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CONTENTS

PEDAGOGY

ECONOMICS

МАЗМҰНЫ

ПЕДАГОГИКА

ЭКОНОМИКА

СОДЕРЖАНИЕ

ПЕДАГОГИКА

ЭКОНОМИКА

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IDENTIFICATION OF CORE DRIVERS OF SUSTAINABLE SOCIO-ECONOMIC DEVELOPMENT OF KAZAKHSTAN

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Abstract. This study is based on the socio-economic indicators presented in the National Development Plan of the Republic of Kazakhstan until 2029 (hereafter, the National Plan). The article sequentially tests two hypotheses: 1) Among all socio-economic indicators in the National Plan, there exists a set of "core" indicators that can be defined as drivers of socio-economic development; 2) Other indicators in the National Plan may exert either positive or negative influence on these "core drivers." To identify statistical and mathematical relationships, the following methods were applied: 1) logarithmic transformation of indicators to reduce heterogeneity; 2) detection of correlation links with an assessment of their strength; 3) construction of a heatmap using Python code integrated into Google Colab (necessary due to the large number of variables simultaneously influencing a single indicator); 4) development of predictive regression diagrams; 5) path analysis to clarify causal mathematical relationships. This multi-stage analysis made possible to identify four "core drivers" that exert a comprehensive influence on the entire system of Kazakhstan's socio-economic policy: 1) reading literacy; 2) household expenditures on food; 3) life expectancy; 4) access to infrastructure in rural areas. The findings and the analytical methodology have a practical character and can be applied in the national planning system to support decision-making on social and economic policy priorities, as well as to minimize economic and social risks.

Key words: socio-economic policy, reading literacy, expenditures on food

products, life expectancy, rural infrastructure, sustainable development, social stability

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ҚАЗАҚСТАННЫҢ ТҰРАҚТЫ ӘЛЕУМЕТТІК-ЭКОНОМИКАЛЫҚ ДАМУЫНЫҢ ИНДИКАТОРЛАРЫН АЙҚЫНДАУ

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Аннотация. Бұл зерттеу 2029 жылға дейінгі Қазақстан Республикасының Ұлттық даму жоспарында (бұдан әрі – Ұлттық жоспар) көрсетілген әлеуметтік-экономикалық көрсеткіштерге негізделген. Мақалада екі гипотеза жүйелі түрде дәлелденеді: 1) Ұлттық жоспардағы барлық әлеуметтік-экономикалық көрсеткіштер арасынан әлеуметтік-экономикалық дамудың қозғаушы күші ретінде анықталатын «ядролық» көрсеткіштер тобы бар; 2) өзге көрсеткіштер осы «ядролық драйверлерге» жағымды немесе жағымсыз әсер ете алады. Статистикалық және математикалық өзара байланыстарды анықтау үшін келесі әдістер қолданылды: 1) гетерогенділікті азайту мақсатында көрсеткіштерді логарифмдеу; 2) корреляциялық байланыстарды анықтау және олардың күшін бағалау; 3) Python тілін қолданып Google Colab арқылы жылу картасын құру (бір көрсеткішке бір мезетте әсер ететін көптеген айнымалыларды өңдеу қажеттілігіне байланысты); 4) болжамдық регрессиялық диаграммалар салу; 5) себеп-салдарлық математикалық байланыстарды түсіндіру үшін path-талдау. Көпсатылы талдау Қазақстанның әлеуметтік-экономикалық саясатының бүкіл жүйесіне кең ауқымды ықпал ететін 4 «ядролық драйверді» анықтауға мүмкіндік берді: 1) оқырмандық сауаттылық; 2) азық-түлік тауарларына арналған шығындар; 3) өмір сүру ұзақтығы; 4) ауылдық жерлерді инфрақұрылымдық игіліктермен қамтамасыз ету. Зерттеудің қорытындылары мен әдістемесі мемлекеттік жоспарлау жүйесінде әлеуметтік және экономикалық саясаттың басымдықтарын айқындау, сондай-ақ экономикалық және әлеуметтік тәуекелдерді азайту мақсатында қолдануға болады.

