualitative competencies (R&D, product and process improvements, implementation of standards and certification) and, accordingly, into increased export potential and improved export quality. Additionally, the study aims to analyze differences in effects across instrument types and enterprise groups (by size, age, sector, and regional context), as international studies document heterogeneous firm responses to various forms of financing and risk sharing (Hall & Lerner, 2010; Kerr & Nanda, 2015). In this respect, the novelty of the article lies in combining firm-level panel data for Kazakhstan with causal identification strategies to examine not only whether financing matters for SMEs, but also through which innovation channels, and under which combinations of instruments, firm characteristics, and regional conditions, financing contributes to export upgrading.

The methodological framework of the study is based on panel data on SMEs in Kazakhstan for 2015–2024 and incorporates several complementary empirical strategies. First, fixed-effects models are used to estimate the relationship between access to external financing and innovative inputs/outputs, accounting for firm-invariant characteristics and common shocks. Second, to reduce endogeneity risks (reverse causality, program selection), instrumental variable estimation (2SLS/IV) is employed, based on quasi-initial variation in the availability of support measures. Third, a mediation mechanism

is analyzed, allowing for the quantitative isolation of the share of financing’s impact on exports that is mediated through innovation activity. Finally, dynamic specifications of the event study format are used to describe the trajectories of key indicators around the moment of receiving the first support and/or the first innovation, enabling comparison of the “before” and “after” periods.

The article thus provides a cause-based analysis of the conditions under which financial support for SMEs is most effectively transformed into innovative activity and renewal of export activities, and formulates practical guidelines for a more modular, “competence-based” design of programs aimed not only at increasing the volume of lending, but also at sustainable growth in the quality and technological complexity of exported products. Compared with earlier descriptive and policy-oriented studies on SME support in Kazakhstan, this article makes a stronger empirical contribution by identifying causal effects, estimating the share of export outcomes mediated by innovation, and distinguishing between the roles of different financial instruments.

### Literature Review

Small and medium-sized enterprises (SMEs) constitute an important source of job creation and structural transformation. Persistent financial frictions, however, often constrain the extent to which they can contribute to productivity growth (Beck & Demirgüç-Kunt, 2006). Schumpeterian and endogenous growth theories emphasize that innovation by young and small firms is a key engine of creative destruction. At the same time, information asymmetries, weak collateral, and agency problems result in credit rationing and higher costs of external finance. These financial frictions fall especially heavily on SMEs and constrain their development (Schumpeter, 1947; Stiglitz & Weiss, 1981; Beck & Demirgüç-Kunt, 2006). Cross-country evidence shows that stronger and better supervised financial systems are associated with faster firm growth and higher aggregate total factor productivity. These relationships are particularly pronounced in economies where small firms account for a large share of enterprises (Levine, 2005). Dynamic approaches indicate that the growth impact of finance is context-dependent. Relaxing financial constraints yields the strongest effects when firms operate near the technological frontier. In these conditions, they can channel additional resources into innovation-driven upgrading (Aghion *et al.*, 2010).

While the theoretical literature consistently associates financial frictions with weaker innovation incentives in SMEs, more recent empirical studies show that this relationship is not linear and depends on the type of information problem, the capabilities of firms, and the institutional environment. Cross-country evidence also suggests that innovation and digital adoption can improve SMEs' access to finance by reducing information asymmetries and increasing transparency, pointing to a two-way relationship rather than a one-directional effect from finance to innovation alone. At the same time, recent research indicates that the easing of financing constraints does not automatically lead to stronger innovation outcomes unless firms possess sufficient absorptive and organizational capacity. This suggests that the finance–innovation nexus should be understood as conditional and heterogeneous rather than uniform across SMEs (Mushtaq, 2022).

SMEs require different forms of finance at different stages of the innovation cycle, but the empirical literature does not support the assumption that all instruments are equally effective. More recent studies point to heterogeneity in both input and output additionality: some support schemes encourage R&D expenditure and the introduction of new products, whereas others mainly promote equipment upgrading, collaboration, or organizational adaptation, depending on the nature of financial constraints and the type of support provided (Hall & Lerner, 2010; Kerr & Nanda, 2015). Research on European SMEs likewise shows that the effects of innovation support differ across sectors, countries, and policy mixes, and that combining instruments may be more effective than relying on a single source of assistance. At the same time, the literature increasingly emphasizes that non-financial support should not be regarded as a residual or secondary factor, since collaboration frameworks, advisory assistance, and institutional conditions can strongly influence innovation outcomes; in this respect, governance support, access to networks, and project selection may be no less important than capital itself (Hall & Lerner, 2010; Kerr & Nanda, 2015). Debt remains the main form of external finance for firms, yet its usefulness for innovative SMEs is often constrained by information asymmetries and insufficient collateral, which helps explain why guarantee schemes and other risk-sharing mechanisms may produce effects different from those of equity-type instruments (Stiglitz & Weiss, 1981; Levine, 2005). For the purposes of this study, this means that financial instruments should be examined not only in terms of availability, but

also by type and by the specific innovation channel through which they may influence export outcomes (Grabowski, 2020).

In Russia, the system of support instruments combines broad, economy-wide measures with more focused programmes for innovative SMEs. These include guarantee schemes operated by the SME Corporation and various instruments offered by development banks and co-investment funds. Export support is also provided by the Russian Export Center. In addition, mission-oriented platforms such as Skolkovo and the (formerly active) Russian Venture Company seek to attract early-stage equity and strengthen firms' non-financial capabilities (Simachev *et al.*, 2014; Gokhberg, 2023). Evaluation studies show mixed effectiveness: tools tend to deliver better outcomes when access is competitive and time-bound and when private-sector actors are involved in governance, and weaker results when allocation is largely bureaucratic or when monitoring and evaluation systems are underdeveloped (Simachev *et al.*, 2014).

In Kazakhstan, a comparable but more compact mix of instruments has been built around the Baiterek holding. Core components include DAMU's guarantee and interest-subsidy programmes, which ease collateral constraints; the Development Bank of Kazakhstan, which finances larger-scale and capital-intensive projects; KazakhExport's insurance products and export-credit lines; and innovation-focused measures implemented via QazInnovations and the AIFC to encourage venture capital activity and green/blended-finance flows (DAMU, 2024; Baiterek, 2024; AIFC, 2024). Experience also indicates that these financial tools work best when they are complemented by quality infrastructure, support with standards and certification, and management upgrading services, especially for younger enterprises and firms located outside the main metropolitan areas (DAMU, 2024; AIFC, 2024).

This international evidence is important for the Kazakhstani case because it shows that the effectiveness of support instruments cannot be judged solely by their formal availability. Recent empirical studies indicate, first, that innovation and export outcomes depend on the interaction between financial support and firm capabilities; second, that different types of innovation do not contribute equally to export performance; and third, that improved financing conditions may influence not only export entry, but also export quality and upgrading. In particular, evidence from developing and emerging-market firms suggests that process innovation may be especially

important for export performance under constrained institutional conditions, while finance-related improvements can have stronger effects on quality-intensive export outcomes among more productive firms. These findings support the article's focus on both mediation, understood as the finance–innovation–export link, and heterogeneity across instruments, sectors, and firm groups (Edeh, 2020).

