

ANNOTATION

**to the dissertation work of Shuren Toktar Kuandykuly on the topic
“Features of the diversification of Kazakhstan’s export basket in the
context of digitalization: assessment methodology and implementation
mechanisms”, presented for the Doctor of Philosophy degree (PhD)
on the educational program 8D04101 – Economics**

Relevance of the research topic.

According to the National Statistics Bureau, crude oil and petroleum products accounted for the largest share of exports in 2023 (53.8%), indicating a critically high dependence of foreign exchange earnings on the state of commodity markets. This structure increases the economy's vulnerability to external shocks and creates procyclicality in macroeconomic indicators: fluctuations in commodity prices are reflected in the dynamics of export revenues, budget revenues, and investment opportunities, hindering long-term planning and increasing the risks of macroeconomic instability.

The relevance of this issue is heightened by the fact that the resource base for commodity specialization is not infinite. International assessments emphasize the finite nature of reserves: for example, in its energy profile for Kazakhstan, the IEA cites oil reserves sufficient for several decades at current production rates (reserves-to-production). Even if Kazakhstan retains its status as a major oil producer (including proven reserves of around 30 billion barrels), long-term sustainable development cannot rely solely on expanding production: as “easy” reserves are depleted, capital intensity and costs increase, and strategic risks are compounded by external structural shifts in demand. Following this logic, international institutions directly link Kazakhstan's economic sustainability to the need for diversification and reduced oil dependence.

Additional impetus is provided by government priorities and the official reform agenda. The messages of the President of the Republic of Kazakhstan emphasize that raw material dependence remains a systemic problem, and economic diversification and digitalization are explicitly identified as key areas of development and complementary vectors of modernization. The address of September 2, 2024, specifically states that the country has been set on a “new vector of development” designed to give “new impetus to economic diversification,” while emphasizing the need to change the structure of the economy and launch a new investment cycle. These guidelines are consistent with state planning documents: the Kazakhstan-2050

strategic course focuses policy on sustainable qualitative growth, technological modernization, and increased competitiveness, while digital infrastructure is consolidated through separate national priorities.

At the same time, the empirical scale and channels of influence of digitalization on the diversification of the export basket remain insufficiently researched for the Republic of Kazakhstan, and there is no single comparable toolkit that would allow for a quantitative link between digital development and structural changes in exports in dynamics. In this regard, this study, based on the adaptation of the composite digitalization index (KZ-DESI) and the application of diversification/concentration indices (HHI, Theil, Gini), is timely and in demand: it provides a transition from declarative theses to a measurable assessment of the role of digital factors and allows identifying key bottlenecks in digital transformation that limit the expansion of the non-resource export base.

The degree of scientific development of the research problem.

The issue of export basket diversification occupies a stable place in theories of international trade and economic development and is interpreted as a key mechanism for structural transformation and increasing resilience to external shocks. Along with classical ideas about specialization, contemporary literature emphasizes the dynamic nature of competitiveness and the role of technology accumulation, human capital, and institutions in the formation of new export niches. Approaches that interpret diversification as a process of expanding production capabilities and developing related products are of significant methodological importance, as they explain differences in the speed and depth of structural shifts. For resource-dependent countries, the theoretical framework is complemented by the concepts of the “resource curse” and “Dutch disease,” according to which the concentration of exports in raw materials can reinforce structural inertia, increase volatility, and hinder the development of non-resource sectors.

Foreign research has produced a significant body of work on measuring diversification, identifying its factors, and analyzing the characteristics of resource economies. In recent years, there has been rapid development in the field of assessing the impact of digitalization and ICT on the structure of exports: digital technologies are seen as a factor in reducing transaction costs, accelerating innovation, expanding firms' access to markets, and increasing exports of services. At the same time, empirical results often depend on the initial conditions of the country and the metrics of digitalization and diversification used.

Kazakh studies mainly focus either on the problems of commodity specialization, export concentration, and industrial and export policy instruments, or

on the digital transformation of the state and business (infrastructure, services, digital skills, and technology adoption in enterprises). However, these areas are more often developed in parallel: digitalization and diversification are analyzed separately, without a single verifiable model of interrelationships and a comparable quantitative assessment of effects.

As a result, a significant gap has been identified in research on the link between digitalization and diversification as it applies to resource-dependent economies, especially in the context of Kazakhstan and Central Asia. The channels through which digitalization influences changes in the export structure, approaches to jointly measuring digital development and multifaceted diversification, and rigorous empirical assessments that take into account resource rents, external shocks, and possible bilateral causality are insufficiently developed. This research gap justifies the need for a comprehensive approach that combines the measurement of digitalization and diversification and subsequent econometric testing of their interrelationship using data from Kazakhstan.