Түйін сөздер: әлеуметтік-экономикалық саясат, әлеуметтік-экономикалық саясат, оқырмандық сауаттылық, азық-түлік тауарларына шығындар, өмір сүру ұзақтығы, ауылдық инфрақұрылым, тұрақты даму, әлеуметтік тұрақтылық

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ОПРЕДЕЛЕНИЕ ЯДРОВЫХ ДРАЙВЕРОВ УСТОЙЧИВОГО СОЦИАЛЬНО-ЭКОНОМИЧЕСКОГО РАЗВИТИЯ КАЗАХСТАНА

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Аннотация. Исследование основано на социально-экономических показателях, содержащихся в Национальном плане развития Республики Казахстан до 2029 года (далее – Национальный план). В статье последовательно доказываются две гипотезы: 1) Среди всех показателей социально-экономического развития, содержащихся в Национальном плане, существуют т.н. «ядровые» показатели, которые могут быть определены как драйверы социально-экономического развития; 2) иные показатели Национального плана могут оказывать позитивное и негативное воздействие на «ядровые драйверы». Для установления статистической и математической взаимосвязей последовательно использованы следующие методы: 1) логарифмирование показателей для смягчения гетерогенности, 2) выявление корреляционных связей с градацией степени их силы; 3) создание тепловой карты посредством написания кода на языке Python и интеграции кода в Google Colab (необходимость написания специального кода продиктована множественностью показателей, оказывающих влияние на 1 показатель, одномоментно); 4) построение прогнозных регрессивных диаграмм; 5) path-анализ для причинно-следственного разъяснения математических связей. Многоступенчатый анализ позволил выявить 4 «ядровых драйвера», имеющих всеобъемлющее влияние на всю систему социально-экономической политики Казахстана. Это такие показатели как: 1) читательская грамотность; 2) расходы на продовольственные товары; 3) продолжительность жизни; 4) обеспеченность инфраструктурными благами сельской местности. Выводы и сама методика анализа имеют прикладной характер и могут быть использованы в системе государственного планирования при принятии решений по определению приоритетов социальной и экономической политики, а так же с целью минимизации экономических и социальных рисков.

Ключевые слова: социально-экономическая политика, читательская грамотность, расходы на продовольственные товары, продолжительность

жизни, инфраструктура сельской местности, устойчивое развитие, социально стабильность

Introduction. In the Republic of Kazakhstan, as in the entire post-pandemic world, there has been an increase in attention to issues of sustainability and socio-economic stability in States. Kazakhstan has made notable strides in recent years toward institutionalizing sustainable development principles, reflected in strategic planning documents such as the National Plan for 2024–2029. Only for the last 3 years, according to the data of LIS "Adilet", 17 concepts were adopted in various spheres of socio-economic development: education, agriculture, migration, digitalization, housing and utilities, energy, infrastructure, etc. (List of Concepts, 2023). In 2024 – 3 concepts, in 2023 – 9 concepts, in 2022 – 5 concepts. The state's efforts indicate that the Kazakh authorities understand the need for large-scale socio-economic changes. This understanding is commendable, but requires appropriate support from academia, government and civil society, taking into account the experience of other countries, as well as the current level of achievement of the sustainable development goals of the 2030 Agenda. The UN report for 2024 on achieving the SDGs notes that ".. for the first time in this century, GDP per capita growth rates in half of the world's most vulnerable countries were lower than in the countries with advanced economies," "... in 2022, almost 60 percent of countries faced abnormally high food prices; in regarding the quality of education, "only 58 percent of students worldwide achieve a minimum level of reading skills by the end of primary school," according to the results of 2023, the global unemployment rate reached a historic low of 5%; the level of external debt in developing countries remains unprecedentedly high, with about 60% of low-income countries at high risk of debt distress or already facing it" (The Sustainable Development Goals Report, 2024). The above statistics also provide guidance for future actions by states on the path to sustainable development.

Thus, the persistence of such and similar challenges underscores the relevance and urgency of further examining the structural dynamics of socio-economic development, which was the main motivation for undertaking our research.

Literature review. For the purposes of this study, the latest research in the field of drivers of socio-economic development was examined. The 2021 study by T. Matyuk and O. V. Poluyaktov, titled *'Socio-Economic Development and Its Relationship with Indicators of Empowerment, Economic Freedoms, and Opportunities'* (Matiuk et al., 2021), the study by T. Akar, titled *'Reflections on the Interrelationship Between Education Indicators and Indicators of Economy, Law, and Human Development'*, highlights the differences in the degree and significance of correlations between education, global competitiveness, income inequality, and the rule of law in developed and developing countries (Acar et al., 2021). Meanwhile, another study by Vijay Anand Dubey, Rakesh Ranjan, and Richa Nangia (2024), titled *'Socio-Economic Variables and Their Impact on Education in India'*, demonstrates, using India as a case study, that education makes a significant contribution to socio-economic development (Dubey et al., 2024). Particularly noteworthy, in our view, is the indicator

of the 'Rule of Law' as a political factor influencing socio-economic development. For instance, in the article *'Rule of Law: Measurement and Deep Roots'* by Jörg Gutmann and S. Voigt, the authors conclude that the rule of law is not predetermined by political systems and is closely associated with income levels. (Gutmann et al., 2015) Thus, in publication of the authors M. Durman, A. Bashtannik, V. Kornienko "Economic efficiency of the modern paradigm of public administration" through correlation analysis revealed that "in 2019, the following factors had the greatest impact on efficiency: Public Administration Efficiency, Quality of Regulation, Rule of Law. Most sources agree on the centrality of GDP, HDI, education, health, and income as core indicators of socio-economic development (Wang et al., 2021; Zhang et al., 2024; Markova, Shmatko & Katchanov, 2016).

