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## Analysis of physical economic theory implementation efficiency in the economic activity of Azerbaijan

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**Abstract.** The physical and economic theory is under-investigated and has no clear definition of its determinants. The main goal of the economic activity of any country is the generation of capital and progress. Azerbaijan is characterised by economic growth, which is accompanied by the country's material resource usage and production of goods by using energy resources and a labour force. The rational use of material resources is quite important, which is the basis for the formation of the country's profitability and the introduction of innovations. That is why the issue of physical economic theory implementation in the economic activity of Azerbaijan is relevant. Establishing the effective use of physical economics in the functioning of the country will help identify the main flaws and develop the main ways to improve the economic activity of Azerbaijan. That is why the study aims to investigate and generalise the aspects of physical economic theory implementation in the economic activity of Azerbaijan. By using the induction method, the determinants of the physical economy were established, which include indicators of industry, energy, trade, and human capital. The analytical method determined that although the economy of Azerbaijan employs a physical economy efficiently, there are problems with the development of production, energy consumption, and labour force. As such, it was determined that the main ways to improve the efficiency of the physical economic theory implementation in the economic activity of Azerbaijan should be: the development and implementation of measures to increase the efficiency of beverage and tobacco, mineral fuel, lubricant, and related material production and employment of measures to reduce energy consumption in the production of non-metallic minerals, iron and steel, chemical and petrochemical products, non-ferrous metals through the introduction of innovative technologies. At the same time, the number of jobs should be increased, the skills of workers should be developed, and the quality of education in Azerbaijan should be improved following international standards. As such, the practical value of the research is predetermined by the characterisation of the main determinants of the physical economy of the country, which can be used in further scientific research to analyse the effectiveness of the physical economic theory implementation in the economic activity of countries

**Keywords:** industry; energetics; trade balance; human capital; wealth; progress



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## INTRODUCTION

With the development of economic science, the concept of physical economic theory was introduced. The modern economic activity of Azerbaijan is based on the use of physical economic theory. The effectiveness of this theory usage is an important issue in the aspect of the development of Azerbaijan's economic stability. It is important to establish the definition and origin of "physical economy" as this term is a new concept that requires a detailed study and personification. Currently, there is no single defined approach to the interpretation of this concept and the corresponding theory. The first to address the concept of "physical economy" was L. Larush (1997), who interpreted this concept as an economy based on the exact natural sciences. The basis of this theory is that the mathematical form of economic laws coincides with the mathematical form of several physical laws. L.F. Vasilevich and M.L. Vasilevich (2013) and Hasanov & Huseynov (2013) considered the nature of physical economics and added the word "fuzzy" to this term, explaining that in economics not all quantities can be measured as in physics, so the authors consider it appropriate to set some of the indicators in the form of fuzzy data, and the theory is called "fuzzy physical economics". Researchers have established that the basic principle of fuzzy physical economy is an optimal approach for the main categories of economics, which include information, risk, and cost. When making economic decisions, the one that is available under the condition of acceptable risk, minimum time, and provides the maximum value per information required is accepted. D.A. Nayko and O.F. Shevchuk (2011) and Magalhães *et al.* (2019) consider the physical economy as a system of measures to build the economy on the model of natural sciences (physics) using mathematical modelling. The physical economy is viewed by researchers based on three principles. First, human actions are formed based on behavioural reactions formalised in the form of supply, demand, income, and expenditure functions. Secondly, although market stability is ensured by the balance of supply and demand, and costs and revenues, these functions are variable due to the development of science and technology, which is why equilibrium never occurs, although the system is constantly moving towards it. Thirdly, physical economy according to scientists should be based on the theory of systems. E. Jonathan (2022) explains physical economics as a theory of physics and economics whose main goal is to establish a connection between financial currency and the use of energy as the most reliable method of enrichment and progress. Wealth and progress are also investigated in this theory. Physical economics is not considered by the researcher as an ideology. According to the author, the physical economy is that humanity is the main factor of progress and wealth, following the current level. That is, the world is predetermined to progress. Progress in terms of physical economic theory is seen as an in-

crease in the amount of energy that humanity converts from one form to another. S. Gierlinger and F. Krausman (2012) and Raupova *et al.* (2014) interpreted the concept of physical economy as the evolution of the use of materials and energy. That is, the authors define material intensity as the main indicator of physical economic theory. The main indicators of the physical economy of a country are domestic production, imports, and exports; domestic consumption of materials, physical trade balance, and material intensity, which is the inverse of material productivity. The researchers also call the level of material and energy consumption per capita the metabolic rate. P. Richmond, J. Mimkes and S. Hutzler (2013) considered the physical economy based on the approach based on two-dimensional numbers and a model that defines the production process as a cycle.