The purpose of this dissertation research is to identify key problems and features of the diversification of the export basket of the Republic of Kazakhstan in the context of digitalization and to justify the role of digital technologies as a tool for accelerating it by developing methodological approaches to assessing the impact of digitalization and determining the mechanisms of its impact on structural shifts in exports.

To achieve this goal, the following tasks have been formulated:

1. To reveal the economic essence and evolution of the conceptual apparatus of export basket diversification as applied to resource-dependent economies; to clarify the content of basic categories and identify the main types of diversification.
2. To determine the place and role of digital technologies in the system of factors influencing export diversification and to substantiate the conceptual logic of the relationship between digitalization and structural changes in the export basket.
3. To summarize foreign experience and methodological approaches to assessing the impact of digitalization on the structure and diversification of exports; identify the models, indicators, and research solutions most applicable to the conditions in Kazakhstan.
4. Assess the level and dynamics of diversification of the export basket of the Republic of Kazakhstan based on a system of quantitative indicators; identify key structural constraints and factors of sustainable export concentration.

5. Assess the level of digitalization of the economy of the Republic of Kazakhstan using integral and component indicators; determine the parameters of digital readiness that are most significant for the expansion of non-resource exports.

6. Perform a cluster analysis of countries around the world based on indicators of export diversification and digital transformation in order to typologize digital diversification trajectories, identify comparable groups of countries, and position Kazakhstan relative to leading clusters and comparable countries.

7. Assess the impact of digitalization on the diversification of the Republic of Kazakhstan's export basket using econometric tools; establish the statistical significance and economic interpretation of the effects obtained, and test their robustness under alternative specifications.

8. Improve the methodological tools for assessing the digital diversification of exports based on the author's DLI index; compare its sensitivity with traditional concentration and diversification indices and justify the directions of its applied use for the export structure of Kazakhstan.

9. Justify the priority areas and tools for diversifying Kazakhstan's export basket in the context of digitalization and develop an organizational and economic mechanism for implementation and monitoring, including a set of policy measures, a KPI system, and a data-driven scenario adjustment logic.

The object of the dissertation research is the macroeconomic system of the Republic of Kazakhstan in terms of its export diversification and economic transformation.

The subject of the dissertation research is a set of theoretical and methodological provisions and applied aspects of research that reveal the essence and directions of development of export basket diversification based on the active use of digitalization tools.

The theoretical and methodological framework of the study combines the provisions of modern theory of international trade and economic development, revealing the nature of specialization and mechanisms of structural transformation. The work is based on the ideas of classical and neoclassical approaches to comparative advantages and factor endowments, as well as on the developments of the “new” and “nearest” trade theory, emphasizing the role of technological heterogeneity of firms, scale, trade costs, and inclusion in global value chains. A complementary conceptual block is provided by theories of endogenous growth and innovative development, where technological change and institutions are seen as sources of increased economic complexity and expansion of the export range. To interpret the characteristics of resource-dependent economies, the theoretical tools of

the “resource curse” and “Dutch disease” are used to explain how the dominance of the raw materials sector and rent-seeking mechanisms reinforce export concentration and limit the development of non-raw materials industries. The link between “digitalization and diversification” is revealed through the approaches of the digital economy and transaction cost theory: digital technologies are interpreted as a factor in reducing information barriers and fixed costs of entering foreign markets, accelerating the coordination of supply chains, and scaling non-resource exports, with key importance attached to the integration of digital technologies into business processes and foreign trade operations.

The methodological framework of the research is based on systematic and comprehensive approaches that allow export diversification to be viewed as a multidimensional result of the interaction of structural factors (resource rent, macro conditions, and competitiveness), the institutional environment, and digital transformation. For quantitative operationalization, index and comparative-analytical approaches are used: the diversification of the export basket is measured by a set of concentration and unevenness indicators (HHI, Theil_norm, Gini), which ensures the comparability of results and takes into account the different sensitivity of indices to the distribution of export shares. The level of digitalization is assessed using the KZ-DESI integral index (adapted to the conditions of Kazakhstan) and ICT indicators, with the possibility of decomposition by components (including the application of digital technologies in business) to identify channels of impact on the export structure. To analyze the trajectory and “proximity” of potential product niches, product space logic and density indicators are used, which allows diversification to be interpreted as a process of developing technologically related areas.

