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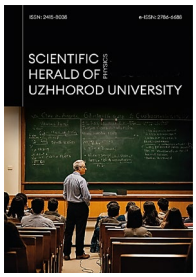

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Structural shifts in the economy and economic growth of the Kyrgyz Republic

Cholpon Askarova*
Kyrgyz National University named after Jusup Balasagyn
720033, 547 Frunze Str., Bishkek, Kyrgyz Republic

Kalybek Choroev
Kyrgyz National University named after Jusup Balasagyn
720033, 547 Frunze Str., Bishkek, Kyrgyz Republic

Topchubai Kultaev
Osh State University
723500, 331 Lenin Str., Osh, Kyrgyz Republic

Abstract

Relevance. After three decades of independence, the economy of the Kyrgyz Republic has not yet been able to make a full-fledged transition to a market economy. Therewith, the development of technology around the world has significantly accelerated innovation, and economic and social processes, which means that Kyrgyzstan has less and less time to close the gap and needs to act quickly.

Purpose. To make a qualitative leap in development, fundamental structural shifts are needed, and the purpose of this work – to consider various areas of application of such shifts and develop recommendations for further steps in this area.

Methodology. The method of statistical analysis was used to explore the dynamics of economic indicators over the previous few years and the method of modelling was used to calculate one of the most important indicators of structural shifts in the economy – the coefficient of elasticity of labour-capital substitution.

Results. As a result, six key parameters of economic transformation – in sectors, regions, technology, ownership, fixed assets and fair competition – were explored and recommendations for future structural shifts were developed for each of them. In addition, the elasticity coefficient has been calculated and the advantages of using the proposed type of production function have been emphasised.

Conclusions. The practical significance of the work lies in the development of a more productive method of elasticity calculation than the conventional one, which considers changes in the indicators of the replacement of labour by capital. In addition, the prepared proposals on structural shifts in certain spheres of the national economy of Kyrgyzstan, considering the positive experience of several leading world economies, are of practical use.

Keywords: innovation; privatisation; free competition; international experience; production function; elasticity of substitution.

Introduction

In the context of ever-increasing globalisation processes, the task of integrating national economies into the global economic system is becoming particularly urgent. Some structural limitations associated with the imbalance of several regions and industries of the Kyrgyz Republic (KR)

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*Corresponding author

force to search for solutions that could restore the balance and thus ensure the integration of the KR into the global economy of the fifth technological mode. Structural shifts in the economy are, first of all, qualitative changes in the links between the elements of the system occurring under the influence of external factors. These links may be different, and several Kyrgyz researchers have already addressed the research of this problem.

Thus, K. Choroev [1] noted that in the transition period of economic development, the usual market interrelationships no longer work effectively and the mechanism, originally designed to generate profits, in crisis conditions can no longer cope with the sectoral distribution of resources. Consequently, in the author's opinion, in the process of structural shifts, it is extremely important to optimise resource allocation between sectors based on the existing realities and the actual state of affairs in the economy. The arbitrator in such a case should be the state authority, which, seeing the whole picture, can make decisions on investments in this or that area, based on the general interests of the state, avoiding individual disproportions at all levels. It usually leads to a change of priorities and redistribution of existing resources towards more relevant sectors of the economy, in connection with which the share of certain components in the gross domestic product (GDP) of the state changes. Therewith, the employment structure of the population changes accordingly, with some professions losing relevance, on the contrary, becoming particularly in demand.

A.T. Mamyraliev *et al*. [2], exploring the interaction of economic growth factors and their impact on the level of development of the Kyrgyz Republic, identified the features of the interaction of production factors for each industry, and identified in which of the modes of such interaction the growth vector would be maximally effective. Having explored two key production factors – production funds and labour resources – the authors concluded that the growth of efficiency of Kyrgyz enterprises is possible due to two factors. On the one hand, it is the attraction of investment in fixed assets, and on the other hand, it is the increase in the economically active population caused by the growth of the birth rate in the late 1990s. Conventionally, due to insufficient development of innovative technologies, the gross product of transition countries consists mainly of raw materials and low-value-added products. In addition, the Kyrgyz Republic is characterised by the problem of disproportions in the sectors of the national economy, left over from the times of the Soviet Union with its administrative-command system of management and differentiation of spheres between different union republics. Since the state lacks developed energy enterprises and natural logistic centres such as seaports, and the industrial and social infrastructure is highly deteriorated, the gap in living standards between the urban and rural populations is deepening.

In this regard, the agricultural sector of Kyrgyzstan, which accounts for about 20% of the country's GDP, is of particular significance. R.K. Izmailov [3], having explored the current state of affairs in industrial agriculture (IA), and trends in its development, identified its low competitiveness and low rates of innovation. The existing measures designed to support agriculture over the previous 30 years of independence are ineffective and have not achieved the intended purposes of the sector's development. The development of a system of agro-industrial and livestock clusters is proposed as a structural shift in this area. The development of a network of such industrial complexes in the country, based in places of territorial concentration of specialised producers, will lead to the simplification of logistic routes and the reduction of costs of product processing. The cooperation of various farmers within a single cluster will strengthen their positions and give them additional impetus while reducing production costs [4; 5].

Speaking about the optimisation of logistics processes, one should consider the geopolitical position of Kyrgyzstan, as the state located in the centre of the Eurasian continent, on the border of the two largest economies of the Eastern Hemisphere – the European Union and China – can play the role of a continental hub. T.K. Bernaliev [6], considered the possibility of developing international logistics in the Kyrgyz Republic in terms of air, rail and road communication, including in the context of the implementation of the ambitious programme "Silk Road International Cooperation Organisation". In this context, an example of a structural shift in the logistics industry could be the construction of a separate railway line across the isthmus between the mountain ranges of the Himalayas, Pamir and Tien Shan, reducing the distance along the China-Kyrgyzstan-Uzbekistan route by 1,200 kilometres. The implementation of such a programme would significantly increase the position of the Kyrgyz Republic as a transit logistics centre, provide an influx of tourists and establish thousands of jobs in the new infrastructure.