As such, the physical economy should be considered as a set of economic processes that have specific patterns, derive from the cycle of production created by mankind, and can be explained by mathematical modelling. As for Azerbaijan, the physical economy is gaining momentum, accompanied by the significant economic growth of the country in the world markets. The purpose of this study is to analyse the aspects of implementation of physical and economic theory in the economic activity of Azerbaijan.

## MATERIALS AND METHODS

The theory and methodology of the study are based on the main expert and scientific research on physical economic theory from Azerbaijan, the European Union, France, Ukraine, and the United States of America. The following methods were used in the study. The analysis was used to establish the specific features of the meaning of the category "physical economy", to define the essence of physical economic theory, and to establish the main determinants of physical economy.

The analysis was used to determine the features of the physical economic theory implementation in the economic activity of Azerbaijan during 2017-2021. This method was also used to systematise the data on the determinants of the physical economy industry of Azerbaijan in terms of the structure and production of food and live animals, beverages and tobacco, raw materials, inedible, except for fuel, mineral fuels, lubricants, and related materials, animal and vegetable oils, fats and waxes, chemicals and related products, industrial goods classified mainly by material, machinery and transport equipment, various industrial products, and other goods. This method was used to analyse the determinants of energy in the physical economy of Azerbaijan and to consider the indicators of GDP at purchasing power parity in 2017, final energy consumption, energy capacity, total energy supply, energy intensity, and GDP produced as a result of energy consumption per unit, and to determine the amount of energy consumed

for the production of iron and steel, chemical and petrochemical products, non-ferrous metals, non-metallic minerals, transport equipment, machinery, food, and tobacco. The analysis was also used to highlight the determinants of physical economy trade in Azerbaijan and to identify the main trends in the development of exports, imports, trade turnover, and trade balance of the country under study. This method was used in the analysis of human capital determinants of the physical economy efficiency in the country's economic activity and was employed in the consideration of indicators of the average annual population, the number of the economically active population, the number of employed, including by ownership, the number of unemployed persons, the number of those who received the status of unemployed in the state employment service and those receiving unemployment benefits, the number of employed women, the number of employees.

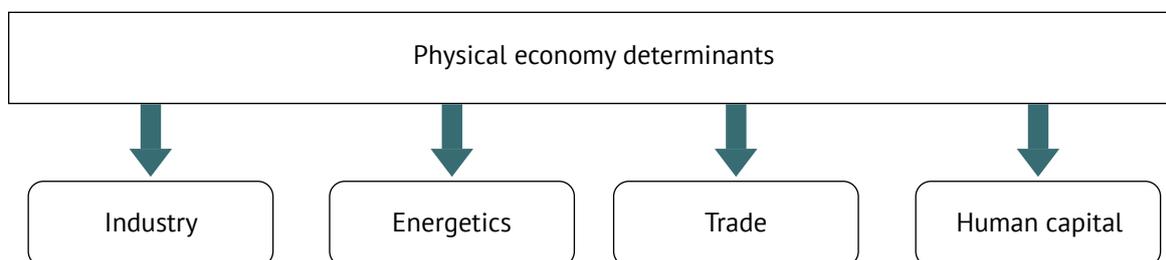
By using the induction method on the preliminary analysis of the state of physical economy indicators, the ways of improving the efficiency of the application of physical economic theory in the economic activity of Azerbaijan were developed and the main areas of improvement of industry, energy, and human capital development were characterised.

The research information is based on the studies by researchers from Azerbaijan, the European Union,

Ukraine, France, and the United States of America on the effectiveness of the application of physical economic theory in the economic activity of the country. For characterising the determinants of the effectiveness of the implementation of physical economic theory in the economic activity of Azerbaijan, the data of the State Statistics Committee of Azerbaijan (2021) on the metrics of industrial production, energy consumption, the trade balance of the country, and the labour market was used.

## RESULTS

The issue of analysing the effectiveness of the physical economic theory in the economic activity of the country has not been previously considered in the scientific literature. Nowadays, physical economic theory is quite vague and does not have a clearly defined approach. It is only established that the physical economy is based on the use of material resources and energy and their transformation into wealth by a person, which, in turn, entails certain laws and can be mathematically modelled (Richmond *et al.*, 2013). However, there are no specifics as to which indicators of the country's activity should be attributed to the physical economy in the scientific literature today. That is why the study identified the determinants of the physical economy and divided them into indicators of industrial, energy, trade, and human capital development (Fig. 1).