The empirical part of the study is based on economic-statistical and econometric methods of testing the formulated hypotheses: analysis of time series and/or panel data, evaluation of models taking into account dynamics and possible long-term relationships, diagnosis of the stability of estimates, and comparison of results using alternative diversification metrics. The information base consists of official and generally accepted statistical sources on foreign trade and digital development, as well as national data necessary for constructing KZ-DESI. The reliability of the conclusions is ensured by comparing the results across several diversification indices, sensitivity checks, and interpretation of estimates, taking into account the structural specifics of the resource-dependent economy and the dominance of the raw materials segment in exports.

The scientific novelty of the dissertation research is determined by the theoretical, methodological, and applied results obtained by the author, which collectively advance scholarly understanding of the specific features and challenges of diversifying Kazakhstan's export basket under conditions of digital transformation. The main provisions reflecting this novelty are as follows:

1. A conceptual model of the impact of digitalization on export diversification in resource-dependent economies has been developed and theoretically substantiated, taking into account channels of commodity specialization and manifestations of the "Dutch disease." The model enables a proper interpretation of the constraints and drivers of structural transformation of the export basket and incorporates digital factors into the explanation of persistent export concentration.

2. An integrated methodology for a comparable quantitative assessment of Kazakhstan's export-basket diversification has been developed. It is based on harmonizing alternative indicators within a unified interpretive framework and on structurally segmenting the export basket into total, non-oil, and non-resource components. This strengthens the validity of conclusions about the effect of digitalization under conditions of strong commodity dominance.

3. A continuous digitalization measure, KZ-DESI, has been adapted and computed for 2008–2023 based on the DESI methodology, providing a time-comparable assessment of digital transformation for subsequent econometric analysis of its relationship with export diversification.

4. A diversification index (DLI; scale 0–1) based on a normalized coefficient of variation has been proposed and empirically tested, increasing the sensitivity of assessment to early and intermediate structural shifts compared with traditional concentration measures.

5. The methodological design of econometric identification of the impact of digitalization on diversification for a resource-based economy has been improved by accounting for external oil shocks and segmenting the export basket.

6. An approach to channel (component) decomposition of the digital effect has been developed, providing a quantitative assessment of the contributions of digitalization components while accounting for the dynamic properties of time series, robustness of standard errors, and control of multicollinearity. This approach makes it possible to identify the most significant digitalization mechanisms and substantiate targeted policy measures.

7. A typology of countries based on cross-country cluster analysis has been proposed, combining indicators of diversification and digital transformation, as well as a parameter capturing the conversion of digitalization into diversification. This

expands the toolkit for comparative diagnostics and for positioning Kazakhstan relative to groups of peer countries.

8. An organizational and economic mechanism for shaping and monitoring the digital diversification of the export basket has been developed. It systematizes public policy instruments by channels of impact, proposes a unified KPI system and a dashboard-based monitoring framework, and introduces a scenario-based feedback loop for adjusting measures based on indicator dynamics.

Main Provisions of the Dissertation Submitted for Defense

1. A quantitative diagnosis of the commodity vulnerability of Kazakhstan's export model was performed on data for 2008–2023, showing statistically significant sensitivity of export revenues to an external oil shock and the persistence of the exchange-rate channel, which explains the reproduction of high export concentration and forms a structural constraint for diversification.

2. A comparable multi-index methodology for assessing export diversification was tested (UN Comtrade, 2008–2023), including the alignment of alternative indicators to a unified interpretive scale and a structural decomposition of the export basket into segments (total, non-oil, non-resource). It was established that the non-oil and non-resource segments are characterized by a consistently higher level of diversification compared with total exports.

3. A continuous digitalization index KZ-DESI for 2008–2023 was formed and calculated on the basis of the EU DESI methodology, providing a time-comparable measure of digital transformation for econometric assessment of its relationship with export diversification.

4. Based on ARDL models, with control for the external oil shock and export segmentation, a long-run relationship between diversification and digitalization was established for the non-oil and non-resource contours; for total exports, a stable long-run effect of digitalization is not statistically confirmed, which reflects the dominance of the commodity sector and the “damping” of the digital effect at the aggregated level.

5. A component (channel) decomposition of the impact of digitalization on Kazakhstan's export diversification (2008–2023) was performed, and it was quantitatively shown that the most significant mechanism is associated with the integration of digital technologies by business, with complementary support from infrastructural connectivity and digital public services.

6. A cross-country cluster analysis of 53 countries by indicators of diversification and digital transformation was conducted (including an assessment of the “conversion” of digitalization into the expansion of export nomenclature), and 4

stable types of economies were identified. It is shown that Kazakhstan belongs to the group of resource-oriented countries with moderate digitalization, but low diversification and weak translation of digital improvements into structural export shifts.