Export upgrading is another channel through which finance and innovation shape development outcomes. In heterogeneous-firm trade models, only the more productive enterprises choose to export, and once they enter foreign markets, the pressure of stronger international competition encourages further innovation and movement up the quality ladder (Melitz, 2003). Product-space analyses likewise indicate that countries diversify their export structures by shifting into “nearby” products that rely on existing capabilities, and that appropriately designed financial instruments and support measures can accelerate the shift toward more complex, higher value-added exports (Hausmann *et al.*, 2014).

In Russia, specialised instruments focused on standards, certification, and design are linked to a higher probability of quality upgrading among participating firms, on the condition that they also have access to working capital and risk insurance (Simachev *et al.*, 2014; Gokhberg, 2023). In Kazakhstan, export-related guarantees, subsidised trade finance, and complementary non-financial support measures (standards, marketing, certification) provided by DAMU/KazakhExport and QazTrade are associated with better survival outcomes in newly entered export markets when they go hand in hand with firms' own capability investments – such as process engineering, compliance systems, and brand development – highlighting the complementarities between financial interventions and the build-up of intangible assets (DAMU, 2024; Baiterek, 2024; AIFC, 2024).

Within the finance–innovation–export nexus, the state can play a catalytic role if its interventions are designed to crowd in private investment, address coordination failures, and absorb non-diversifiable risks without weakening market incentives. The concept of “smart” industrial policy underscores the importance of strong horizontal institutions, including effective competition policy, reliable contract enforcement, functional insolvency frameworks, and well-developed capital markets. These should be complemented by vertical, time-limited instruments that address clearly identified externalities in specific sectors or activities (Rodrik, 2004).

Risk-sharing tools such as guarantees, co-investment funds, outcome-based grants, and export credit/insurance can alter the risk–return profile of innovative SME projects while preserving private-sector governance and incorporating built-in sunset clauses (Aghion *et al.*, 2010; Kerr & Nanda, 2015; Rodrik, 2004). Mission-oriented approaches additionally argue for public investment that helps shape and enlarge markets by setting a strategic course, permitting experimentation and learning, and embedding robust monitoring and evaluation mechanisms to avoid capture and ensure real additionality. Kazakhstan's blended- and green-finance pilot schemes at the AIFC illustrate both the potential of these instruments and the demanding governance standards they require (Gokhberg, 2023; AIFC, 2024).

Overall, the literature points to three conclusions that are directly relevant to the empirical design of this article. First, access to external finance can be expected to increase innovation inputs and outputs, although the strength of this effect is likely to differ across firms and institutional environments. Second, innovation should be considered not simply as a parallel outcome, but as a transmission channel through which financing influences export participation and export quality. Third, the effects of support are unlikely to be uniform: equity-type instruments are more often associated with product innovation, whereas credit- and guarantee-based tools may be more important for process upgrading and capability accumulation. These considerations underpin the article's use of firm-level panel models, instrumental-variable estimation, mediation analysis, and heterogeneity tests across instruments, sectors, firm size, age, and regional context.

## Methodology

Our empirical analysis relies on an unbalanced panel of Kazakhstani SMEs for 2015–2024, complemented by a smaller Russian subsample used exclusively to contrast the effects of different support instruments. The core dataset is assembled by linking several administrative and reporting sources at the firm level. The starting point is the business register, which serves as the reference frame for firm identifiers, sector codes, region, year of registration, and size category. This register is combined with annual financial statements that provide information on sales, total assets, leverage, fixed assets, and employment-related indicators; with administrative records from support programmes, including guaran-

tees and interest subsidies from DAMU, grants and co-investment or venture capital instruments from QazInnovations and, where available, the AIFC, as well as export credit and insurance products from KazakhExport; with customs and export records; and with information on innovation and certification activities, including R&D expenditure, product and process innovation, and the adoption of ISO, HAC-CP, and related standards. The linkage is carried out using anonymized firm-level identifiers harmonized across sources. Where direct matching of identifiers is incomplete, additional checks based on sector, region, and reporting year are used to confirm consistency. Observations with unresolved identifier conflicts, duplicate records, or non-overlapping reporting periods are excluded from the final analytical dataset.

The final analytical sample includes 7,500 firm-year observations for Kazakhstan, which correspond to approximately 1,350–1,600 unique SMEs, depending on the specification and the availability of data for particular variables. The panel is unbalanced, since firms enter and leave the sample over time, some enterprises appear only after registration or formalization, and not all administrative sources provide complete annual information for every firm. The dataset covers SMEs from all major regions of Kazakhstan and includes enterprises from manufacturing, tradable services, construction, and domestically oriented service activities. In terms of size structure, the sample broadly reflects the composition of the SME sector, with micro and small firms making up most observations, while medium-sized firms represent a smaller but economically more significant segment. As participation in support programmes and the completeness of reporting differ across firms, the panel should be regarded as broadly informative rather than fully representative of the entire population of Kazakhstani SMEs.

Empirical workflow and replication protocol:

1. Build the panel and align identifiers. Link the business register to financial statements, program participation data, innovation/certification records, and customs/export variables using anonymized firm IDs. Exclude observations with mismatched IDs, non-active firms, and panels with fewer than two consecutive yearly observations.

2. Specify core variables. Construct finance indicators (loan access; credit intensity; receipt of guarantees/subsidies; grants; VC/co-investment), innovation measures (R&D intensity; product and process innovation dummies; standards/certifications), and export outcomes (export participation;

export revenue; unit-value/quality z-score; alternative sophistication metrics).

3. Data pre-processing. Deflate monetary variables to constant prices; winsorize continuous indicators at the 1st and 99th percentiles; classify sectors according to NACE Rev.2; define firm size and age categories; and assign firms to regional types.

4. Baseline fixed-effects estimation. Estimate within-firm FE models for innovation and export outcomes, including firm fixed effects and sector×year fixed effects, with standard errors clustered at the firm level.

5. Causal identification via 2SLS/IV. Run 2SLS regressions using program eligibility thresholds and staggered changes in support intensity as instruments. Report first-stage diagnostics and over-identification tests.

6. Mechanism analysis (mediation). Evaluate the finance → innovation → export pathway using sequential regressions (with fixed effects and an IV-predicted finance index), compute the mediated share, and quantify uncertainty via clustered bootstrap.

7. Dynamic effects (event-study). Estimate lead-lag specifications around the first treatment (support and/or innovation) to check pre-trends and map post-treatment dynamics.

8. Robustness and sensitivity checks. Re-estimate models under alternative outcome definitions, matching procedures, sample cuts, and placebo scenarios; present a pre-defined set of robustness tables and figures.