**Figure 1.** Physical economy determinants relative to the economic activity of the country

**Source:** compiled by the author

Determinants of the physical economy industry concerning the economic activity of the country reflect the specific features of the state of production results. That is, they facilitate the analysis of the production of the goods by using the country's resources. This is where the law of physical economy is used when one energy is transformed into another. Energy indicators in the aspect of the physical economy should be considered as the consumption of energy resources for production. The use of energy allows changing the form of materials from one to another. Meanwhile, foreign trade, mainly exports and imports, is also a determinant of the physical economy. The trade balance of the country reflects the physical economic activity of the state in international markets. Human capital is integral for the circulation and interaction of the above determinants of the physical economy. After all,

it is the person who is the basis of the economic and physical development of the country. In this aspect, it is advisable to consider the saturation of the country's labour market, which allows the introduction of the latest technologies and innovations in the country. In general, a set of industrial, energy, and trade determinants in interaction with human capital form the physical economy of the country.

During further research in order to analyse the effectiveness of the physical economic theory in the economic activity of Azerbaijan, the features of the development of certain determinants of the physical economy are considered. First, the analysis was carried out and the growth rates of the determinants of the industry of the physical economy of Azerbaijan were determined. The main indicators are the volume of production in the country by industry (Table 1).

**Table 1. Industrial physical economic determinant dynamics of Azerbaijan according to the industry sphere, thousand USD, 2017-2021**

Sections of commodities	2017	2018	2019	2020	2021	Growth rate. %
Total	8.783.301	11.465.915	13.667.475	10.732.039	11.705.787	33.27
Food and live animals	1.282.743	1.270.899	1.558.029	1.553.766	1.768.186	37.84
Beverages and tobacco	231.804	250.314	182.630	143.657	165.614	-28.55
Raw and inedible materials (except fuels)	231.128	313.645	362.083	271.888	323.304	39.88
Mineral fuels, lubricants, and related materials	378.811	723.720	827.328	280.263	333.637	-11.93
Animal and vegetable products, fats, and waxes	125.217	114.043	115.474	137.930	188.839	50.81
Chemicals and related products, not specified elsewhere	1.040.095	1.192.782	1.313.403	1.347.707	1.520.877	46.22
Manufactured goods classified primarily by material	1.684.695	2.173.823	2.140.640	2.002.315	2.148.879	27.55
Machinery and transport equipment	2.933.283	3.481.462	3.876.177	4.033.988	4.054.860	38.24
Miscellaneous manufactured articles	860.019	1.124.657	1.161.676	959.591	1.102.344	28.18
Commodities not classified elsewhere in SITC	15.507	820.570	2.130.037	934	99.248	540.00

**Source:** The State Statistical Committee of the Republic of Azerbaijan (2021)

Table 1 shows that in general, production in the industry of Azerbaijan tended to grow by 33.27%, which indicates an increase in the level of efficiency of the physical economic theory application in the country's economic activity. At the same time, during 2017-2021, there was an increase in the production of food products, raw inedible materials (except fuel), animal and vegetable oils, fats and waxes, chemicals and related products, industrial goods (classified

mainly by material), machinery and transport equipment, various industrial products. Goods that are not classified to the rest have experienced significant growth in the industry. At the same time, the volume of industrial production in Azerbaijan of beverages and tobacco, mineral fuels, lubricants, and related materials decreased. Industrial production structure in the span of the analysed period had the following nature (Table 2).

**Table 2. Dynamics of the industrial physical economic determinant dynamics of Azerbaijan according to the industry sphere, % from 2017 to 2021**

Sections of commodities	2017	2018	2019	2020	2021
Total	100.0	100.0	100.0	100.0	100.0
Food and live animals	14.6	11.1	11.4	14.5	15.1
Beverages and tobacco	2.6	2.2	1.3	1.3	1.4
Raw inedible materials (except fuels)	2.6	2.7	2.6	2.5	2.8
Mineral fuels, lubricants, and related materials	4.3	6.3	6.1	2.6	2.9
Animal and vegetable products, fats, and waxes	1.4	1.0	0.8	1.3	1.6
Chemicals and related products, not specified elsewhere	11.8	10.4	9.6	12.6	13.0
Manufactured goods classified primarily by material	19.2	19.0	15.7	18.7	18.4
Machinery and transport equipment	33.4	30.4	28.4	37.6	34.6
Miscellaneous manufactured articles	9.8	9.8	8.5	8.9	9.4
Commodities not classified elsewhere in SITC	0.3	7.1	15.6	0.0	0.8