7. An index DLI (0–1) based on a normalized coefficient of variation of shares across the full set of commodity positions (including zero ones) was proposed for use and tested, providing increased sensitivity to early and intermediate structural shifts of the export basket under gradual non-resource diversification.

8. Based on the product space approach, priority directions for diversification of Kazakhstan’s export basket under digitalization were substantiated and ranked, and a sector-specific package of digital implementation instruments was formed; recommendations were developed on the organizational-economic mechanism and the monitoring contour of digital diversification, where policy instruments are structured by channels of impact and linked to the KPI/dashboard system and a scenario logic for adjusting measures on the basis of data.

The theoretical significance of the dissertation research lies in advancing scholarly understanding of the mechanisms shaping export diversification in resource-dependent economies under conditions of digital transformation. The study expands the conventional theoretical framework, in which diversification is explained primarily by factors of production, the institutional environment, and technological progress, by incorporating digitalization as an independent structural factor affecting the export structure through the reduction of transaction and information costs, changes in firms’ organizational capabilities, and accelerated entry into new product niches. Accordingly, the interpretation of export structural transformation is refined as a process determined not only by resource rents and macroeconomic constraints (“Dutch disease”), but also by the level of the economy’s digital maturity and the degree of digital integration of business.

The theoretical contribution also consists in refining and comparing approaches to measuring export-basket diversification. It is substantiated that different concentration and inequality indices (HHI, Theil_norm, Gini) capture different aspects of the distribution of export shares and respond differently to changes under conditions of strong commodity dominance. This complements the methodology of export-structure research and improves the correctness of interpreting results for economies with pronounced export concentration. In addition, an emphasis on the integration of digital technologies into business processes as a key transmission channel makes it possible to уточнить the theoretical model of the “digitalization–diversification” relationship, separating infrastructural effects of

digital development from the effects of the actual adoption of digital solutions at the firm level and in foreign trade operations.

Overall, the research provides a more coherent theoretical foundation for further studies aimed at explaining the heterogeneity of digitalization effects in countries with high resource rents, and it establishes a framework for comparative analysis of the structural and institutional conditions under which digital transformation can be converted into sustained expansion and increasing sophistication of the export basket.

The practical significance of the dissertation research

The practical significance of the dissertation research is determined by the possibility of using the obtained results and the developed instruments in designing and evaluating public policy in the areas of digital transformation, industrial development, and export promotion of the Republic of Kazakhstan. The proposed approach to the joint measurement of digitalization and export-basket diversification enables regular monitoring of structural shifts in exports, identification of vulnerabilities related to commodity concentration, and a quantitative assessment of the extent to which digital changes are “converted” into the expansion of non-resource exports. This strengthens the evidence base for managerial decision-making in implementing the priorities of national digitalization programs and measures to support non-resource exports.

The research results may be used by authorized public bodies and development institutions when refining mechanisms to stimulate export diversification, in particular when designing instruments aimed at reducing barriers for firms’ entry into foreign markets through digital solutions (e-commerce, digital contract support, electronic certification procedures, digital logistics, integration with customs and trade platforms). Identifying the component “Application of digital technologies in business” as the most “applied” channel of digitalization impact makes it possible to prioritize support measures for business digital transformation more precisely, focusing them on the adoption of digital management systems, data, and supply chains, rather than only on expanding infrastructure and connectivity.

The methodological results of the study (algorithms for calculating diversification indices, approaches to decomposing digitalization, and methods for testing the robustness of estimates under high export concentration) can be applied in the analytical practice of ministries, monitoring centers, and research organizations to prepare forecasts, scenario assessments, and to substantiate program documents in the field of industrial and export policy. In addition, the dissertation materials and findings can be used in the educational process when developing teaching and

methodological materials for disciplines related to economic policy, foreign trade, the digital economy, and applied econometrics.

Approbation of the research results

The results of the dissertation research have been widely disseminated through scholarly publications: a total of 7 works have been published, including 3 articles in journals recommended by the Committee for Quality Assurance in Science and Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan (CQASHE/MSHE RK); 1 article in a Scopus-indexed first-quartile (Q1) journal with an 80th percentile; and 2 articles published in the proceedings of international conferences.

Description of the doctoral candidate's contribution to each publication

1. Diversification of business through digital technologies: case study of kazakhstan industrial companies // Economics - innovative and economics research journal. - 2025. - №13(3). - P. 429-448. Contribution of the doctoral candidate - 60%.