9. Replication materials. Supply code files, model output logs, and a data dictionary; document R/Stata/Python package versions and random seeds

Let firms be indexed by  $i$ , sectors by  $s$ , regions by  $r$ , and years by  $t$ . The outcome variables comprise innovation inputs and outputs  $Innovi_{it}$  (such as  $R\&Dintensity_{it}$  and product/process innovation indicators) and export outcomes  $Export_{it}$  (export participation, export quality). Financial variables are denoted by  $Fin_{it}$  and capture loan access, the credit-to-assets ratio, and participation in support instruments. The vector  $X_{it}$  contains time-varying firm characteristics (log of sales, leverage, share of tangible assets, age). Firm-specific fixed effects are represented by  $\alpha_i$ , sector-by-year fixed effects by  $\delta_{s \times t}$ , and standard errors are clustered at the firm level.

To improve transparency, the analytical file is constructed through a staged filtering procedure. First, the initial register-based universe is limited to active SMEs observed at least once during the period 2015–2024. Second, firms without a valid

anonymized identifier or with inconsistencies across the core sources are excluded. Third, observations with missing values for the main financial variables, implausible balance-sheet relationships, or discontinuous reporting that prevents panel construction are removed from the baseline regressions, although they may still be included in auxiliary descriptive summaries when key classification variables are available. Fourth, firms with fewer than two usable yearly observations are omitted from fixed-effects estimation, since within-firm identification requires variation over time. As a result, the final panel reflects the intersection of administrative programme records, financial reporting, and innovation and export information rather than the full registry population.

Export-related indicators are constructed from customs records, which provide information on whether firms export, their destination countries, and unit values, as well as an export quality measure derived from standardized unit values and product-complexity metrics (sectoral z-scores based on HS-level classifications). Treatment (“receipt of support”) is assigned at the instrument–year level, and the initial control group consists of non-beneficiary firms located in the same sector–region–size strata.

The representativeness of the sample is assessed along three dimensions: firm size, sector, and region. The sample retains the predominance of micro and small enterprises that is typical of Kazakhstan’s SME structure, while medium-sized firms are somewhat overrepresented relative to their share in the population because they report more consistently and appear more frequently in support and export datasets. In sectoral terms, tradable manufacturing and better-documented service activities are represented more fully than informal or weakly reporting segments. Regionally, all major oblasts and the largest urban centres are included, although firms from metropolitan areas are more likely to have complete linked records. For this reason, the empirical estimates should be interpreted as applying most directly to the formal and reporting-intensive segment of Kazakhstani SMEs, especially those potentially connected to innovation, support programmes, and export activity.

In the baseline specification, we estimate within-firm (fixed-effects) models that relate innovation inputs and outcomes to firms’ access to external finance. This setup allows us to capture both the extensive margin – dummy variables indicating whether the firm obtained a loan, received a grant/

VC/co-investment, or benefited from a guarantee/interest subsidy – and the intensive margin, proxied by the ratio of credit to total assets. Each regression includes firm fixed effects, sector-by-year fixed effects, and a set of time-varying controls (log sales, leverage, the share of tangible assets in the balance sheet, and firm age). Standard errors are clustered at the firm level.

Fixed-effects models (FE). For innovation outcomes we estimate:

$$Innov_{it} = \beta Fin_{it} + \gamma \cdot X_{it} + a_i + \delta_{s,t} + \varepsilon_{it} \quad (1)$$

For export outcomes:

$$Export_{it} = \theta Fin_{it} + \gamma \cdot X_{it} + a_i + \delta_{s,t} + u_{it} \quad (2)$$

When  $I Innov_{it}$  or  $Export_{it}$  is a binary variable (for instance, an indicator for a new-to-market product or exporter status), we estimate linear probability models with fixed effects to keep the specification transparent and comparable across regressions; the estimated coefficients are read as changes in probability in percentage points. For continuous outcomes (such as R&D intensity or the export quality z-score), coefficients are interpreted either as semi-elasticities or as level effects, depending on how the variables are scaled.

To address potential endogeneity (arising from reverse causality, selective participation in support programmes, and measurement error), we additionally estimate 2SLS/IV models. The instrumental variables draw on two sources of plausibly exogenous variation: programmatic eligibility thresholds (for example, cut-offs by firm size, sector, or risk scores) and the phased regional and temporal expansion of guarantee schemes and budget envelopes. Instrument relevance is assessed using Kleibergen–Paap rk F statistics, and the validity of over-identifying restrictions is evaluated with Hansen tests. Evidence on instrument strength and the plausibility of the exclusion restriction – including balance checks around thresholds and placebo tests for pre-treatment trends – is reported in an online appendix.

Instrumental-variable approach (2SLS). We treat  $Fin_{it}$  s endogenous because of potential feedback from outcomes to financing and non-random participation in support schemes. As instruments  $Z_{it}$ , we employ program eligibility cut-offs and the staggered introduction and scaling-up of support intensity across regions and years. The corresponding 2SLS system is:

First stage:

$$Fin_{it} + \pi Z_{it} = \rho \cdot X_{it} + a_i + \delta_{st} + v_{it} \quad (3)$$

Second stage:

$$Innov_{it} = \beta \widehat{Fin}_{it} + \gamma \cdot X_{it} + \alpha_i + \delta_{sxt} + \varepsilon_{it} \quad (4)$$

and analogously for export outcomes  $Export_{it}$ .

For the instruments, we report: first-stage strength using Kleibergen–Paap rk Wald F-statistics (with the usual rule-of-thumb  $F > 10$ ; Hansen J-test p-values in over-identified specifications; balance diagnostics around the eligibility cut-offs for pre-treatment covariates; and placebo regressions with leads of treatment and outcomes to probe the plausibility of the exclusion restriction.

We adopt two complementary approaches to quantify the finance  $\rightarrow$  innovation  $\rightarrow$  exports mechanism.

For the mediation analysis (finance  $\rightarrow$  innovation  $\rightarrow$  export), we measure the indirect effect through innovation using a sequence of regression equations:

$$Innov_{it} = a FinIndex_{it} + \gamma \cdot X_{it} + a_i + \delta_{st} + e_{it} \quad (5)$$

$$Export_{it} = b Innov_{it+l} + c FinIndex_{it} + \eta X_{it} + a_i + \delta_{st} + \xi_{it} \quad (6)$$

In this setup,  $l \in \{0, 1, 2\}$  reflects empirically plausible implementation and commercialization delays that are fixed in advance.  $FinIndex_{it}$  denotes a standardized summary measure of the different finance variables; in the causal specification it is constructed from IV-based predictions of these components to limit endogeneity concerns.

The indirect effect is given by the product  $a \times b$ , while the direct effect corresponds to  $c'$ . The proportion of the total effect that is mediated is calculated as the mediation share.