Within the methods used in different works, the most popular are: correlation, regression and path-analysis. One of the classic studies related to socio-economic and political indicators by Lewis-Beck, M., published in 1977, attaches special importance to the so-called "path analysis", which involves not only a statistical analysis of the factors themselves, but also related ones. The author argues that the use of simple correlation will never be sufficient for a full-fledged analysis. At the same time, he claims that the influence of socio-economic factors will always be greater than political ones (Lewis-Beck, et al., 1977). Domenko Yu. in his article "Correlation-regression analysis as a tool for strategic planning" considers it necessary to include this tool in the normative legal acts governing the development of strategies for the socio-economic development of the region. The authors Cap, V., Feurich M. and Lukavets M. propose the use of statistical methods, namely multivariate regression and residual analysis, to identify the efficiency of budgetary funds (Čáp, 2024).

Methods. *Data.*As data for analysis, we defined the indicators specified in the National Development Plan of the Republic of Kazakhstan until 2029, approved by Presidential Decree № 611 on June 30, 2024. (National Plan, 2024) The National Plan from 2022 to 2029 consists of 39 main positions, from 2025 to 2029 these indicators are of a planned nature.

1.1. Methodology

Drawing on insights from previous research and the structure of the National Development Plan. National Development Plan is a unique document, which combine statistical data from different spheres of economic development. The present study employs a combined correlation, regression and path analysis approach in order to identify key socio-economic drivers of sustainable development in Kazakhstan.

The data analysis was carried out according to the following scheme:

The first step is logarithmization. The National Plan consists of heterogeneous statistical data in various measurement systems; therefore, the first step was to logarithmize the data to ensure their uniformity. Logarithmization was performed in the Excel spreadsheet editor;

The second step is the primary correlation of data to identify the most significant socio-economic indicators. Based on the correlation data, a gradation of socio-economic indicators into four groups was created (Table Decoding correlation links):

High positive correlation – range of values equal to 80% (0.8 – 0.8999). Values of 0.8 and above reflect a «very strong» relationship between indicators. We highlight this range separately because such correlations are relatively rare in socio-economic data and, as a rule, indicate either a close interdependence of processes or the presence of a common systemic driver. A «high» rating means that the relationship is statistically significant for the formation of a list of «core» indicators, which are then considered as dependent variables (Y) in regression and subsequent causal analysis.

Stable connections. (0.6 – 0.79999) – range of values equal to 60–70%, corresponds to «strong» and «stable» relationships, which in empirical data on development more often reflect stable joint changes in variables, but not necessarily as «rigid» a relationship as when r≥0.8. We designate this level as stable because it provides sufficient grounds for including factors in subsequent model testing (regression analysis and heatmap).

Average correlation (blue) – range of values equal to 40–50% (0.4 – 0.59999). In the context of socio-economic analysis, they are important for understanding the overall architecture of interrelationships (e.g., when visualising a heatmap), but on their own they are often insufficient for identifying a 'core driver' because they may reflect the mixed influence of several factors, indirect effects, or different sensitivities of indicators to external conditions. Therefore, this range is used primarily as an analytical background.

Low correlation (purple) – the range of values is 30–10% (0.3999 – 0.1). In the study, correlations of this level are not used to select core drivers, but are recorded for completeness and to identify indicators that do not systematically «fit» into the network of interdependencies or exert influence through non-linear mechanisms.

Key socio-economic indicators are designated as drivers of socio-economic development and are further analyzed as dependent variables (Y);

The third step is the creation of a correlation "heatmap" (Heatmap 1, 2, 3, 4) in order to identify the positive and negative influence of factors (X – independent variables) on (Y – the dependent variable). The red colors – is negative influence; green colors – positive influence. The scale of influence level inside of each heatmap. The code for the "Heatmap" was written in the Python programming language and implemented using the Google Colab environment.

Forth step – regressions (Diagram 1,2,3,4). The regression illustrates the predictive behavior of indicators. More than 16 correlation links were identified, that is why regression made with Python code in GoogleColab.

But data analysis theory suggests that correlation and regression may, but does not necessarily, indicate causation. In other words, strong and consistent correlations between indicators only suggests the possibility of common causes and implicit relationships between them. Causality can be further explored and revealed through more detailed qualitative analysis (Alves Ana, 2023). Against this backdrop, the third methodology we applied was principal component analysis and path-analysis, which contributed to the analytical substantiation of correlation and regression relationships.