When evaluating the prospects for fundamental shifts in the development of the Kyrgyz Republic, one cannot ignore such an important factor of sustainable development as the "green economy". In their work D.K. Akanov & N.Z. Zhakypov [7] raised an important issue of the introduction of "green transport" in the cities of Kyrgyzstan. Despite the independence of these studies and the difference in approaches, both authors come to the same conclusion – to achieve results, Kyrgyzstan needs systemic shifts in the field of environmental security. Among the priority steps, the researchers name an environmentally oriented transport policy based on modern environmental standards and information campaigns dedicated to increasing public responsibility for environmental conservation.

Thus, most areas of application of structural economic shifts have already been explored by the domestic scientific community separately. The purpose of this work – to explore structural shifts and their impact on the economy of the Kyrgyz Republic in a more comprehensive way.

Literary Review

In addition, many foreign researchers have devoted their works to the research of structural shifts in the world economy. For example, F. Ulaşan & D. Lee [8] explored the reasons for the dramatic economic growth of South Korea, which over the previous few decades had transformed from one of the poorest countries in the world to a technological leader. Such changes were allowed by the transformation of public governance, and it was

decisive governance that helped to overcome immature social and political conditions.

Another example of an "Asian miracle" is the city-state of Singapore, which in 60 years managed to raise GDP from $500 per capita to $65,000 and ranked ninth in the world by this indicator. U. Çakmak [9] who explored Singapore's structural shift in the economy concluded that the state was able to achieve such performance due to globalisation, free market capitalism and the stressed significance of education. This experience is particularly useful for countries that are struggling with territory and natural resource availability.

J. Boehlke *et al*. [10] compared the experiences of two countries with different political and social characteristics, but shared experience of fundamental economic shifts – Ireland and Turkey. The researchers analysed the determinants of accelerated economic growth and found that in the stable Irish economy with a well-educated society, growth was driven by net exports, while in the case of Turkey, periods of accelerated growth were associated with a programme to promote small businesses and facilitate their registration.

The European experience of economic breakthrough is usually associated with the collapse of the Soviet model when many states were able to develop independently in the paradigm of market freedom. Thus, after the fall of the Berlin Wall and the unification of two artificially divided German economies, according to M. Fritsch *et al*. [11], a positive synergy effect emerged. The strict anti-entrepreneurial policies that prevailed under the Soviet regime led to a structural shift in the behaviour of the inhabitants of the German Democratic Republic (GDR) and after the unification of the country, the number of self-employed in East Germany overtook and significantly exceeded that of West Germany.

In addition, another structural economic shift in Eastern Europe – the so-called "shock therapy" in Poland – occurred during the collapse of the socialist bloc. G.W. Kolodko [12] believes that the definition of the long-term purposes of this tectonic shift was largely correct, and many of the structural reforms of that time are still relevant today – in particular, effective financial supervision and the expansion of the knowledge-based economy.

Despite its geographical remoteness from Kyrgyzstan, the experience of structural shifts that occurred in South America can be useful. Therewith, it should be considered that the sharp economic surge was largely due to the conditions of the military dictatorship. According to A. Kaiser [13], the phenomenon of Chile's neoliberal economy, although it led to a significant increase in the country's GDP, did not affect the lives of the vast majority of citizens. A similar situation was observed in Brazil – although the military government initiated several reforms and attracted significant investments in the development of infrastructure, the dependence on imported oil was not calculated during this structural shift, and with the onset of the energy crisis in 1979, the "Brazilian economic miracle" came to an end. Thus, when developing a strategy for fundamental economic transformation, it is necessary to consider the previous experience of national economy.

Materials and Methods

The method of statistical analysis was used to analyse six key criteria of systemic economic shifts – in sectoral, interregional and technological structures, in the structure of ownership, in the structure of production assets, and in the structure of competition – based on official data for the last few years. In addition, the modelling method was used to analyse the influence of factors, where the production function was used to determine the relationship between the main factors (input) and the results of the production process (output), which reflects a sufficient degree of stable quantitative correlation between inputs and outputs.

The production function with constant elasticity of substitution (CES) is often used to describe the functioning of an economic system, according to which the value of the elasticity of substitution of labour activity by capital σ in the system under consideration is constant. The problem arises that such a situation does not occur very often in the real economic system. Consequently, it is necessary to make an additional assumption based on the possibility of using a production function of this type but describing a special case of system functionality. Therewith, such modelling results in a decrease in the forecast accuracy of the obtained estimates.

To avoid such errors, it is recommended to use the neoclassical production function with variable elasticity of labour substitution by capital (VES-function), which considers changes in the values of elasticity of labour substitution by capital σ in the analysed system. In modern economic science, there are different variants of analytical representations of such production functions. According to one of the methods, the rate of substitution of labour by capital γ can be characterised as a dependence on the capital stock k in the economic system examined:

$$\gamma = \alpha + \beta k, \begin{cases} \beta > 0, \\ -\alpha/\beta < k. \end{cases} \quad (1)$$

In this case, σ can be defined by the dependence:

$$\sigma(k) = 1 + \left(\alpha/\beta\right) k^{-1} \begin{cases} \sigma(k) < 1, \sigma(k) > 1 \\ \dfrac{d\sigma(k)}{dk} < 1, \dfrac{d\sigma(k)}{dk} > 1 \end{cases}, \quad \sigma < 0, \sigma > 0, \quad (2)$$

and the VES-function, in this case, will have the form:

$$Y = Ae^{\lambda t}\left[(1+\beta)KL^{\beta} + \alpha L^{1+\beta}\right]^{1/1+\beta}. \quad (3)$$

Thus, if evaluate γ through the expression:

$$\gamma = k\left(\frac{1}{\alpha+\beta k} - 1\right), \begin{cases} 0 < \alpha < 1 \\ 0 < \alpha + \beta k < 1, \end{cases} \quad (4)$$

here: α and β – function parameters.