2. Digital transformation and the relationship with economic growth // Bulletin of Karaganda University. Economy Series. - №4(108). - 2022. - P. 112-125. Contribution of the doctoral candidate - 70%.

3. Бәсекелестік тенденцияларын салыстырмалы талдау үшін мәтінді интеллектуалды талдау технологиясын қолдану // Қарағанды университетінің хабаршысы. Экономика Сериясы. - №4(112). - 2023. - Б. 213-228. Contribution of the doctoral candidate - 60%.

4. The evolution of business ecosystems: A text mining-based analysis of innovation and competition (1993–2023) // Bulletin of Karaganda University. Economy Series. - №1(117). - 2025. - P. 52-63. Contribution of the doctoral candidate - 60%.

5. Digital marketing strategy for the future // Digital economy: new business architectonics and transformation of competencies: Collection of materials of the International Scientific and Practical Conference. - Karaganda, 2021.-P.122-124. Contribution of the doctoral candidate - 70%.

6. Infonomics: The Digital Age and prospects of the world economy // Digital economy: new business architectonics and transformation of competencies: Collection of materials of the International Scientific and Practical Conference. - Karaganda, 2022.-P.194-198. Contribution of the doctoral candidate - 70%.

Structure and volume of the dissertation

The dissertation consists of an introduction, a main body comprising three chapters, a conclusion, a list of references, and appendices. The total length of the work is 206 pages and includes 31 tables, 13 figures, and 2 appendices. The list of references contains 133 sources.

In Chapter 1, the author conducts a systematic study of the theoretical and methodological foundations for analyzing export diversification under digitalization. The evolution of scholarly approaches to diversifying the export basket of

resource-dependent economies is examined; the mechanisms of commodity specialization and manifestations of the “Dutch disease” are explained; and the research linkage “digitalization–export diversification” is substantiated as a factor of structural transformation. Methods for measuring export concentration and diversification are systematized; principles for interpreting the indicators are уточнены; and the need to distinguish export-basket contours (total, non-oil, non-resource) is justified. As a theoretical and methodological outcome, a conceptual model of the channels through which digitalization affects export diversification is developed, and the logic for integrating digital factors into the subsequent empirical analysis is defined. The results of Chapter 1 establish the theoretical foundation of the study and serve as a basis for constructing measurement indices and for econometric testing of hypotheses in the following chapters.

In Chapter 2, the author performs a comprehensive empirical analysis of the export structure and digital transformation of the Republic of Kazakhstan. Using UN Comtrade data for 2008–2023, a quantitative diagnosis of the commodity vulnerability of the export model is carried out, and concentration/diversification parameters are evaluated using a comparable multi-index methodology that aligns alternative indicators to a unified interpretive scale and structurally decomposes the export basket into total, non-oil, and non-resource segments. A continuous digitalization index, KZ-DESI, is constructed and computed for 2008–2023 based on the EU DESI methodology, providing a time-comparable measure of digital transformation. Based on ARDL econometric models, with control for the external oil shock and the exchange-rate channel, long-run relationships between digitalization and diversification are established for the non-oil and non-resource contours, and the absence of a stable effect for total exports is explained by the dominance of the commodity sector. In addition, a component decomposition of the digitalization effect is conducted, revealing the key role of business integration of digital technologies, and a cross-country cluster analysis of 53 countries is performed, enabling a typology of countries by digitalization and diversification parameters and positioning Kazakhstan within the group of resource-oriented economies with weak “conversion” of digital improvements into structural export shifts. The results of Chapter 2 provide the evidence base for substantiating the policy priorities and mechanisms proposed in Chapter 3.

In Chapter 3, the author develops applied recommendations and implementation mechanisms for diversifying Kazakhstan’s export basket under digitalization. Based on the product space approach, priority directions for diversification are substantiated and ranked, and a sector-specific package of digital implementation instruments is

formulated, aimed at reducing transaction costs of entering foreign markets, expanding digital promotion channels, and increasing firms' digital maturity. An organizational and economic mechanism and a monitoring framework for digital diversification are proposed, including a KPI/dashboard system, a schedule for updating indicators, and a scenario-based logic for adjusting measures on the basis of data. Particular attention is paid to configuring coordination among export, industrial, and digital policies, as well as to instruments for supporting the non-oil and non-resource export contours, given the identified heterogeneity of the digital effect. The results of Chapter 3 ensure the practical feasibility of the proposed export-diversification management model and form a basis for enhancing the resilience of external economic development and expanding non-resource export niches of the Republic of Kazakhstan.

Dissertation candidate

A handwritten signature in blue ink, appearing to read 'Shuren T.K.', written in a cursive style.

Shuren T.K.