In line with this framework, we formulate the following hypothesis**:** Within the set of socio-economic indicators, a limited number of variables demonstrate strong statistical correlation with others and can thus be identified as core drivers of sustainable socio-economic development. To test the hypothesis will be used only values demonstrating strong and consistent correlations within the following range:

Additionally, indicators that appear as influencing factors in more than 50% of cases—i.e., those recurring as influencing factors more than 19 times—are also taken into account (Table). The next level of verification involves path analysis, which is used to identify logical and causal relationships among the established correlations.

Therefore, the econometrical analysis of the main components will allow us to identify the most important socio-economic indicators, and path-analysis will allow us to consider and substantiate the components, establish relationships with current reality.

Results. We conducted correlation, correlation "heatmap" and regression.

The decoding of found correlation relationships presented in Table "Decoding correlation links" produced on the basis of the data presented in the National Development Plan of Kazakhstan and allows us to see the different degrees of correlation links between specific statistical indicators *(the names of the factors coincide with the numbering in the right column of the table).*

Table 1. Decoding correlation links.

№	Indicator	High	Stable	Average	Low
1	GDP, billion US dollars (current prices)	5, 6, 7, 24	8	-	-
2	Real economic growth rate, % regarding last year	5, 6, 7	8	-	-
3	Index of cumulative growth of labor productivity, 2022=100	9, 34	-	-	-
4	GDP, billion US dollars (current prices)	5, 6, 7	-	8	-
5	The share of expenditure on food products in the structure of monetary expenditure of the population, %	11, 13, 15, 16, 18, 20, 22, 23, 26, 27, 29, 30, 35, 37	8, 10, 14, 19, 21, 24, 25, 36	-	-
6	Life expectancy at birth, years	10, 11, 13, 15, 16, 19, 20, 22, 23, 25, 26, 27, 30, 35, 36, 37	8, 14, 21, 24	-	-
7	Reader's literacy	11, 13, 16, 18, 20, 23, 27, 28, 29, 35, 37	8, 10, 14, 15, 19, 21, 22, 24, 25, 26, 30, 36	-	31
8	Mathematical literacy	28, 29	23, 27, 30, 31, 35, 37	10, 11, 14, 15, 19, 20, 21, 22, 25, 26, 36	
9	Natural science literacy	17, 32	12, 33, 34	-	-

10	Number of Kazakhstani universities in the top 700 of the QS ranking World University Rankings, units	13, 18, 28, 29	-	-	-
11	The proportion of the population with incomes below the subsistence level/below the poverty line, %	13, 29	-	-	-
12	Cities level of provision of social benefits	34	-	-	-
13	RS, level of provision of benefits	14, 15, 16, 19, 20, 21, 22, 25, 26, 36	24	-	31
14	The level of wear and tear of heat, water supply and sanitation networks regulated by the NMH, %	16, 18, 28, 29	-	-	-
15	Level of population satisfaction with environmental quality of life, %	16.29	-	-	-
16	Coverage of geological and geophysical exploration of the territory, thousand sq. km	21, 24, 25, 30, 37	-	-	-
17	Volume of introduced electric capacities, with accumulation from 2022, GW	34	-	-	-
18	Share of electricity from renewable energy sources, % of total production	19, 20, 21, 22, 25, 26, 36	24	-	31
19	Energy intensity of GDP, toe / thousand US dollars in 2015 prices	21, 29, 37			
20	Transportation	29.37	-	-	-
21	Exports of manufactured goods, billion US dollars	24, 28, 29	-	-	-
22	thousand TEU transportation via Kazakhstan	29	-	-	-
23	Share of processed products in the agro-industrial complex**, %	-	-	-	-
24	Volume of export of IT products and services, million US dollars	27, 28, 30, 35, 37	29	-	-
25	Level of activity in the field of innovation, %	28, 29	-	-	-
26	Number of domestic tourists served by accommodation facilities, million people	29	-	-	-
27	Number of incoming tourists served by accommodation facilities, million people	-	-	-	31
28	Share of GAV SME in GDP, %	36	-	-	31

29	Share of GAV of medium-sized businesses in GDP, %	36	-	-	31
30	Investment in fixed capital (IFC), % of GDP	-	-	-	34,37
31	Share of foreign investment in total IFC, %	34	-	-	-
32	Growth in business loans, % (from 2022 level)	-	34	-	-
33	Gross IFDI, US $ billion	-	-	-	-
34	Maximum greenhouse gas emissions, % (to the 1990 level)	-	-	-	-
35	Level of water losses in agriculture through water transport channels, %	-	-	-	-
36	Non-oil deficit of the republican budget, % of GDP	-	-	-	-
37	The value of the Rule of law index from World Justice Project on a scale of 0 to 1	-	-	-	-
38	The value of the Public Administration efficiency Index from World Bank (scale -2.5 to 2.5)	-	-	-	-
39	Saving irrigation water through the introduction of water-saving technologies in irrigated agriculture, million m^3 per year	-	-	-	-
Compiled by the authors based on correlation data					

As we can see from the Table, high and stable correlations are found in the largest number for the following indicators than can be named as **core drivers are:** *The share of expenditure on food products in the structure of monetary expenditure of the population* – 22 correlations from 39 factors; *Reader's literacy* – 23 correlations from 39; *Life expectancy at birth, years* – 16 correlations from 39; *Level of provision of benefits in rural regions* – 11 correlations from 39 factors.