Then the dependences for σ will have the following form:

$$\sigma(k) = 1 - \frac{\beta k}{(\alpha+\beta k)^2 - \alpha}, \begin{cases} \sigma(k) < 1, \sigma(k) > 1 \\ \dfrac{d\sigma(k)}{dk} < 1, \dfrac{d\sigma(k)}{dk} > 1 \end{cases}, \quad \beta < 0, \beta > 0, \quad (5)$$

$$Y = Ae^{\lambda t}K^{\alpha}L^{1-\alpha}e^{\beta k}. \quad (6)$$

The assumptions of dependencies of γ, σ and k proposed in this way, on the one hand, guarantee that changes in σ are in direct correlation with changes in k, and, on the other hand, meet all the requirements for this type of production functions. To construct δ-homogeneous production functions of VES type, it is necessary to identify the structure of the production function by solving such a system of differential equations:

$$\begin{cases} \frac{g'(k)}{g(k)} = \frac{\delta}{\gamma(k)+k} \\ \frac{\gamma'(k)}{\gamma(k)} = \frac{1}{k\sigma(k)} \end{cases}, \quad (7)$$

here: δ – homogeneity indicator of the function; k – degree of armedness of the funds k=K/L; g(k) – transformed function in the form:

$$Y = f(K,L) = L^{\delta}f(1,k) \rightarrow \frac{Y}{L^{\delta}} = f(1,k) = g(k), \quad (8)$$

γ(k) – the maximum rate of replacement of labour by capital:

$$\gamma(k) = \frac{\delta g(k) - kg'(k)}{g'(k)}, \quad (9)$$

σ(k) – the degree to which capital can be substituted for labour for the δ-homogeneous function:

$$\sigma(k) = \frac{1}{k}\left(\frac{d\gamma(k)}{dk}\right)^{-1}. \quad (10)$$

Since it is assumed that the choice of the value of δϵ [0.1] is made according to a predefined optimisation criterion, it will be necessary to construct the function g(k) for a given value of δ. If the structure of the function σ(k) is considered, the function g(k) can be defined by these expressions:

$$\gamma(k) = b \cdot exp\left(\int_a^k \frac{dt}{\sigma(t)t}\right), \quad (11)$$

$$g(k) = c \cdot exp\left(\int_a^k \frac{\delta dt}{\gamma(t)+t}\right), \quad (12)$$

where: a, b and c – some positive constants.

Thus, having a definite number of values of the volume of output of finished products $Y = \{Y_i\}$, where $Y = f(L,K)$, $(i = \overline{1,n})$, and values $K = \{K_i\}$,, $L = \{L_i\}$, which are characteristic of the economic system examined during a particular time interval and can be expressed either in value or in index format, it is possible to construct a δ-homogeneous production function of VES-type. In addition, this methodology of calculation has the values of homogeneity indicator δ_j: $\delta_j \in [0.1]$. Due to them it is possible to determine the indicator of the provision with funds of the system examined $k_i = {K_i}/{L_i}$, and the indicators of the function $g^{\delta_j}(k_i)$ at the static indicator δ_j:

$$g^{\delta_j}(k_i) = {K_i}/{L_i^{\delta_j}}. \quad (13)$$

By ordering the values of function $g^{\delta_j}(k_i)$ by increasing values of k_i, a series of g_{lj} $(l = 1, n_l; n_l = 1, n)$ is developed and the values of g_{lj} can be approximated by functions $\tilde{g}_{lj}$ that satisfy the requirement:

$$F_j = \sum_l^{n_l}\left(g_{lj} - \tilde{g}_{lj}\right)^2 \rightarrow min. \quad (14)$$

Thus, based on the developed formulas, using the modelling method, the coefficient of elasticity of substitution of labour activity by capital as one of the important indicators of structural shifts in the economy can be calculated.

Results and Discussion

Prerequisites for structural shifts

During the Soviet period, most of the production capacities and logistic chains in the Kyrgyz economy were developed based on the all-union economic model, which, after independence, led to a significant disproportion of industries. The development of raw material enterprises occurred against the backdrop of declining manufacturing industries, which forced the Kyrgyz Republic to sell low-value-added products for export and, consequently, to lose a significant part of its profits.

To restore the balance between the sectors of raw material extraction and processing, and to attract innovative development technologies to the country, state support programmes have been repeatedly developed; however, due to several subjective and objective reasons, systemic and effective modernisation reforms have not yet been implemented. To date, there is a conceptual mismatch between the existing backward economic structure and the urgent social needs of the population of modern Kyrgyzstan. To destroy this adverse homeostasis, it is proposed to divide the task of structural shifts in the KR economy into separate criteria and, using the existing experience of developed economies, to develop recommendations for each of them. The list of such criteria is debatable, however, in this case, it is proposed to present it in the following form:

1. Systemic shifts in industry structure.
2. Systemic shifts in interregional structure.
3. Systemic shifts in technological structure.
4. Systemic shifts in ownership structure.
5. Systemic shifts in production funds structure.
6. Systemic shifts in competitive structure.