**Source:** The State Statistical Committee of the Republic of Azerbaijan (2021)

Table 2 shows that the most significant determinants of the industrial efficiency of the physical economy of Azerbaijan during 2017-2021 were industrial goods, categorised mainly by material, machinery, transport equipment, and food. The production in these industries in general during the analysed period took about half of the country's production. At the same time, a significant impact on the performance of the physical economy of the country's economic activity was made by the production of various industrial products and chemicals and related products. Beverages and tobacco, raw materials, inedibles, mineral

fuels, lubricants, and related materials, animal and vegetable oils, fats and waxes were completely insignificant in the structure of industrial production of Azerbaijan. It can be concluded that due to the growth of production of the main structural elements of the country's industry, the effectiveness of the application of physical economic theory in the economic activity of Azerbaijan has a positive trend.

Further research attention is focused on the development of physical economy energy determinants of Azerbaijan. Firstly, the specific features of energy generation in the country will be analysed (Table 3).

**Table 3.** Physical economy energy determinants dynamics in the context of Azerbaijan's energy intensity trends during 2017-2021

Energy capacity (GDP. PPP *)	2017	2018	2019	2020	2021	Growth rate. %
GDP by purchasing power parity prices of 2017, million USD	139.152.8	141.240.1	144.771.1	138.545.9	146.304.6	5.14
Energy final consumption – total. thousand TOE	9.361.2	9.894.3	11.348.5	11.264.1	12.053.7	28.76
Energy capacity (conversion to the final consumption of total energy), thousand TOE /thousand USD	67.3	70.1	78.4	81.3	82.4	22.47
Total energy supply, thousand TOE	15.506.8	15.590.7	17.085.6	16.642.8	17.566.6	13.28
Energy capacity (in conversion to total energy consumption). thousand TOE / thousand USD	111.4	110.4	118.0	120.1	120.1	7.75
GDP produced per unit of energy consumption. 1 USD/ thousand TOE	9.0	9.1	8.5	8.3	8.3	-7.19

**Source:** The State Statistical Committee of the Republic of Azerbaijan (2021)

Table 3 shows that almost all energy intensity indicators of Azerbaijan during the analysed period tended to increase, which indicates both the growth of energy efficiency and the effectiveness of the application of physical economic theory in the country's economic activity. GDP at purchasing power parity in 2017 increased by 5% during 2017-2021, and such low growth rates were characterised by the energy intensity indicator (in terms of total energy consumption). The indicators of final energy consumption and energy capacity were relatively better developed in the energy sector of

Azerbaijan. Although at the same time, there is a decrease in the GDP produced as a result of energy consumption per unit, which can be explained by economic changes in the country, such as inflation and rising prices, which has nothing to do with the efficiency of the use of physical economic theory. Thus, the increase in production in the country is accompanied by an increase in energy consumption, which is another postulate of physical economic theory. Therefore, it is necessary to analyse the dynamics of the volume of energy consumed to produce the respective product (Table 4).

**Table 4.** The volume of energy products consumed to produce a product in the amount of 1 AZN (at current prices) in the industrial sectors, kg of oil equivalent/AZN during 2017-2021

Industry	2017	2018	2019	2020	2021	Growth rate, %
Industry	0.139	0.118	0.153	0.149	0.121	-13.22
Iron and steel	0.203	0.170	0.184	0.167	0.143	-29.65
Chemical and petrochemical	0.369	0.365	0.729	0.772	0.287	-22.31
Non-ferrous metal	0.325	0.290	0.302	0.328	0.235	-27.57
Non-metallic minerals	0.470	0.375	0.395	0.550	0.520	10.58
Transport equipment	0.117	0.118	0.005	0.006	0.006	-95.06
Machinery	0.039	0.034	0.045	0.040	0.033	-15.76

Table 4, Continued

Industry	2017	2018	2019	2020	2021	Growth rate, %
Food and tobacco	0.067	0.051	0.071	0.039	0.038	-43.00
Paper, pulp, and printing	0.032	0.031	0.043	0.039	0.041	27.42
Wood and wood products	0.077	0.050	0.060	0.067	0.055	-28.51
Textile and leather	0.072	0.063	0.064	0.055	0.046	-36.20
Non specified	0.048	0.036	0.043	0.026	0.029	-38.88