The second stage of the analysis is a correlation heatmaps and regression analysis to identify the influence of factors and predict the behavior of the underlying indicators as a 4 core drivers.

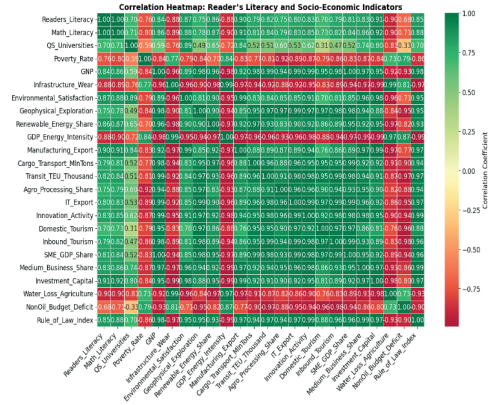

Figure 1 - Heatmap of factors affecting on Reader's literacy

Compiled by the authors

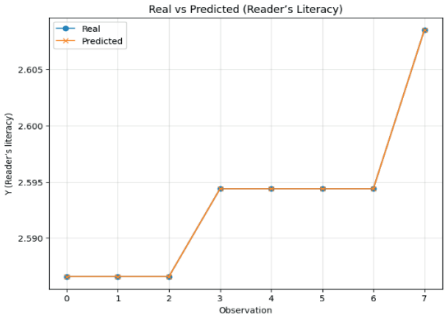

Figure 2 - Reader's literacy (regression)

Compiled by the authors

The most significant indicators for socio-economic development have proven to be those related to education: the indicator "Reading literacy" *(Table, Figure 1,2)*, have the largest number of correlations that fall within the range of stable relationships. The "reading literacy" indicator correlates to a high degree with the rule of law index, and the "mathematical literacy" indicator demonstrates a stable connection with this index. Stable connections of the indicator "reading literacy" correlate with the indicators "mathematical literacy" (8) and "QS World University Rankings" (10), as well as with indicators related to social infrastructure (14, 15), economic activity (19, 21, 22, 26, 30, 36) and innovation (24, 25). The indicator "Mathematical Literacy" to a greater extent illustrates stable connections with economic indicators (23,27,30,31). In general, the indicators of stable correlations repeat the results of high-degree correlations, which can be regarded as evidence of the presence of causality and interdependence of the indicators. The data of the "Reading literacy" indicator correlate to a high degree with the indicators related to the population's income and access to social benefits. Such a relationship is logical, since the higher the population's income and access to social benefits, the more stable the "reading literacy" indicator. There is a high correlation of the "reading literacy" indicator: with indicators 16, 18, 35, which can be explained by the science-intensive nature of these indicators; with indicators 20, 23, 27, 28, 29 related to entrepreneurial activity and industrial development.

The «heatmap» *(Figure 1)* illustrate **positive influence:** mathematical literacy; number of Kazakhstani universities in the QS World University Rankings Top-700; cumulative labor productivity growth index; life expectancy at birth; level of social welfare provision in cities; level of satisfaction with environmental quality of life; coverage of geological and geophysical exploration of the territory; volume of introduced electric capacities; share of electricity from renewable energy sources (RES); volume of IT service exports; level of innovation activity; share of SMEs in

GDP; water savings through agricultural technologies; **negative influence:** share of the population with income below the subsistence minimum/below the poverty line; share of food expenditures — poverty reduces educational opportunities; depreciation of utility networks; energy intensity of GDP.