A methodological limitation is that the mediation analysis relies on composite and proxy-based measures. In particular, the finance index combines several dimensions of external support and financing intensity, while innovation is measured through proxies such as R&D expenditure, indicators of product and process innovation, and variables related to standards and certification. These measures are substantively meaningful, but they may contain measurement error, either because some components reflect reporting practices rather than underlying

ing capability, or because they only imperfectly capture latent constructs such as innovation quality or export upgrading. To minimize this risk, the index is standardized at the component level, estimated both with and without individual components, and re-specified using alternative single-variable measures. In addition, the mediation results are tested against alternative definitions of innovation and export quality, including both narrower and broader sets of proxies, in order to ensure that the main conclusions do not depend on a particular index construction.

t–2 to t+4 around two key milestones: the first observed innovation and the first instance of receiving program support. The specifications include firm fixed effects, sector  $\times$  year fixed effects, and a full set of leads and lags, which makes it possible to test for the presence of pre-treatment trends. We assess heterogeneity by interacting the finance variables with firm size (micro, small, medium), age brackets, sector clusters (export-oriented manufacturing and ICT versus construction and locally oriented services), regional type (large urban centres versus lagging regions), and broad categories of instruments (equity-like tools versus risk-mitigated credit).

In the event-study specification (dynamic effects), let  $E_i$  be the event year (the first year of receiving support or the first innovation). Define event time as  $k = t - E_i$ . We then estimate:

$$Y_{it} = \sum_{k \in K, k \neq -1} \beta_k \cdot 1[t - E_i = k] + \gamma \cdot X_{it} + a_i + \delta_{st} + \varepsilon_{it} \quad (7)$$

Here  $Y_{it}$  denotes the innovation or export outcome,  $K$  is the set of event-time dummies (for example,  $k \in \{-2, -1, 0, 1, 2, 3, 4\}$ , and  $k = -1$  is used as the reference period).

Interpretation. The coefficients  $\beta_k$  show how outcomes differ from the year just before the event.

Pre-trend test. We test the joint hypothesis  $H_0: \beta_{-2} = \beta_{-3} = \dots = 0$ . A lack of significant pre-event coefficients (flat pre-trends) is consistent with a causal interpretation.

Standard errors. Standard errors are clustered at the firm level; results are presented using coefficient plots with 95% confidence intervals.

As robustness checks, we implement propensity-score matching within sector–region–size–age cells; replace the main innovation variables with alternative proxies, including patent filings, software launches, major product redesigns, and narrower measures of certification-based capability upgrading; and use different indicators of export sophistication, including PRODY/EXPY metrics and

changes in the composition of destination markets. We also re-estimate the mediation models by substituting the composite finance index with its individual components and with reduced-form variants that exclude potentially noisy indicators. In addition, firms that simultaneously participate in several support schemes are excluded, and all specifications are re-estimated under alternative rules for outlier treatment and functional form. These checks are intended not only to assess sample sensitivity, but also to reduce the risk that the main findings are driven by measurement error in constructed indices or proxy variables.

Model checking and interpretation:

1. Fixed-effects framework. Identification comes from within-firm changes after netting out sector×year shocks; we examine how sensitive the estimates are to different sets of controls and alternative functional forms.

2. Instrumental-variables framework. We document first-stage strength and over-identification statistics and demonstrate, using placebo and lead specifications, that the results are not driven by differential pre-trends around eligibility rules or expansion episodes.

3. Multiple instruments and treatments. We check that the findings are robust when dropping firms that take part in several support schemes at the same time and when instruments are introduced separately.

4. Measurement sensitivity. We examine whether the main coefficients remain stable under alternative constructions of the finance index, narrower and broader sets of innovation proxies, and different indicators of export quality. We also compare mediation estimates derived from the composite index with those based on separate financial instruments in order to assess whether the indirect effects are sensitive to aggregation choices.

Robustness and sensitivity checks (reported in a unified way).

1. Alternative definitions of outcomes: substitute baseline innovation indicators with patents, software releases, or major product redesigns; replace export sophistication indicators with PRODY/EXPY and measures of shifts in destination markets.

2. Sample restrictions: drop firms that participate in several programs; remove observations with extreme leverage or other outliers; limit the sample to tradable industries; focus on balanced-panel subsets.

3. Matching and selection adjustment: apply propensity-score matching within sector–region–

size–age cells and compare fixed-effects estimates on the matched samples.

4. Placebo exercises: assign fictitious treatment to ineligible cohorts or years and estimate lead effects, which should be close to zero.

5. Robustness of inference: use firm-level clustered standard errors, wild cluster bootstrap when the number of clusters is small in subsamples, and Oster-style bounds to assess the impact of omitted variables.

6. Measurement-error robustness. The core mediation models are re-estimated using alternative versions of the finance index, leave-one-component-out specifications, separate regressions for specific instruments, and simplified proxies for innovation and export performance in order to verify that the mediated effects do not depend on a single operationalization of the underlying latent constructs.

The empirical analysis is implemented in R, Stata, and Python, with fully documented replication scripts and a comprehensive data dictionary. Access to confidential firm-level information remains with the original data holders, and the article reports only anonymized, aggregated results in tables and figures.

All estimation routines are embedded in a unified replication pipeline (from data cleaning and variable construction through baseline FE, 2SLS/IV, mediation analysis, event-study models, and robustness checks). We supply a data dictionary that specifies each variable, the coding schemes for sector/region/firm size, and the exact transformations used (price deflators, winsorization cut-offs). Random components (bootstrapping, matching) are executed with fixed seeds and fully logged. Because the underlying firm-level data are confidential, the original microdata remain with the data providers; the replication package works with anonymized identifiers and generates only aggregated tables and figures that comply with disclosure requirements.

## Results and Discussion

Before proceeding to the econometric results, it is useful to clarify the empirical coverage of the analytical sample. The final panel contains 7,500 firm-year observations and includes SMEs observed repeatedly over the period 2015–2024, covering the main firm-size groups, sectors, and regions of Kazakhstan. Because the panel is unbalanced, the number of firms observed in each year varies, reflecting firm entry and exit, the timing of registration, and

differences in reporting completeness across the linked administrative sources. The descriptive statistics presented below therefore refer to the effective estimation sample rather than to the entire SME population.

The section opens with descriptive statistics for the SME sample. Micro and small enterprises are most numerous, whereas medium-sized firms account for a disproportionately high share of sales,

value added, and exports (Table 1). Financing constraints are more common among younger firms and those engaged in innovation. Innovation activities and certification are highly concentrated and occur more frequently among exporters than among non-exporters (Table 2). Firms receiving support are typically larger, more often active in tradable sectors, and more likely to implement standards and certifications (Figures 1–2).

**Table 1**

*Sample composition and economic contribution by firm size*

Firm size	Share of firms (%)	Share of employment (%)	Share of value added (%)	Share of exports (%)	Mean age (years)	Mean employees
Micro*	58.0	32.0	18.0	7.0	7.2	9
Small	31.0	42.0	38.0	29.0	9.8	34
Medium	11.0	26.0	44.0	64.0	12.4	145
Total	100.0	100.0	100.0	100.0	—	—

\*Micro enterprises are defined as firms with fewer than 10 employees, small enterprises as those with 10–49 employees, and medium-sized enterprises as those with 50–249 employees. Shares sum to 100 within each column. The descriptive statistics are calculated for the effective analytical sample used in the panel estimations rather than for the full population register of SMEs. Because the panel is unbalanced, firm counts and shares are based on pooled firm-year observations unless stated otherwise.