Structural shifts in industries

It is the sectoral shifts that are the most urgent for the economy of Kyrgyzstan. Disproportion and deformation of inter-sectoral interrelationships, which occurred in the 90s of the 20th century, still have an adverse impact on the development of the national economy. Therewith, the country has a high IA potential that should be developed. Historically, it is the agricultural sector that became the foundation of the economy and for a long time was the guarantee of human survival. The agricultural sector of the Kyrgyz Republic, due to objective geographical and climatic conditions, has been facing serious challenges for

many generations. Therewith, it is now that technological development allows the introduction of several breakthrough innovations that will be able to partially offset the adverse environmental impact. The policy of sustainable development in the agricultural sector involves finding ways to optimise the utilisation of available resources and the efficient use of production capacities to reduce production costs and improve the quality of products.

N. Parpieva *et al*. [14], who explored this issue, considered the efficiency of resource utilisation in Kyrgyzstan's agriculture in the context of sustainable development policy. They called the main tasks of the country's IA the assessment of resource potential, work on the availability and efficiency of these resources, and improve the competitiveness of the national agrarian economy, which echoes the development of recommendations for the establishment of structural shifts reflected in this work. Modern agriculture in the Kyrgyz Republic is characterised by low levels of innovative investment and, consequently, low efficiency [15; 16]. This self-sustaining pattern has been going on for years and has already led to a significant decline in the potential of agricultural land, as over the years engineering and irrigation facilities have deteriorated and become obsolete, and potential investors in the sector, seeing the current state of affairs, avoid risky investments. To overcome this situation, it is necessary to consider that the process of shifting employment from IA to higher-margin industries has been a global trend for the past ten years. As developing economies grow, demand for non-food goods and services increases, and the labour force previously employed in IA moves to more modern and higher-paying sectors of the economy.

Therewith, mechanisation and automation of production, and using more advanced fertilisers and resistant genetically modified crops, lead to a decrease in using unskilled human labour against the backdrop of increasing yields. Consequently, the solution for Kyrgyzstan's agricultural sector should not be a quantitative factor requiring maximum involvement of low-skilled workers, but a qualitative shift designed to introduce digital technologies and purchase comprehensive programmes to increase yields. The tools for such a structural shift could be:

1. Establishing a favourable investment climate for foreigners with the right to dispose of the result of labour, but without land ownership.
2. State support for preferential lending to agrarians.
3. A set of measures designed to add value to human capital, such as training farmers in digitalisation.
4. A centralised programme for the purchase of complete technological cycles for the cultivation of safe genetically modified products by the state and their subsequent leasing to small and medium-sized farmers.
5. Systematic erosion control of agricultural lands and reclamation works designed to expand their fund.

Some positive changes in the development of industries in Kyrgyzstan can be observed now. Thus, according to the official statistics of the National Statistical Committee of the Kyrgyz Republic [17], the production of the main types of agricultural products in farms of all categories in 2022 increased compared to previous periods. More detailed data on types of agricultural products are presented in Table 1.

Table 1. Production of main types of agricultural products in KR by years, thousand tonnes

Crop	2018	2019	2020	2021	2022
Grain	1741.5	1781.4	1856	1329.1	1867.3
Raw cotton	74.7	80.2	72.8	66.9	76.5
Tobacco	1.8	0.9	1	1.1	1.2
Sugar beet	773	741.1	448.8	365.6	468.1
Potato	1446.6	1373.8	1327.2	1289.1	1275
Vegetables	1094.9	1113.6	1131.2	1114.2	1163.6
Meat	221.3	226.2	230.4	230.5	248.3
Milk	1589.7	1627.8	1668	1698.9	1734.1
Eggs, million pcs.	533.2	561.3	562	564.2	607.9
Wool	12.8	12.9	13.1	13.1	12.9

As presented in Table 1, production volumes for grains, vegetables, meat, milk, and eggs in 2022 are higher than the four previous years, indicating that the industry is ready for structural change.

Systemic shifts in interregional structure

These changes imply the elimination of the imbalance that has developed in certain regions of the country due to their resource, geographical or social peculiarities. The uneven contribution of some regions of Kyrgyzstan their regional products to the total GDP has led to the conventional division of the country into subsidised regions and donor regions. Therewith, the experience of developed countries suggests that the optimal solution is to delegate a significant part of state management to the localities since it is there that a fair compromise between the interests of regional communities interested in ensuring regional development and the national policy of the central government is possible.

Considering regional peculiarities due to traditional-social, resource and organisational capabilities, local communities should form a local network system that includes, in addition to territorial authorities, public representatives, journalists, popular bloggers, influencers, opinion leaders, and elders. Under these conditions, as the regions evolve, a platform will be developed where local business entities will be able to coordinate and synchronise their actions. The principles and sources of funding for such initiatives are important. It is optimal to develop regional development funds to address specific problems and tasks in a particular territory. To avoid corruption and bias, all cash flows and investments to implement regional

projects should have specific and transparent purposes, and funding decisions should be based on the results of competitions [18-20]. In addition, clustering is an essential factor of regional development, which provides, on the one hand, an inflow of financing, and, on the other hand, develops a specific thematic niche and attracts specialists of a specific profile. In this case, employees united by the same interests establish their community in the cluster, in a sense a "community of interest", which has a positive impact on the growth of human capital and eliminates staff turnover. In addition, the establishment of such regional structures is a good practice for local authorities that improve their project management skills in the course of their work.