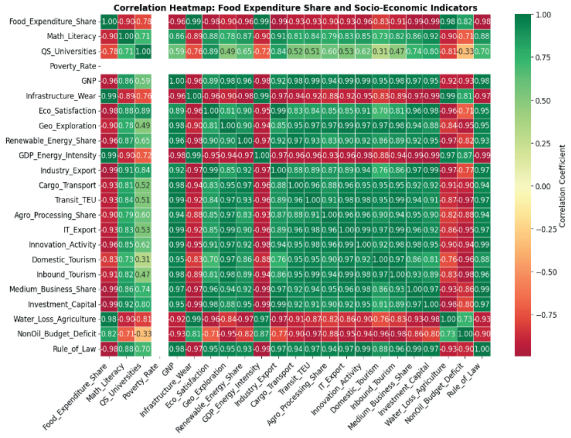

Figure 3 - Heatmap of factors affecting on Expenditure on food products
Compiled by the authors

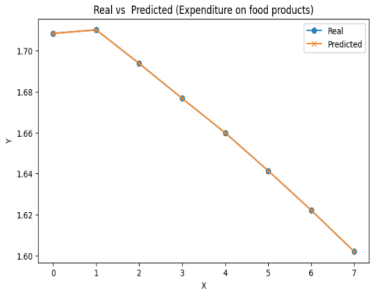

Figure 4 - Expenditure on food products (regression)
Compiled by the authors

The indicator "The share of expenditures on food products in the structure of monetary expenditures of the population" *(Table, Figure 3,4)* was of interest, which correlates with 22 indicators out of 39 related to a high positive correlation. 8 indicators are in the range of stable relationships. From which we can assume that this indicator is one of the main socio-economic indicators that systematically affects the entire population of the country. The indicator closely correlates with the poverty line (11), provision of social benefits in rural areas (13), ecology (15), entrepreneurial activity (27, 29, 30), logistics issues (20, 22, 26, 35). Moreover, this indicator highly correlates with the rule of law index. Stable correlations are recorded with such education indicators as "mathematical literacy" (8) and World University Rankings (10), as well as with indicators of infrastructure (14), entrepreneurial and economic activity (19,21, 36) and innovation (24,25). These connections are more than logical, since the need for food is the basis of the consumption pyramid and the feeling of insecurity in this matter causes a systemic negative effect in society.

Regression analysis (Figure 4) confirms the correlation data (Figure 3), the lines practically coincide, which means that the model very accurately reproduces the relationship between X variables and Y. The trend is downward: from approximately 1.71 to 1.60. This means that as factors X11, 13, 15, 16, 18, 20, 22, 23, 26, 27, 29, 30, 35, 37, 8, 10, 14, 19, 21, 24, 25, 36 change, the share of food expenditures in the overall structure decreases. The determination coefficient $R^2 \approx 1$ — the model explains almost 100% of the variability of Y; The prediction error is almost zero; It

can be said that the linear combination of factors: X11, 13, 15, 16, 18, 20, 22, 23, 26, 27, 29, 30, 35, 37, 8, 10, 14, 19, 21, 24, 25, 36 completely describes the trend in the share of food expenditures.

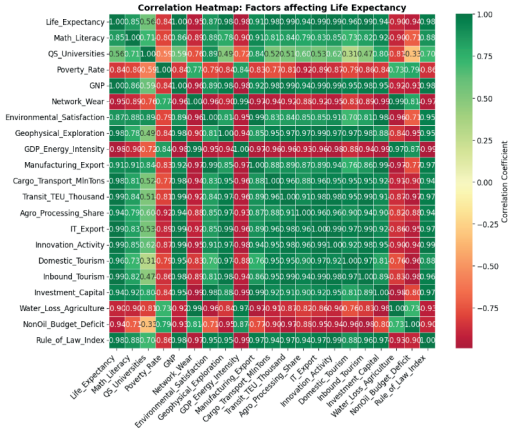

Figure 5 - Heatmap of factors affecting on Life Expectancy

Compiled by the authors

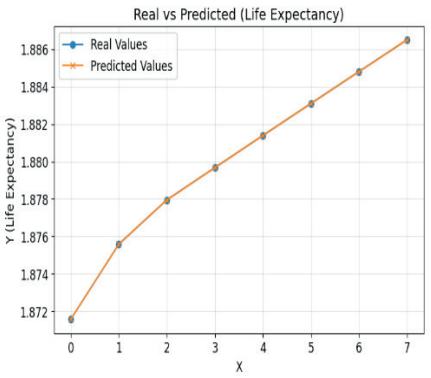

Figure 6 - Life Expectancy (regression)

Compiled by the authors

The "Life Expectancy" *(Table, Figure 5,6)* indicator correlates with 20 out of 39 indicators. Strong stable links are recorded with the following indicators: poverty (11), level of provision with goods (12), ecology (15), economic activity (19, 20, 22, 23, 26, 27, 30, 36), innovation (25), rule of law (37) and education – World University Rankings (10).

Stable links correlate with the indicators: "mathematical literacy" (education), deterioration of heating, water supply and sanitation networks (infrastructure), economy (21) and innovation (24). Thus, the indicators of strong and stable connections systematically duplicated each other in different variations, thereby confirming their truth on the basis of statistical laws.

The regression analysis (Figure 6) confirms the findings of the correlation analysis, with a coefficient of determination $R^2 \approx 1.0$, indicating complete alignment of trends in total calculation.