*Note:* compiled by the author based on the analytical sample

Table 1 indicates a pronounced size-related capability gradient. Although micro and small firms account for 89% of all enterprises, medium-sized firms (11% of the sample) generate 44% of total value added and 64% of exports. This pattern im-

plies that policy impact will be greatest when high-potential small firms are supported in crossing key capability thresholds toward medium scale – above all in management, technology, and quality and compliance capacity.

**Table 2**

*Access-to-finance barriers and innovation metrics by exporter and non-exporter firms*

Indicator	Non-exporters	Exporters
Loan rejection or discouragement (% of firms)	27.4	18.1
Collateral-to-loan ratio (% of principal)	142	118
Interest premium over prime (percentage points)	5.1	3.6
R&D intensity (% of sales)	0.8	2.1
Firms with a new-to-market product (%)	9.7	26.8
Firms with process innovation (%)	18.2	37.4
Standards certification (any, % of firms)	21.5	58.6
Average number of certifications (count)	0.3	1.1
Observations (firms)	6.12	1.38

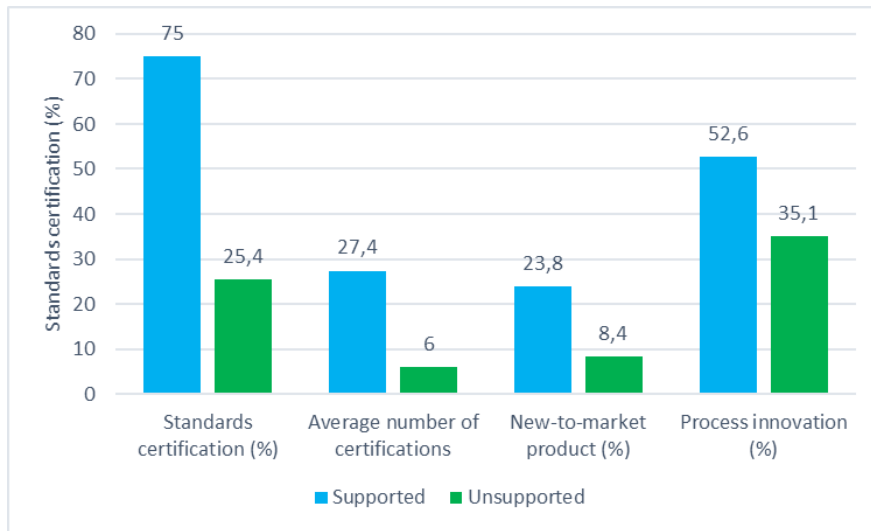
*Note:* Exporter = any positive goods/services exports in the last 3 years. Financing indicators refer to the past 12 months; innovation and certification refer to the past 2 years; author's calculations based on the study sample

Table 2 shows that exporters experience fewer financing constraints and allocate more resources to intangible assets: they exhibit higher R&D intensity, undertake product and process innovations more often, and display markedly higher rates of standards and certification adoption. This configuration aligns with strong complementarities between access to fi-

nance, capability development (R&D/design/compliance), and sustained engagement in export markets.

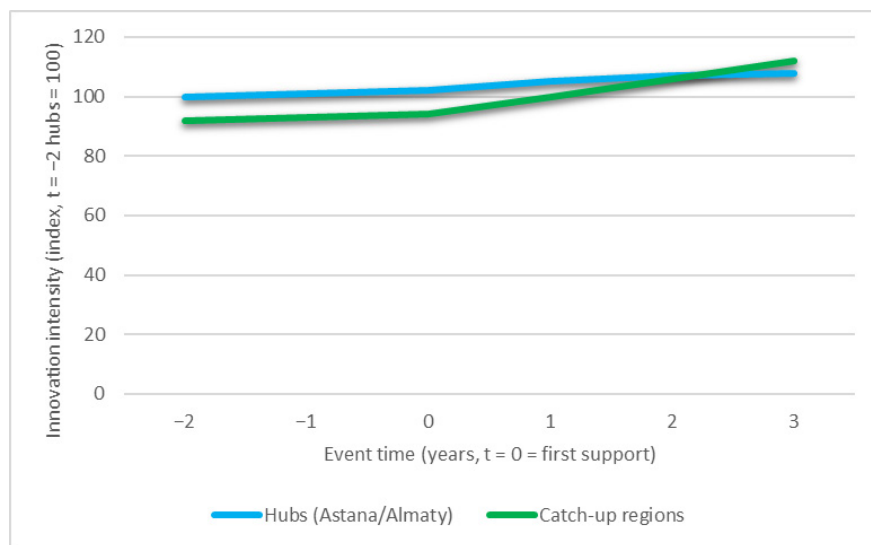
Figure 1 demonstrates that supported SMEs adopt quality standards and certifications more often than non-supported firms, indicating that support is associated with capability development and preparation for export activities.

**Figure 1**  
*Adoption of Quality Standards and Certifications among SMEs with and without Support*



Note: Compiled by the authors based on their calculations using DAMU (2024) and Baiterek (2024).

**Figure 2**  
*Changes in Innovation Intensity Around First Support Episode in Leading Hubs and Lagging Regions*



Note: Compiled by the authors based on a panel database of SMEs and administrative reporting on government support programs from DAMU (2024) and Baiterek (2024).

Figure 2 shows that innovation intensity increases after the initial support episode ( $t = 0$ ) in both leading hubs and lagging regions. The post-support rise is more pronounced in catching-up regions, which points to stronger marginal effects where initial capability levels are lower.

After controlling for firm fixed effects, sector×year shocks, and time-varying covariates,

access to external finance is positively related to R&D intensity and to the likelihood of introducing new products (Table 3). Instrumental-variable estimates exploiting eligibility cut-offs and the phased expansion of guarantee windows remain positive and exceed the corresponding FE–OLS coefficients (Table 4), which supports a causal reading of the results.

**Table 3**

*Fundamental relationships between access to finance and innovation performance (FE–OLS)*

Dependent variable	Loan obtained (t)	Credit/ Assets (t)	Grant (t)	Guarantee/ Subsidized loan (t)	VC/Co-investment (t)	Firm FE	Sector×Year FE	N	R <sup>2</sup> (within)
R&D intensity (% of sales)	0.18*** (0.04)	0.27*** (0.06)	0.42*** (0.09)	0.11** (0.05)	0.55*** (0.12)	Yes	Yes	7,500	0.41
New-to-market product (dummy)	0.031*** (0.009)	0.046*** (0.012)	0.072*** (0.018)	0.014* (0.008)	0.089*** (0.022)	Yes	Yes	7,500	0.28
Process innovation (dummy)	0.027*** (0.008)	0.035*** (0.011)	0.019* (0.011)	0.053*** (0.014)	0.036** (0.017)	Yes	Yes	7,500	0.24

*Note:* Coefficients are marginal effects for dummies (linear probability model with firm FE) and semi-elasticities for R&D intensity. Controls: log sales, leverage, tangible/assets, firm age. Clustered SE at firm level in parentheses. \*, \*\*, \*\*\* denote 10/5/1%; author's estimates based on firm-level panel data.