As mentioned above, competitions and grants should be an integral part of such a model of regional development, as they increase the level of trust on the part of the population, give every citizen a chance for a social elevation and are a guarantee of targeted and reasonable use of funds. Last but not least, this approach is crucial for the change of elites, developing a new managerial culture and eliminating the corruption that Kyrgyz people inherited from the era of rigid centralisation and administrative distribution. The current imbalance of the regions is demonstrated by the following indicators obtained from the National Statistical Committee of the Kyrgyz Republic [21]. The difference is as follows:

1. In terms of average monthly wages – almost 2 times (Bishkek – 34154 soms, Osh region – 17626 soms).
2. In terms of poverty rate – 4 times (Jalal-Abad region – 52.7% vs. Chui region – 13.2%);
3. In terms of unemployment rate – 2.2 times (11.3% in Batken region, 5.1% – in Talas region).
4. In terms of investments in fixed capital, Issyk-Kul region's indicators are 22 times higher than those of Talas region.
5. In terms of regional gross product – 13 times (in Bishkek city – 39% against 3% of Naryn region).

This disproportionality of regional development was noted by G.G. Das *et al*. [22], who, based on the results of a study of nine regions of the Kyrgyz Republic using a comparative-static general equilibrium model, concluded that the disruption of regional balances both has an extremely adverse impact on the living standards of the population and increases social tensions in the Republic and even threatens its territorial integrity. Thus, to maintain governability, Kyrgyzstan requires structural shifts in decentralisation and strengthening of regional centres. The priority steps towards such structural shifts are as follows:

1. Identifying their local "locomotive of development", the conventional priority area that needs to be developed.
2. Development of a detailed sustainable development strategy for each territorial entity – from region to aiyl aimak – with fixation of intermediate benchmarks.
3. Toughening of centralised legislation against even minimal manifestations of corruption.
4. Establishment of regional development funds.
5. Increasing communication between community residents, establishing and maintaining local websites, Facebook pages, Telegram feeds, and other activities to support citizens' sense of belonging to their community.

Reducing dependence on toxic economies under international sanctions to zero.

Systemic shifts in technological structure

Technological changes are primarily conditioned upon the introduction of innovative practices of the new way of life into the national economy. The global focus on technology development leaves no choice for national economies. Those countries that lag behind the current innovation trends at this stage will no longer be able to compete for the markets of highly processed products and will remain only a raw material appendage of the developed world. Therefore, Kyrgyzstan must make a structural shift in this area and implement its innovation potential as soon as possible, finding the necessary resources both for revolutionary technological development and for mental changes in society, involving an increase in the level of education and growth of human capital of citizens. A separate task is the need to make an innovative breakthrough with simultaneous modernisation of the social sphere to ensure the growth of competitiveness of domestic human capital without departing from the principles of the social state.

The current situation in the field of research and development (R&D) in Kyrgyzstan is worrying, as the country's scientific and technological potential is not in demand and has been stagnating for several decades. It is easier and cheaper for both government agencies and businesses in the Kyrgyz Republic to acquire ready-made technological solutions abroad – equipment, programmes, and know-how of the chemical industry – than to design domestic developments from scratch. This dependence on imported suppliers, plus difficulties in attracting investment in R&D due to the declining prestige of knowledge-intensive industries in Kyrgyzstan, and a high level of corruption, which increases the cost of any start-up, puts domestic innovation activities in an inherently lose-lose situation.

The solution could be the establishment of a system of innovation and technology centres (ITCs), starting with the development of a protectionist legal framework and ending with the attraction of Western grants. Such ITCs should become foci that unite technological chains of innovation infrastructure, linking people, finances and production facilities. In addition, at a higher level, ITCs will become platforms that bring together regional, national and industrial policy interests. The infrastructure of innovation and technology centres will include various educational institutions, legal assistance companies, science and technology parks and business incubators. Therewith, technoparks, working in individual settlements, on the one hand, influence their social and technological development, and, on the other hand, provide residents of these territories with additional employment opportunities. At this stage, practical work in this area is already underway – an innovation centre has been established in Karakol based on the K. Tynystanov Issyk-Kul State University, and a joint Kyrgyz-Turkish technopark is planned to be opened in Bishkek's Manas University.

South Korean researchers E. Lee & J.S. Mah [23] explored the economic development and industrialisation of Kyrgyzstan in the transition period and gave their assessment of the country's innovation potential.

According to the authors, Kyrgyzstan needs to think now about the next stage of economic development and a new industrial-oriented strategy of economic development. To strengthen such industries, it is crucial to strengthen infrastructure and make the necessary investments in human capital development. The assumption that the Kyrgyz Republic can benefit from the promotion of value-added industries is particularly valuable from experts from South Korea, the country that was able to implement the economic "Miracle on the Hangang River". The dynamics of technological development of Kyrgyzstan can be assessed by the indicators of using information and communication technologies by enterprises and organisations. Detailed information is presented in Table 2.

Table 2. Key indicators on using information and communications technology

Indicator	2018	2019	2020	2021	2022
Total companies	12152	12701	11491	11112	11477
Of these were used:					
1. PC	11881	12421	10692	10765	11029
2. Local computer networks	3531	3683	3417	3201	3248
3. Email address	6833	8080	7821	7780	8208
4. Internet	6271	6604	7195	7355	7651
5. Dedicated ADSL lines	4370	4623	4541	4206	4287
6. Own websites (in Kyrgyz language)	1915 (472)	2041 (554)	1910 (561)	2174 (595)	2316 (625)

Source: Kyrgyzstan in figures [14].

As can be observed from the table, the development of digital technologies in Kyrgyzstan at the level of organisations and their employees is growing. Particular attention should be devoted to the positive dynamics of using the native language on the websites of organisations. As part of the upcoming structural shifts in the technological structure of the Kyrgyz Republic, it is necessary to highlight the programme for the construction of small hydrological, wind and solar power plants throughout the country. In particular, 19 plants are planned to be built in 2023 alone, including hydroelectric power plants (HPPs) in Bala-Saruu, Leilek, Kyshtut, Kogart and Issyk-Ata, and SESs in Kun-Bulagy and Bishkek.