Heatmap illustrate logical Correlation Heatmap (Figure 5) divided the factors into two planes: those exerting a positive influence and those exerting a negative influence. Positive influence: Mathematical literacy - reflects the quality of education; The number of Kazakhstani universities in the QS World University Rankings Top 700 - an indicator of institutional and educational progress, correlates with the growth of population qualifications and, consequently, health; GNP (gross national product) - characterizes economic strength; GDP growth allows for the financing of healthcare, infrastructure, and social programs; Level of population satisfaction with

environmental quality of life - improvement of the environment directly increases life expectancy; Coverage of geological and geophysical exploration of the territory - an indicator of scientific and technological development and rational use of natural resources; Export of manufacturing industry products - reflects industrialization and the sustainability of the economy, creating jobs and income growth; Share of processed products in the agro-industrial complex - contributes to food security and improved nutrition; Volume of IT service exports - a symbol of digital transformation and the innovative potential of the economy; Level of innovation activity - a driver of modernization of the economy and social infrastructure; Number of domestic and inbound tourists - reflects the development of services, infrastructure, and the quality of the urban environment; Investment in fixed capital (IFC) - stimulates the modernization of healthcare, education, and utilities systems; Rule of Law Index - institutional stability and citizens' trust in the system increase social well-being. Negative influence: Share of the population with incomes below the subsistence minimum - increases social inequality, limiting access to healthcare and education; Wear of heating, water, and energy supply networks - reduces quality of life and public health; Energy intensity of GDP - a high level indicates production inefficiency and environmental pollution, which reduce life expectancy; Level of water loss in agriculture - reflects irrational resource use, negatively affecting rural regions; Non-oil budget deficit - may limit social spending and government programs.

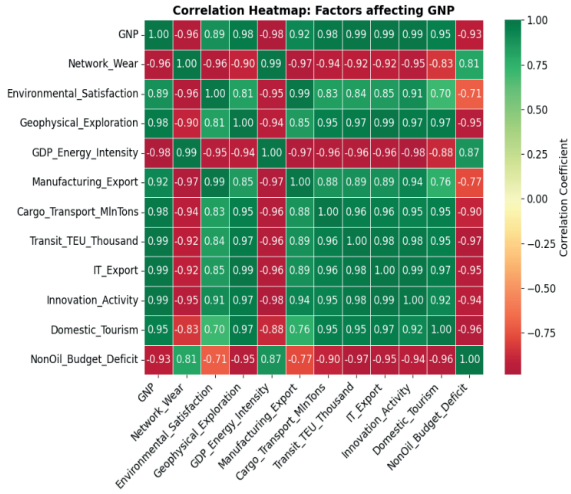

Figure 7 - Heatmap of factors affecting on Level of provision of benefits in rural regions
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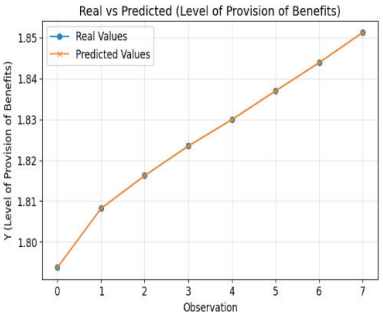

Figure 8 - Level of provision of benefits in rural regions (regression)
Compiled by the authors

Although the indicator "level of provision of rural settlements with benefits" *(Table, Figure 7,8)* does not meet the strict frequency threshold used to define core indicators-correlating with 12 out of 39 variables - it nonetheless exhibits consistent and meaningful connections with several critical development domains. These

include infrastructure (heating, water supply, and sanitation), environmental quality of life, and economic performance.

The Heatmap data (Figure 7) also illustrate the positive and negative influence of the factors. Positive influence: The level of population satisfaction with environmental quality of life; the coverage of geological and geophysical exploration of the territory; exports of manufacturing industry products; millions of tons of cargo transportation; thousands of TEU shipments through Kazakhstan; the volume of IT product and service exports; the level of innovation activity; the number of domestic tourists. Negative influence: The level of wear and tear of heating, water supply, and sewerage networks; the energy intensity of GDP; the non-oil deficit of the republican budget.

Regression analysis (Figure 8) shows that the real and predicted indicator values almost completely coincide ($R^2 \approx 1.0$) (Diagram 4).

Discussion. The results obtained allow us to highlight several important implications.

First, the results indicate that reading literacy in Kazakhstan is deeply embedded within the broader socio-economic system. Rather than functioning as an isolated educational outcome, it reflects cumulative effects of innovation capacity, institutional quality, and economic structure. Indicators related to digitalization, innovation, and governance exert the strongest positive influence, while poverty and infrastructure depreciation consistently act as constraining factors. This confirms that literacy operates as a system-integrative variable linking social, economic, and institutional development trajectories.