The pattern reported in Table 3 is analytically important because it shows that financing does not influence innovation in a uniform manner. Rather, different instruments appear to ease different constraints within the firm. Equity-type instruments, such as grants and venture capital or co-investment, are more strongly associated with new-to-market product innovation, which is consistent with the view that high-risk, intangible, and longer-horizon projects require forms of finance that can accommodate uncertainty and delayed returns. By contrast,

guarantees and subsidized loans are more closely connected with process innovation, suggesting that these instruments are more effective when firms pursue incremental upgrading, the modernization of production routines, or efficiency gains related to equipment. This distinction supports the theoretical argument developed in the literature review: the relationship between finance and innovation is instrument-specific and depends on the type of capability being developed rather than on access to liquidity alone.

**Table 4**

*IV/2SLS estimates of how financing affects firms' innovation activity*

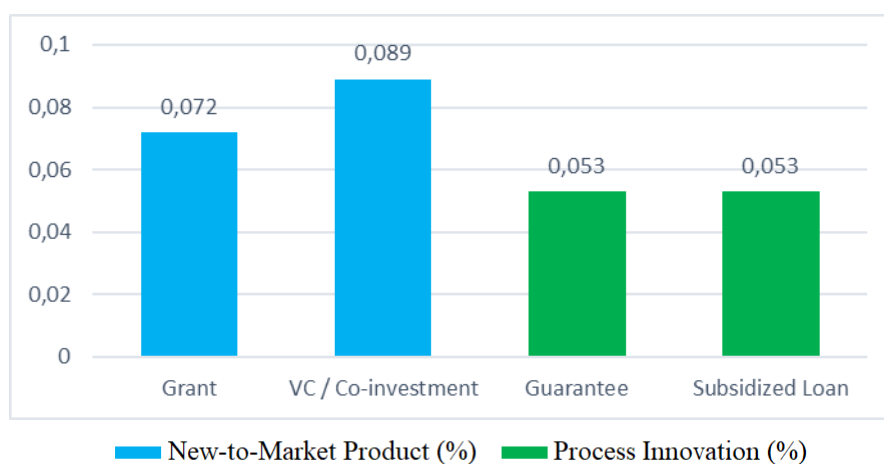
Dependent variable	Endogenous regressor	2SLS coef.	SE	KP rk F (1st-stage)	Hansen p-val.	N
R&D intensity	Credit/Assets (t)	0.44***	(0.14)	23.7	0.31	7.500
New-to-market product	Loan obtained (t)	0.062***	(0.019)	26.5	0.44	7.500
Process innovation	Guarantee/ Subsidized (t)	0.081***	(0.024)	19.8	0.39	7.500

*Note:* Instruments: program eligibility thresholds; staggered expansions of guarantee windows by region×year. All models include firm FE and sector×year FE plus baseline controls. KP rk F = Kleibergen–Paap rk Wald F statistic. Robust SE clustered by firm; author's estimates based on firm-level panel data.

The IV results reinforce the interpretation of financing as a causal determinant of innovation rather than merely a correlate of stronger firms. The fact that the 2SLS coefficients remain positive and, in some cases, are larger than the corresponding fixed-effects estimates suggests that standard models may underestimate the effect of financing, since financially constrained firms are often negatively selected in both observable and unob-

servable characteristics. In substantive terms, this indicates that easing financing constraints may produce the greatest marginal effect precisely in cases where firms are least able to self-finance risky investments aimed at capability development. This finding is consistent with the theoretical expectation that credit frictions are especially restrictive for SMEs engaged in intangible and innovation-related activities.

**Figure 3**  
*Innovation Results by Type of Financial Instrument*



*Note:* Authors' calculations based on panel data of SMEs in Kazakhstan for 2015–2024 and administrative data from DAMU (2024), Baiterek (2024), and AIFC (2024).

Figure 3 provides visual support for an important allocation principle: the effectiveness of policy depends not only on the volume of support, but also on how well a particular instrument matches the technological and organizational task facing the firm. The figure indicates that product innovation and process upgrading should not be regarded as interchangeable outcomes of the same financial intervention. From the perspective of policy design, this means that the choice of instrument should correspond to the structure of firm needs: where the goal is experimentation, design, or product differentiation, equity-type and grant-based

support appears more appropriate; where the goal is modernization, scaling, or compliance-related upgrading, risk-mitigated credit may be the more suitable option.

The mediation analysis shows that innovation is a central transmission channel: around 40% of the effect of finance on exports operates via innovation (Table 5), with higher mediated shares in quality-intensive tradable sectors (Figure 4). Event-study patterns display flat pre-trends and a distinct post-support improvement in innovation and export performance (Figure 5), which is consistent with a causal mechanism.

**Table 5***Mediation and Sequential Effects in the Finance–Innovation–Export Relationship*

Equation	LHS variable	Key RHS variables	Coef. (SE)	N	R <sup>2</sup>
(A) Innovation	R&D finance index (t)		0.29*** (0.06)	7.500	0.37
(B) Export participation	Innovation (t to t+1)		0.085*** (0.020)	7.500	0.22
	R&D finance index (direct)		0.045** (0.018)		
(C) Export quality (unit-value/ quality z-score)	Innovation (t to t+2)		0.21*** (0.06)	6.20 0	0.27
	R&D finance index (direct)		0.09* (0.05)		

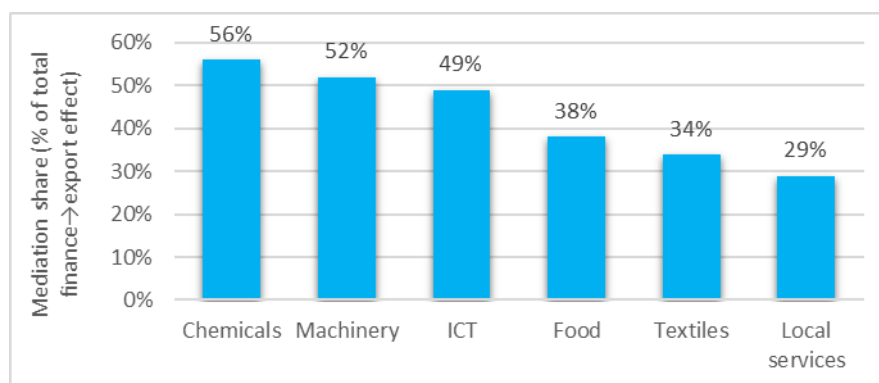
*Note:* R&D finance index = standardized composite of loan obtained, credit/assets, grant, VC/co-investment (IV-predicted components). All equations include firm FE, sector×year FE, and baseline controls. Mediation share = (A×B)/(A×B + direct). Pooled mediation share: 0.41 (quality-intensive sectors: 0.52); authors' estimates based on firm-level panel data.