Systemic shifts in ownership structure

In addition, the privatisation of state property is an essential factor in economic reforms. After the collapse of the Soviet Union, privatisation of enterprises and an increase in the share of private property were the first systemic signs of a free market. The transition from a planned economy and command and control system to market relations was a chance for Kyrgyzstan to improve the efficiency of individual employees and teams and entire industrial sectors.

The first stage of privatisation and the development of the private sector in the economy began immediately after the Republic's independence when the majority of the country's residents became owners of shares in spontaneously privatised enterprises [24; 25]. In addition, as part of "small-scale privatisation", small trade, consumer services or catering facilities were sold for relatively symbolic sums of money to the labour collectives themselves. It was through these shops, hairdressing salons and cafés that the first structural shift occurred in the minds of citizens, exposing many of the pros and cons of a market economy.

At the second stage of privatisation in the mid-90s, large machine-building plants, energy enterprises, and coal mines were already among the enterprises to be privatised. A socially just project was developed, according to which all citizens received special coupons (upai) and the opportunity to exchange them for shares in large enterprises through a system of special investment funds at coupon auctions. However, even the second phase failed to achieve the declared purposes, namely fair distribution of state property to the population. The management of the most attractive objects, taking advantage of the financial illiteracy of former Soviet citizens, purchased shares for nothing, and those objects that did reach ordinary shareholders had no prospects for development and were soon subject to bankruptcy proceedings [26-28].

In the early 2000s, as part of the third stage of property redistribution, such landmark enterprises for the Kyrgyz economy as Kyrgyztelecom, Kyrgyzenergo, Kyrgyzstan Aba-Zholdoru, and Kyrgyzgaz were restructured. Large foreign enterprises, such as Reemstma and Coca-Cola, gradually entered the market and organised their production and logistics in the Kyrgyz Republic, laying standards of modern management and corporate culture. Despite the correct purpose of all three waves of privatisation aimed at establishing a market economy and transforming the inefficient state machine, the key purposes were not achieved. In addition to the fact that citizens could not be made full-fledged co-owners of businesses, the very choice of privatisation objects was questionable, the system of consulting inexperienced private investors was not thought through, and there were no legislative mechanisms for arbitration.

However, the main adverse result of the privatisation reforms of that time was the property stratification of the population, during which the overwhelming majority of Kyrgyz people became very poor and a few became very rich. Therewith, the true foundation of a successful market economy and democratic system – the middle class – never emerged. Nevertheless, the "invisible hand of the market" was able to standardise some processes at the level of private enterprise over time, and the additional degree of economic freedom for citizens gradually bore fruit. After exploring the characteristics of private enterprise in Kyrgyzstan, M. Avcı & K. Ardıç [29] conclude that to establish a business based on sustainable development, it is necessary to focus on the adaptation and implementation of information technology, and for the implementation of this task, cooperation between the private and public

sectors is particularly important. Table 3 contains data that demonstrates the changes in the ownership structure of Kyrgyzstan over 5 years.

Table 3. Indicators of small and medium-sized enterprises in the Kyrgyz Republic

	2017	**2018**	**2019**	**2020**	**2021**
Number of small enterprises (SE)	13858	14520	16199	16302	16252
Number of medium-sized enterprises (SME)	795	769	779	717	798
Number of individual entrepreneurs (IE)	389778	401658	411405	418763	429985
Number of farms	428730	439602	452308	461581	467423
Number of employed, SE+SME+IE, thousand people.	479	493	519	520	523

Source: Small and medium enterprises [30].

According to the above data, there are positive dynamics throughout the entrepreneurial structure of Kyrgyzstan. Therewith, for a structural shift in this area, further liberalisation of legislation is needed to remove existing barriers for private entrepreneurs and promote the development of a middle class.

Systemic shifts in production funds structure

It is changes that ensure that the share of inputs exceeds the share of retired equipment and are a guarantee of material resources renewal. Modernisation of fixed production assets, as expensive means that serve for a long time and transfer their value to the manufactured products gradually, is a key strategic task of the modern economy. Engineering solutions at this stage allow, through resource-saving and waste-free technologies, to increase the quantity of finished products and stock output using the same volumes of raw materials. Another way to increase productivity is through the development of specialisation programmes. Specialised, and therefore simplified, production structures enable the discharge of workers from auxiliary and maintenance services, which allows the company to increase the shift ratio without increasing the number of employees and to run second or third shifts, minimising downtime.

Therewith, notably, after the elements of production assets are commissioned, the process of their physical ageing and deterioration starts, which adversely affects such production characteristics as accuracy, reliability and efficiency. Decrease in labour productivity, and increase in electricity, fuel and raw materials costs caused by wear and tear are supplemented by increase in repair and maintenance costs of obsolete equipment. To compensate for these losses, the mechanism of depreciation is used, which involves the gradual transfer of the cost of wearing equipment to the products that are produced with this equipment. In a conventional economy, a high share of depreciation and amortisation is a guarantee of business development, as these costs are part of the profit, which is not subject to taxation [31-33].

In addition to the physical and functional ageing of fixed assets, there is their moral deterioration, and the more innovative technologies are actively developed in the world, the faster such ageing occurs. Old equipment inevitably loses its residual value, similar models are withdrawn from production, which, in turn, affects the availability and price of spare parts. Thus, very soon there comes a point when it is cheaper for the owner to purchase new technological equipment than to maintain the increasingly expensive operation of the old one. Meanwhile, the fourth industrial revolution, based on digital technologies, affects both production relations and the life of society in general, which means that it should be considered both in the economic and the social aspect, which is especially relevant for Kyrgyzstan [34; 35].