**Source:** The State Statistical Committee of the Republic of Azerbaijan (2021)

Table 4 shows that the highest volume of energy was used to produce non-metallic minerals. A significant amount of energy consumption in Azerbaijan during 2017-2021 was also required to produce iron and steel, chemical, and petrochemical products, and non-ferrous metals. Relatively small amounts of energy were consumed in the production of transport equipment, machinery, food and tobacco, paper, pulp and printing, wood and wood products, textiles and leather, and oth-

er unspecified products. Moreover, in general, during the period there is a general decrease in energy consumption, which can be explained by the effectiveness of the application of physical economic theory in the economic activity of Azerbaijan as there is an expansion of production using fewer energy resources due to the introduction of new technologies. The specific features of the development of physical economy trade determinants in Azerbaijan were further investigated (Table 5).

Table 5. Dynamics of physical economy trade determinants of Azerbaijan during 2017-2021

Indicator	2017	2018	2019	2020	2021	Growth rate, %	
In million US dollars	trade turnover	24,103.3	30,955	33,302.7	24,464.6	33,912.5	40.7
	imports	8,783.3	11,465.9	13,667.5	10,732	11,705.8	33.3
	exports	15,320	19,489.1	19,635.2	13,732.6	22,206.7	45.0
	balance	6,536.7	8,023.2	5,967.7	3,000.6	10,500.9	60.6
Actual prices as a percent of the previous year*	trade turnover	85.2	96.1	96.8	72.7	87.2	2.3
	imports	83.8	100.2	93.5	64	90	7.4
	exports	86.1	93.8	98.8	78.8	85	-1.3

**Source:** The State Statistical Committee of the Republic of Azerbaijan (2021)

Table 5 shows that the determinants of trade in the analysed country during 2017-2021 had growth trends, which indicates an increase in the efficiency of the use of physical economic theory in the economic activity of Azerbaijan. During the analysed period, trade turnover increased by 40.7%, imports increased by 33.3%, and exports – by 45%. Accordingly, the trade balance had a positive trend and increased by 60.6%, which indicates the high productivity of production in the country. That is, Azerbaijan produces much more products than is purchased in other countries. Such trends indicate that economic activity is focused on the use

of physical economic theory as the basis of economic activity in Azerbaijan is the production of products from materials, i.e., transformation from one form to another. At the same time, the actual prices as a percentage of the previous year's turnover and imports in the study period increased and decreased relative to exports, which indicates a high quantitative physical and positive trade balance. During the further study, the features of the creation of one of the significant determinants of Azerbaijan's physical economy are analysed. Such a metric is human capital as without a person no processes would take place in the country.

Table 6. Dynamics of physical economy trade determinants of Azerbaijan during 2017-2021

Main social-economic indicators of the labour market	2017	2018	2019	2020	2021	Growth rate, %
Average annual number of populations – thsd. persons	9.854.0	9.939.8	10.024.3	10.093.1	10.137.8	2.9
Number of the economically active population, thsd. persons	5.073.8	5.133.1	5.190.1	5.252.5	5.303.9	4.5