The mediation results reported in Table 5 move the analysis beyond the standard question of whether

finance matters and instead address how it matters. The finding that around 40% of the finance effect on exports is transmitted through innovation indicates that financing contributes to export upgrading not only by expanding working capital or market reach, but also by enabling firms to accumulate capabilities that are necessary for competing in external markets. This is theoretically important because it supports a capability-based interpretation of SME internationalization: firms do not export more simply because they have more liquidity, but because financing helps them transform liquid-

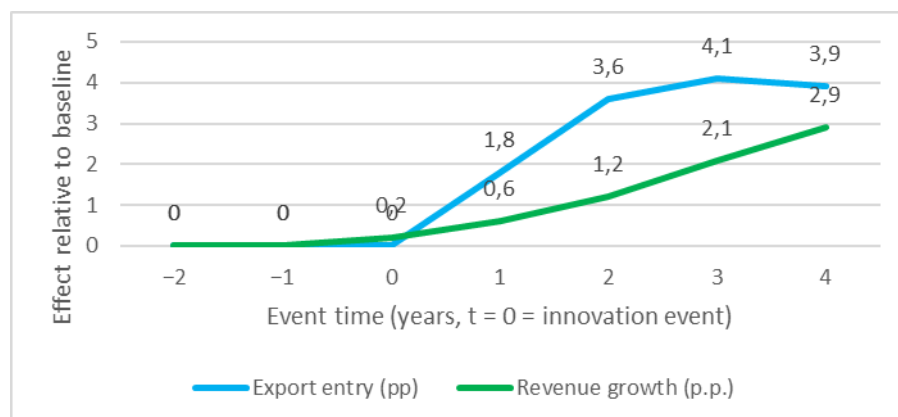
ity into product improvement, process adaptation, certification, and other intangible assets that raise export readiness and export quality. The stronger mediated share in quality-intensive sectors further suggests that the finance–innovation–export nexus is most powerful where competitiveness depends on cumulative capability formation rather than on cost alone.

Figure 4 indicates that mediation through innovation is highest in capability- and quality-intensive tradable sectors and weaker in sectors where exports depend less on R&D and certification.

**Figure 4***Sectoral Distribution of Finance–Export Effects Channelled via Innovation*

*Note:* Authors' calculations based on panel data of SMEs in Kazakhstan for 2015–2024 and administrative data from DAMU (2024), Baiterek (2024), and AIFC (2024).

**Figure 5**  
 Dynamic Profile of Innovation Effects on Export Market Entry and Export Revenue Growth



Note: Authors' calculations based on panel data of SMEs in Kazakhstan for 2015–2024 and administrative data from DAMU (2024), Baiterek (2024), and AIFC (2024).

Figure 5 is consistent with a dynamic interpretation of the innovation process. The delayed response of export entry and export revenues suggests that the benefits of financing are not immediate, which accords with the view that innovation-driven upgrading requires time for implementation, certification, market testing, and commercial scaling. This temporal pattern is analytically important because it helps explain why short-term evaluations may underestimate programme effectiveness: support directed at innovation should not be assessed only through contemporaneous export outcomes when the underlying mechanism operates through capability accumulation and delayed commercialization.

The heterogeneity results show that the marginal productivity of financial support differs systematically across firm groups, which carries important theoretical and policy implications. Medium-sized

firms appear to convert additional finance into innovation and export gains more effectively than micro firms, as they are more likely to possess the organizational base required to absorb new resources. At the same time, small firms demonstrate substantial gains once they pass key capability thresholds, suggesting that the transition from small to medium scale is a strategically important stage for policy intervention. The stronger effects observed in tradable manufacturing, ICT, and catch-up regions further indicate that support generates the highest developmental returns where capability gaps are significant but still capable of being overcome. In this sense, the findings support a selective rather than uniform approach to SME policy: the objective should be not broad financial expansion as such, but the targeted easing of constraints in contexts where finance can stimulate capability upgrading.

**Table 6**  
 IV Results on Heterogeneous Finance Impacts on Innovation and Export Outcomes

Group	R&D intensity ↑ per 0.1 Credit/Assets	New-to-market product ↑ (pp) from VC/Co-investment	Process innovation ↑ (pp) from Guarantee/Subsidized loan	Export quality ↑ (z) via innovation	N
Firm size					
Micro (<10 emp.)	0.26** (0.12)	0.041* (0.022)	0.037** (0.018)	0.08 (0.06)	2.840
Small (10–49)	0.39*** (0.11)	0.067*** (0.020)	0.072*** (0.021)	0.17** (0.07)	3.210
Medium (50–249)	0.53* (0.16)	0.071** (0.030)	0.096* (0.028)	0.24* (0.08)	1.450
Firm age					
Young (<5 years)	0.41*** (0.14)	0.092* (0.026)	0.051** (0.024)	0.19** (0.08)	2.120

Continuation of the table

Group	R&D intensity ↑ per 0.1 Credit/Assets	New-to-market product ↑ (pp) from VC/Co-investment	Process innovation ↑ (pp) from Guarantee/Subsidized loan	Export quality ↑ (z) via innovation	N
5–10 years	0.45*** (0.13)	0.066** (0.027)	0.079*** (0.025)	0.21** (0.09)	2.980
>10 years	0.38*** (0.12)	0.040* (0.023)	0.088* (0.024)	0.16** (0.07)	2.400
Sector					
Tradable mfg. & ICT	0.49* (0.12)	0.081* (0.021)	0.082*** (0.022)	0.28* (0.08)	3.540
Construction & local services	0.31** (0.13)	0.036* (0.020)	0.061** (0.025)	0.10* (0.06)	3.960
Region					
Hubs (Astana/Almaty)	0.42*** (0.11)	0.062** (0.025)	0.074*** (0.022)	0.18** (0.07)	3.650
Catch-up oblasts	0.47* (0.15)	0.070** (0.027)	0.089* (0.026)	0.23* (0.09)	3.850
<i>Note:</i> IV specifications mirror Tables 3–4. Entries are second-stage coefficients with firm FE, sector×year FE, and baseline controls; robust SE in parentheses. ***, **, * denote 1/5/10% significance. “Export quality via innovation” is the coefficient on predicted innovation in the quality equation; authors’ estimates based on firm-level panel data					

Robustness tests show that the key results hold when using alternative measures, different sample constraints, different matching schemes, and placebo distributions, which supports the interpretation of the finance → innovation → export relationship through the prism of the accumulation and development of firm competencies.

The results indicate that SME programmes deliver the largest export-upgrading effects when financial support is directly linked to capability building (R&D, design, standards and certification, managerial improvement). This points to the need to target high-potential small firms that are moving toward medium scale and to give priority to catch-up regions where marginal returns are greater. Supporting quality infrastructure and export-readiness services is essential to turn additional liquidity into durable competitive advantages.

Additional robustness checks show that the mediation results are not driven by a single index specification. The estimated indirect effect running from finance to innovation and then to export remains positive when the composite finance index is replaced with narrower variants, when individual financing instruments are introduced separately, and when innovation and export quality are measured with alternative sets of proxies. Although the size of the mediated share changes somewhat across specifications, the main conclusion remains the same: a substantial part of the export effect of finance operates through the formation of innovation-related capabilities.