Second, a declining share of food expenditures reflects structural improvements in living standards and economic security. Its strong association with education, innovation, institutional quality, and infrastructure suggests that food expenditure functions as an integrative proxy for socio-economic resilience rather than merely a consumption indicator.

Third, life expectancy emerges as a long-term outcome variable synthesizing economic capacity, institutional quality, environmental conditions, and human capital. The heatmap results reveal a clear structural division between enabling factors - such as education quality, innovation, exports, and institutional stability - and constraining factors, including poverty, infrastructure degradation, and energy inefficiency. This confirms that improvements in life expectancy are not driven by isolated interventions, but by coordinated progress across multiple policy domains.

Fourth, the level of provision of social benefits in rural areas of Kazakhstan is closely linked to the development of innovation, exports, and environmental infrastructure. The higher the indicators of innovation activity, transport and IT infrastructure, the higher the provision of social benefits in rural areas. Conversely, the deterioration of utility networks, inefficient energy use, and budget deficits act as restraining factors. Notably, a stable association is also observed with innovation-related indicators. According to the Bureau of National Statistics Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, 7,518,241 people live in rural

areas (Population Statistics, 2024), which at the time of October 1, 2024 amounted to 37.18% of the total population of the country. This demographic significance reinforces the relevance of rural provision not merely as a statistical relationship, but as a strategic policy concern. Ensuring adequate benefits for rural populations is essential not only to improve living standards but also to mitigate urban migration pressures and the overloading of infrastructure in major cities.

Discussions formulated in integrated path diagram (Figure 9), where green lines indicate positive influence and red are negative.

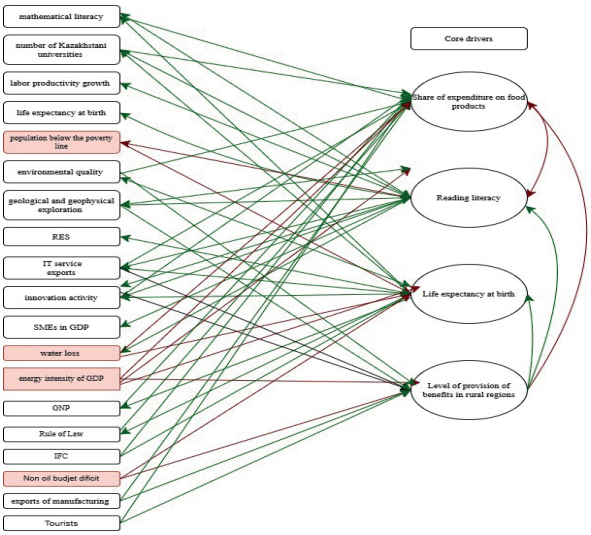

Figure 9 – Integrated path diagram of core drivers

Indicators for which no correlations have been identified can be considered as indicators of influence. The degree of influence can be determined by the repeatability of the indicator among other indicators.

Thus, important elements of socio-economic development are the rule of law and innovation. The "Rule of Law Index" appears in the share of expenditure on food products in the structure of monetary expenditure of the population (5), reading and mathematical literacy (7 and 8), , economics (19, 30), logistics (20) and innovation (24), while, for example, innovation indicators (24 and 25) exert an influence on as many as 15 other indicators. Overall, the findings provide empirical support for the hypothesis that a limited subset of socio-economic indicators demonstrate strong statistical interconnectedness with other developmental metrics and can be considered principal drivers of sustainable socio-economic development in Kazakhstan.

Conclusion. The analysis presented in this study, based on correlation heatmap, regression and path analysis of forward-looking indicators from Kazakhstan's National Development Plan (2024–2029), supports the both hypotesises that a small set of socio-economic indicators functions as key drivers of sustainable development and posotive and negative influence on it of another indicators. Specifically, the

most influential indicators identified include reading literacy, food expenditures, life expectancy, and - though falling below the primary statistical threshold - provision of rural areas with benefits, whose developmental relevance is reinforced by demographic and infrastructural considerations. These indicators exhibit consistent interdependence with broader domains such as poverty reduction, innovation, education, environmental sustainability, and access to public services. Their statistical and systemic significance confirms the initial hypothesis that certain socio-economic variables, due to their strong interrelations with other development metrics, can be considered foundational within the structure of Kazakhstan's development strategy. Furthermore, the Rule of Law Index, though political in nature, emerges as a key enabling factor, strongly influencing a range of core indicators. This suggests that improvements in governance and institutional quality may yield cascading effects across multiple policy areas. The methodology employed in this research - while constrained by the prospective nature of the data - offers practical utility for state planning processes. It can be used to inform evidence-based prioritization in the design of social and economic policies, particularly in efforts to mitigate developmental risks and improve strategic policy alignment.

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