Table 6, Continued

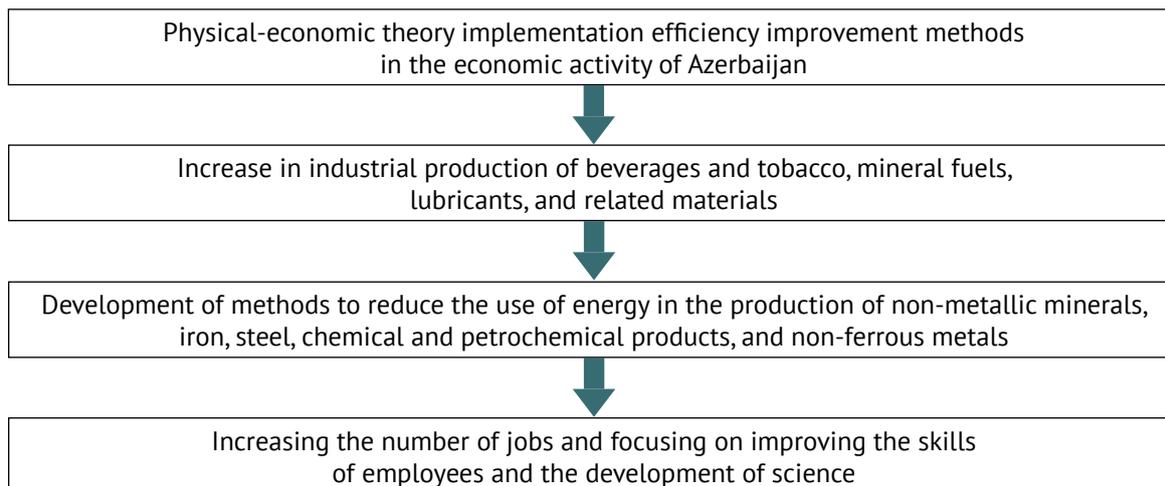
Main social-economic indicators of the labour market	2017	2018	2019	2020	2021	Growth rate, %
Number of employed persons, thsd. persons	4.822.1	4.879.3	4.938.5	4.876.6	4.988.2	3.4
including by property forms:						
State	1.158.4	1.154.9	1.156.8	1.123.2	1.115.3	-3.7
Non-state	3.663.7	3.724.4	3.781.7	3.753.4	3.872.9	5.7
Number of unemployed persons, thsd. persons	251.7	253.8	251.6	375.9	315.7	25.4
Persons received unemployment status in a state employment agency, person	38.481	20.088	812.724	...	...	2,012.0
of which receiving benefits as unemployed	6974	1117 <sup>5)</sup>	540 <sup>5)</sup>	7275	...	4.3
Number of employed women – thsd. persons	2.319.3	2.349.9	2,381.7	2.351.5	2.408.1	3.8
Number of employees <sup>2)</sup> – thsd. persons	1.525.0	1.551.7	1.646.6	1.698.7	1.709.1	12.1
Average monthly nominal wages and salaries of employees – manat	528.5	544.6	635.1	707.7	732.1	38.5
Professional training of staff – person	4502	5,629	5.130	3.478	3.713	-17.5
Number of officials and specialists who improved qualifications – person	11.499	17.676	26.037	14.122	14.604	27.0
Costs spent on upgrading of professional level of the staff, training new qualifications, and improving the professional skills, mln AZN	9.5	11.6	11.6	5.8	9.2	-3.2
Special weight of costs incurred the increase the vocational training of employees in the total labour costs, percent	0.08	0.10	0.08	0.04	0.05	-39.1

**Source:** The State Statistical Committee of the Republic of Azerbaijan (2021)

Table 6 shows that the average annual population during the study period in Azerbaijan increased by 2.9%, the number of economically active population increased by 4.5%, and the number of employed also increased by 3.4% due to employment in non-state structures. The increase in the number of unemployment had a rather high growth trend during 2017-2021, as their number increased by 25.4%. That is, the efficiency of the physical economy is slowing down due to the irrational use of labour in the country. At the same time, the number of people who received the status of unemployed in the state employment service increased significantly, and the number of people receiving unemployment benefits was insignificant to the total and had insignificant growth trends. The low level of unemployment benefits and the high number of unemployed are followed by the migration of the population, i.e., the loss of the main components of building an effective physical economy in the country. The number of employed women and the total number of employees is also increasing, which is caused by a significant increase in the average monthly

nominal wage of employees (The State Statistical Committee..., 2021). Professional training of personnel relative to the number of people in Azerbaijan during the period under review tended to decrease, although the number of officials and specialists who improved their qualifications increased. Moreover, the number of expenditures spent on raising the professional level of staff, training new qualifications, and improving professional skills decreased. At the same time, the share of expenditures on the professional development of employees in total labour costs also decreased. This trend reflects the concentration of the improvement of the determinants of human capital in Azerbaijan only on officials, which in the future may be accompanied by a decrease in the level of efficiency of the application of physical economic theory in the economic activity of the country (Mammadov, 2021).

Following the analysis of the physical economic theory implementation efficiency in the economic activity of Azerbaijan, it is possible to identify the following ways of its improvement (Fig. 2).



**Figure 2.** Methods of physical economic theory implementation efficiency improvement in the economic activity of Azerbaijan