In addition, this idea is traced in the work of N. Rajaonarison & N. Tanaka [36], who, having explored the dynamics of technological development of industry in the Kyrgyz Republic, found a direct correlation between fixed assets upgrades and the growth of human capital at enterprises. In addition, the authors proved that in Kyrgyzstan there was a decrease in the poverty rate along with an increase in annual per capita income, and they named construction, wholesale and retail trade, and transport as the most promising sectors of the economy. This focus on specific sectors should help to shift investors' attention to these areas, reducing dependence on gold mining and remittances from labour migrants.

K. Mehta *et al.* [37], in turn, explored the problem of modern industrial foundations in terms of sustainable development and renewable energy in Kyrgyzstan. In their work, they analysed the country's development potential in this area and concluded that the reorientation of production facilities to solar energy will significantly strengthen the economy of the Kyrgyz Republic, since practically all over the country there are zones with favourable relief, and the intensity of solar radiation here is on average 60% higher than in most of the European territory. Returning from theory to practical indicators, the actual volume of industrial production in the Kyrgyz Republic can be noted. The data for the previous five years by region are presented in Table 4.

Table 4. Industrial output (by region)

	2018	**2019**	**2020**	**2021**	**2022**
Kyrgyz Republic	257349	283972	325090	370534	425946
Batken region	2811	2975	3111	4349	4547
Jalal-Abad region	26808	28711	28306	36609	45375
Issyk-Kul region	49965	62280	78831	74738	88130
Naryn region	2623	2870	3207	3294	4004

Osh region	9621	10386	9458	13517	14575
Talas region	1291	1578	1900	15129	22855
Chui region	116570	128103	155656	167981	183840
Bishkek	42841	42292	40054	48979	56548
Osh	4819	4776	4568	5938	6072

Source: Production volume to the industrial products on territory (million soms) [17].

The year-on-year growth of industrial production indicators, both in individual regions and by regions, demonstrates a correctly chosen replacement strategy in the structure of fixed production assets.

Systemic shifts in competitive structure

The establishment of conditions for fair competition is the most important step towards the development of a full-fledged market economy. After gaining independence, Kyrgyzstan had to fight the state monopoly in most sectors, as only free and fair competition could contribute to the growth of the quality of goods and services and the expansion of their nomenclature. It was these changes that ensured the development of the market, the emergence of new players and optimised technologies. Equal and transparent conditions for doing business allow entrepreneurs to invest without fear in technology upgrades and, as a result, reduce costs, increase profit margins and receive even more funds for development [38; 39].

Therefore, the national policy of the Kyrgyz Republic is developed according to the principles of fair competition and, if necessary, guarantees entrepreneurs protection from monopolism. Legislatively, these relations are regulated by a special Antimonopoly Regulation Service under the Ministry of Economy and Commerce of the Kyrgyz Republic and the Law of the Kyrgyz Republic "On Competition" dated 22 July 2011 No. 116. The most important component of full-fledged competition is the possibility of access to commodity markets for foreign suppliers. In this area, Kyrgyzstan is guided by civilised provisions and ensures unimpeded integration of its economy into the global world, being a guarantor of the safety of foreign investors' activities on an equal footing with residents of the Kyrgyz Republic. Therewith, in case of necessity to protect domestic producers, the authorities of the country may apply additional privileges and protections, which is not a violation of international antimonopoly law.

C.Y. Lee [40] explored the problem of developing a competitive culture in Kyrgyzstan from the perspective of South Korea's experience, where a strong and binding corporate culture is rightly considered a critical component of organisational success and impressive economic development of the country. Since Kyrgyzstan has similar traditions and culture, its leaders carefully examine the Korean management style and corporate culture, considering it as a model for Kyrgyz organisations. In the author's opinion, modern Kyrgyz managers need to consider the mistakes of their Korean colleagues and avoid them when developing a competitive culture at home. An indicator of the correct antimonopoly national policy is the dynamics of foreign trade volumes as in case of deterioration of the investment climate, foreign suppliers have the opportunity to quickly switch commodities and money flows to more favourable markets. Indicators of foreign commodity turnover of the Kyrgyz Republic are presented in Table 5.

Table 5. Main indicators of foreign trade in goods

	2018	**2019**	**2020**	**2021**	**2022**
Total external turnover, million USD	7128	6975	5692	8332	11816
Of them, with the countries of the Commonwealth of Independent States (CIS)	3246	3228	2899	4063	5271
Of them, outside CIS countries	3882	3746	2792	4270	6545
Of them, with EAEU countries	2802	2742	2440	3426	4532
Of them, outside the EAEU countries	4327	4232	3252	4906	7284

Source: Kyrgyzstan in figures [21].

Despite the positive dynamics of foreign trade, Kyrgyzstan's potential for developing transparent competition remains quite large. A structural shift in this area could be the codification of disparate antimonopoly legislation and the development of a universal Entrepreneur's Code establishing uniform regulatory principles. This Code should exclude such manifestations of monopolism as the dominance of individual economic entities, cartel collusion between representatives of the same industry, and dumping or, on the contrary, excessive monopoly prices.

Calculation of the elasticity coefficient

One of the significant indicators of structural shifts in the economy is the coefficient of elasticity of substitution of labour activity by capital. This coefficient can be calculated by the modelling method based on the formulas developed above. Based on the data characterising the functioning of the KR economy in the period from 2001 to 2021, a δ-homogeneous production VES-function of the following form was obtained:

$$Y = 32{,}17e^{0{,}21}K^{0{,}48}L^{0{,}5}e^{-2{,}32k}. \quad (15)$$

The value of σ in this case was:

$$\sigma = 1 + \frac{\alpha k}{[b-\alpha k]^2 - b}, \quad (16)$$

where: α=2.32; b=0.48.