The study has several limitations. First, the mediation analysis is based on constructed indices and proxy variables, which may not fully capture latent

concepts such as innovation quality, the depth of organizational upgrading, or the sophistication of export performance. Some degree of measurement error is therefore unavoidable, especially where administrative reporting is uneven or where observable indicators reflect only part of the underlying capability. Second, although alternative index constructions and proxy sets produce substantively similar results, the exact magnitude of the mediated effect should be interpreted with caution. Third, despite the use of instrumental-variable approaches, residual selection bias may still remain. Fourth, the panel horizon does not permit a reliable assessment of the long-term persistence of effects and spillovers. In addition, general-equilibrium mechanisms are not taken into account within the firm-level analysis.

The empirical findings point to several more specific policy conclusions. First, the evidence presented in Tables 3 and 6 indicates that differentiation of instruments should become a central principle in the design of SME support. Grants, venture capital, and co-investment mechanisms should be targeted mainly at younger and innovation-oriented firms engaged in product development, whereas guarantees and subsidized loans are better suited to firms focused on process modernization, equipment renewal, and compliance upgrading. Second, the mediation results in Table 5 suggest that financial support should not be assessed solely through disbursement volumes or short-term firm survival. Since a substantial share of export gains is transmitted through innovation, support programmes should include explicit capability-oriented components, such as certification, testing, design, quality infrastructure, and managerial upgrading, and should

evaluate whether firms transform funding into measurable innovation outputs. Third, the heterogeneity estimates show that targeting is important. The strongest export-upgrading effects are found among medium-sized firms, enterprises in tradable sectors, and firms located in catch-up regions. This indicates that policy should give priority to firms and territories where the marginal return to capability-oriented support is greatest, rather than distributing instruments uniformly across the SME sector. Fourth, the dynamic evidence from the event-study analysis demonstrates that programme evaluation should take time lags into account. Innovation-oriented support is unlikely to generate immediate export gains, so monitoring systems should rely on medium-term indicators that capture the sequence from financing to innovation and then to export upgrading. Taken together, these findings support a shift away from volume-based SME support toward a modular architecture in which instrument choice, capability services, territorial targeting, and evaluation horizons are aligned with the empirically observed mechanisms of upgrading.

Taken together, the results point to a capability-centred reading of the finance–innovation–export nexus in Kazakhstani SMEs: relaxing financing constraints raises innovation inputs and outputs, and a sizeable fraction of the resulting export gains is transmitted through innovation, with the expected lags between innovation and commercialisation. Effects are strongest when support is closely matched to firm needs and complemented by standards, certification and managerial upgrading, particularly for high-potential firms growing into the medium-size segment and for catch-up regions. Overall, the findings argue for a modular package of instruments that links liquidity to measurable capability formation and export-quality upgrading, under transparent governance and clearly defined additionality safeguards.

More broadly, the empirical evidence suggests that the contribution of finance to SME export development is conditional rather than automatic. The results are most consistent with a capability-based interpretation, according to which financing matters because it enables certain firms, in particular sectors and regions, to undertake innovation and quality upgrading that later lead to export gains. This shifts the analytical focus away from the simple logic of “more finance = more exports” and toward the question of how financial instruments interact with firm heterogeneity, institutional support, and the sequencing of capability formation. In this respect, the article contributes not only descriptive evidence on

SME support in Kazakhstan, but also a more structured explanation of why some forms of finance are more developmentally effective than others.

### Conclusion

The results show that easing financial constraints for SMEs leads to concrete capability gains and, with a short delay, to export upgrading and subsequent firm growth. Controlling for rich sets of fixed effects, both access to external finance and the degree of its utilisation are associated with higher R&D intensity and a greater probability of introducing new-to-market products and implementing process improvements; instrumental-variable estimates lend support to a causal reading of these links. The mix of instruments plays a decisive role: risk-bearing, equity-like tools (grants, venture capital and co-investment schemes) are most strongly related to product innovation, while guarantees and subsidised loans are more often connected with process modernisation and investment in machinery and equipment. Roughly 40% of the total finance→export effect is transmitted through innovation – with this share exceeding 50% in quality-intensive tradable industries – indicating that financial support boosts export performance mainly when it fosters the build-up of intangible assets (design, standards, certification) rather than simply scaling up existing operations.

The heterogeneity patterns indicate where policy attention should be concentrated. Medium-sized firms are the most effective at converting additional finance into innovation and stronger export outcomes, while small enterprises show the highest proportional improvements once they pass critical capability thresholds. Younger firms respond more sensitively to equity-type instruments, whereas more established businesses benefit relatively more from partially de-risked credit; the strongest quality upgrading is recorded in tradable manufacturing and ICT. In less developed regions, the marginal effect of finance is higher when it is bundled with non-financial assistance (standards, export-readiness, managerial upgrading). The time profile of effects is also intuitive: innovation typically precedes export entry by about one to two years, after which revenue growth accelerates, reflecting the lag needed for commercialization and market expansion.

For Kazakhstan’s policy architecture, the evidence argues for a modular toolkit that ties liquidity provision directly to capability development at the firm level. In practice this implies:

- expanding competitive VC/co-investment facilities and results-based grant schemes aimed at young, innovation-driven enterprises;

- widening guarantee programmes and asset-backed credit to finance process upgrading in more established SMEs;

- systematically integrating complementary services – quality infrastructure, certification support, IP assistance and export-readiness coaching – into financial interventions;

- prioritising high-potential small firms on a path toward medium size, as well as lagging regions where the additional impact of support is highest.

Governance mechanisms should uphold additivity and crowding-in by means of transparent eligibility criteria, time-bound support, clearly specified KPI frameworks (covering innovation inputs and outputs, export quality and mobilised private investment), and robust ex-post impact evaluations with results disclosed to the public.

Several reservations qualify the interpretation of these results. The available indicators of innovation and export quality are noisy and only indirectly

reflect underlying capabilities; selection effects and unobserved shocks cannot be fully excluded; and long-run general-equilibrium adjustments (such as exchange-rate dynamics or emerging input bottlenecks) lie outside the scope of this work. Future research should extend the time horizon to judge persistence and spillovers, exploit sharper policy discontinuities for identification, and analyse how financial support interacts with public procurement and green-transition instruments. Even with these constraints, the evidence reinforces a capability-centred view: when carefully structured finance is paired with standards-related assistance and managerial upgrading, Kazakhstan can accelerate export-led development and secure lasting productivity gains. Nevertheless, the stability of the main results across alternative proxy definitions and index constructions suggests that the central findings are not tied to any single operationalization of the mediation mechanism.

#### Conflict of interest

There is no conflict of interest.

#### Author contributions:

AAN – conceptualization; theoretical framework development; supervision; formal analysis; interpretation of results; writing – original draft; writing – review and editing.

BDA – methodology; data curation; dataset preparation for empirical analysis; formal analysis; interpretation of results; writing – original draft; writing – review and editing.

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*Received: 8 January 2026*

*Accepted: 20 March 2026*