**Source:** compiled by the author

To improve the efficiency of the physical economic theory implementation in the economic activity of Azerbaijan, it is necessary to expand the production of beverages and tobacco, mineral fuels, lubricants, and related materials, which will increase the determinants of the physical economy of the country's industry. The decrease in the production of these products is caused by a decrease in demand based on higher prices for these goods (Mammadov & Vali, 2020). Therefore, the authorities should take measures to slow down the inflation rate. At the same time, it is important to take measures to introduce newer technologies that would help to reduce energy consumption in the production of non-metallic minerals, iron, steel, chemical and petrochemical products, and non-ferrous metals. It is also important to improve the state of human capital in the labour market of Azerbaijan. After all, human development and qualification are the basis of the efficiency of the physical economy. The country's authorities should focus on the development and introduction of new jobs for the population (Integrated Country Strategy, 2022). For example, one such measure can be support for small and medium-sized businesses in the country, reducing the tax burden on the private sector of Azerbaijan. It is also important to develop a quality education system, which should be guided by international standards and technological progress. At the same time, it is important to eradicate corruption from the education system and conduct a qualitative assessment of the knowledge of future specialists. It is also recommended to establish requirements for the country's enterprises to develop and introduce separate departments in firms, which should be engaged in the motivation and professional training of workers and carry out measures to improve the skills of the company's employees (Asian Development Bank, 2022). All the above-mentioned measures will help increase the

efficiency of human actions towards increasing wealth and progress in the country through the transformation of energy and matter from one form to another, which is the main principle of the application of physical economic theory in the economic activity of the country.

## DISCUSSION

The issue of the physical economic theory implementation effectiveness in economic activity today is ambiguous and has no consistent approach. In addition, the problem of the physical economic theory of employment effectiveness in Azerbaijan has not been studied before.

L.F. Vasilevich and M.L. Vasilevich (2013) in their study only generalised the essentials and principles of physical economic theory. It was determined that from the central principle of fuzzy physical economics, the law of capital interaction and the law of the duration of economic cycles are derived, the mathematical form of which coincides with the form of the thermodynamic law. The researchers suggest that the duration of economic cycles is determined by the critical degree of capital concentration. The argument of the thermodynamic approach in these laws is determined by a fuzzy set of the economic environment, the characteristics of which cannot be clearly defined. Based on the general approach of fuzzy physical economics and the law of the duration of economic cycles, the authors suggest a hypothesis that the power of economic crises coincides in form with the thermodynamic law of Stefan-Boltzmann (Gilberto *et al.*, 2022). Accordingly, from the central principle and law of fuzzy physical economics identified by the researchers, it is established in the paper that economic crises will be observed more often, and their negative impact will be even greater. Therefore, the researchers recommend a transition from a market economy to a regulatory market economy and consider it necessary to reproduce a rational ratio of these two

regulators. Although, the researcher notes that it is no longer possible to change the speed of the process of capital concentration, which is the main factor of crises, only by changing the economic environment without changes in the person (Vasilevich & Vasilevich, 2013).

Temel *et al.* (2003) in his study reviewed the literature of previous researchers on this issue and summarised these materials mainly from a philosophical point of view. The author noted that in terms of physical economy, the wealth of a nation or state is equal to the amount of energy that can be converted from one form to another, which is also the most important indicator of progress. The researcher determined that energy cannot be created or destroyed because it is only transformed from one form to another. This is what humanity creates, that is, from the simplest biological functions to the most advanced technologies, it is a man who transforms energy and matter from one form to another. The author noted that there is a limited amount of energy in the universe, which is why there is a consistent standard by which the economy can be measured. Physical economic theory, according to the scientist, allows one to determine the value of the economy by establishing the amount of energy converted from one form to another in this economy. It is important to develop an indicator or measurement that should be clear and constant to measure the efficiency of the physical economy. The researcher emphasises that such an area will require the joint work of physicists and economists and a lot of time. At the same time, he recommends first formulating the goal of the physical economy based on establishing a link between financial currency and the use of energy as a means of the most reliable and consistent creation of wealth and progress. Such a goal of physical economy, according to the author, would contribute to the unification of science, economics, and philosophy.

E. Jonathan (2022) and Nasibov (2018) noted that physical economics does not provide religious security and is not an ideology, because it is only the best theory of wealth and progress that is available according to the current level of knowledge. That is, the author resorted to philosophy and determined that this view may constitute the logical core of the worldview, but it is not necessarily a worldview, because the choice is always up to the individual.

The literature review included the paper by S. Gierlinger and F. Krausman (2012), which is based on the consideration of the physical economy of the United States of America. This study is more analytical than theoretical and is based on the consideration of indicators of the physical economy concerning the United States. The physical economy of the country was considered in the aspect of resource use. To compile a comprehensive database of physical economy development metrics in the country, an array of data on trends in the development of material and energy flows in the U.S. economy was formed and standard methods of general

economic accounting of material flows were used, and the used production, imports, and exports were quantified. The study provided indicators of the main groups of materials: biomass, fossil energy, ores, and non-metallic minerals. The work of these researchers has established that the development of the US physical economy over the past century reflects a characteristic pattern of sociometabolism and transition, as there has been a significant increase in both the production and trade of materials, a transition from the dominance of renewable biomass to fossil and mineral materials, as well as an increase in the reproduction rate.