To test the significance of the obtained results, the calculation of the approximation characteristic was

performed, which demonstrated the following values: s^2=0.13; dw=2.01; v=3.32; R^2=0.834. The values of these coefficients demonstrate that the obtained parameter estimates are statistically significant. Therewith, the coefficient of elasticity of production funds is on a downward trend, and the indicator of fund yield, while the elasticity of labour is growing, albeit insignificantly. The sum of the coefficients of these two factors does not exceed unity, which means that the growth of production does not overlap the volume of costs. Thus, due to the calculated production VES-function, an approximate value of the result of the economic system Y and the transformed function g(k) was obtained in the range from 75% to 82% to the initial data. Notably, the VES-function developed in this research yields a lower standard deviation than the previously used CES-functions. Consequently, the calculation methodology used in this work is more reliable and offers more accurate approximations of values and functions.

Conclusions

The analysis of possible structural shifts in the economy of Kyrgyzstan, conducted in this work, is intended to help in choosing further ways of development of the country. The current state of affairs forces to acknowledge that for three decades of independence, the Kyrgyz Republic has not managed to fully emerge from the post-Soviet paradigm and eliminate the legacy of command and control administration. There is still a low level of development of logistics infrastructure, a significant predominance of imports over exports, a high share of the shadow economy and dependence of households on remittances of those family members who were forced to go to work in other countries. Therewith, positive economic and social processes are occurring in Kyrgyzstan, which need to be supported at the state level as long as public opinion trusts them.

One of the tools for calculating the efficiency of such changes is the proposed methodology for calculating the coefficient of elasticity of labour-capital substitution. By using such a VES-type production function, it will be easy to determine how much and in what proportions labour and investment should be invested in the development of a particular sector of the economy. Moreover, using this function, calculations can be performed at the level of an individual production enterprise, calculating the most optimal ratio of labour and investment resources. Due to this property of the model and due to such aggregation, it is possible to explore the economy of the state in general, without reducing it to a purely sectoral section.

This complex calculation of the elasticity of labour-capital substitution at the national level could be the subject of further research. In general, the most promising steps in terms of structural shifts include opportunities for reallocation of resources between industries and regions and changes in innovation policy. For example, shifting financial flows from purely commodity-based industries to the processing industry and the resulting higher value-added products will affect the profitability of the entire chain of production processes. The same applies to shifts in geographical specialisation, where regions deprived of mineral resources will be able to make a comparable contribution to Kyrgyzstan's GDP due to the development of digital technologies and the establishment of an appropriate ecosystem. In addition, attention should be devoted to stimulating privatisation and anti-monopoly processes, as their previous waves did not bring the planned effect.

Necessary economic changes for the Republic are impossible without programmes of renewal and modernisation of the main production assets, which means that morally and physically obsolete equipment and machines must be replaced by new models, financing these shifts either through public funds within the framework of targeted programmes or through the crowdfunding system. The second option is preferable, as this system involves the accumulation of private funds for a specific technological project. Thus, the contribution by an individual or household of even a small amount of their funds will increase financial responsibility among the population and help to find additional investments for technological upgrading of the production sphere.

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Conflict of Interest

None.

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Структурні зрушення в економіці та економічне зростання Киргизької Республіки

Чолпон Аскарова
Киргизький національний університет імені Жусупа Баласагина
720033, вул. Фрунзе, 547, м. Бішкек, Киргизстан

Калибек Чороєв
Киргизький національний університет імені Жусупа Баласагина
720033, вул. Фрунзе, 547, м. Бішкек, Киргизстан

Топчубай Култаєв
Ошський державний університет
723500, вул. Леніна, 331, м. Ош, Киргизстан

Анотація

Актуальність. Після трьох десятиліть незалежності економіка Киргизької Республіки все ще не змогла здійснити повноцінний перехід до ринкової економіки. При цьому розвиток технологій у всьому світі значно прискорив інноваційні, економічні та соціальні процеси, а це означає, що у Киргизстану залишається все менше часу, щоб скоротити відставання, і потрібно діяти швидко.

Мета. Щоб зробити якісний стрибок у розвитку, потрібні фундаментальні структурні зрушення, і мета цієї роботи – розглянути різні сфери застосування таких зрушень та розробити рекомендації щодо подальших кроків у цьому напрямку.

Методологія. Метод статистичного аналізу було використано для дослідження динаміки економічних показників за попередні кілька років, а метод моделювання – для розрахунку одного з найважливіших індикаторів структурних зрушень в економіці – коефіцієнта еластичності заміщення праці капіталом.

Результати. В результаті було досліджено шість ключових параметрів економічної трансформації – у секторах, регіонах, технологіях, власності, основних фондах та добросовісній конкуренції – і для кожного з них розроблено рекомендації щодо майбутніх структурних зрушень. Крім того, було розраховано коефіцієнт еластичності та підкреслено переваги використання запропонованого типу виробничої функції.

Висновки. Практична значущість роботи полягає в розробці більш продуктивного методу розрахунку еластичності, ніж традиційний, який враховує зміни показників заміщення праці капіталом. Крім того, практичне значення мають підготовлені пропозиції щодо структурних зрушень в окремих сферах національної економіки Киргизстану з урахуванням позитивного досвіду ряду провідних світових економік.

Ключові слова: інновації; приватизація; вільна конкуренція; міжнародний досвід; виробнича функція; еластичність заміщення.