Wang *et al.* (2022) and Polimeni and Polimeni (2007) established that the analysis of flows showed that population growth plays a significant role in this aspect. The authors also found that the US economy is characterised by a disproportionately large share of global resource use. Indeed, the per capita consumption of materials in the US is higher than in other developed countries. The study also shows that decisions on the spatial organisation of the economy and infrastructure have a long-term impact on resource use. At the same time, the exact interaction of the main factors that contribute to the use of materials is not fully understood and requires further research.

L. Freeman (2022) in his study recommended that African citizens develop the physical economy. The researcher explained that the basis of the physical economic theory is that wealth is not formed based on the financial system, but its base is a person and what they produce. The author suggests that it is possible to improve the development of Africa through science and technology because the human mind is the only known force in the world that can discover new physical principles. Discoveries of physical principles are accompanied by the creation of new technologies that allow producing more wealth with the same or less effort. Scientist suggests that the African continent's desire to spread nuclear energy in its economies will not only increase energy production but also the growth of the entire physical economy. Such trends will contribute to raising the level of education, skilled labour, development of scientific centres, and modernisation of the economy. According to the researcher, the development of the physical economy will help to improve the infrastructure of this continent, because the introduction of the latest technologies increases the productivity of workers. Improvement and development of the physical economy contribute not only to the expansion of production but also increase the level of influence of each citizen and increase the standard of living of the population. That is if most of the population does not participate in the production itself, but at the same time develops technologies and scientific potential of the country and participates in the economic development of the country (Freeman, 2022). Human development and quality organisation of social activity are the main factors of efficiency of the physical economy.

As for Azerbaijan, there are studies and reviews of the general state of the economy (Nuri Aras & Suleymanov, 2016; McNerney *et al.*, 2021). The most detailed among the latest studies on the development of the Azerbaijani economy is the study by E. Mammadov (2021). The researcher found that according to the results of 2021, the economy recovers after the pandemic, but the risks remain high, which is explained by the rising inflation rate in the country. The increase in nominal income and wages is relative to the price level, as inflation arose due to higher prices for imported goods. As a result of such trends, the Central Bank of Azerbaijan raised the discount rate, referring to the growth of inflationary pressures from outside and inside the country. Although the primary task should be to prevent price increases. The researcher noted that the exchange rate dynamics remained stable due to the massive inflow of foreign currencies. Moreover, despite the positive signs of growth in non-oil production, the economic recovery mainly lasted until 2021, because the country's dependence on hydrocarbons continues to be higher, which necessitates further strengthening of the market-oriented economic structure, and diversification of the economy (Quality of life indicators, 2021).

As such, the conducted study of the research papers on the analysis of the efficiency of physical economic theory implementation has shown that the researchers have not previously identified these aspects concerning the Azerbaijan region, and in most papers, there is no clear separation of indicators that characterise the physical economy of the country. The study conducted by the author allows including the shortcomings of the previous ones and considering the specific features of the determinants of the physical economy, with the help of which it is possible to analyse the effectiveness of the use of this theory in the country and to establish further ways to improve the efficiency of the application of physical economic theory in the economic activity of Azerbaijan.

## CONCLUSIONS

As such, the study of physical economic theory established that its nature is human actions to increase wealth and development progress in the country through the transformation of energy and matter from one form to another. That is, the physical economy considers material production, energy use, and increasing human potential as the main means of enriching the

country and its progress. The study also identified the main determinants of the physical economy, which include industry, energy, trade, and human capital. Accordingly, while analysing the effectiveness of the application of physical economic theory in the economic activity of Azerbaijan, it was found that the country's industry was characterised by an increase in production in all sectors, except for the creation of beverages and tobacco, mineral fuels, lubricants, and related materials. At the same time, the analysis of energy determinants reflected the presence of expansion of production using fewer energy resources due to the introduction of new technologies in Azerbaijan. The study of the state of trade determinants in the country showed that there is a high level of productivity in the country, as Azerbaijan produces much more products than purchased in other countries and there is a high quantitative physical and positive trade balance. The analysis of the determinants of human capital showed that the unemployment rate in the country is growing, the degree of professional training of workers is decreasing, and the level of qualification of employees is decreasing, which is accompanied by the migration of the population. According to the analysis of the determinants of the physical economy of Azerbaijan, the ways to improve the efficiency of the application of physical economic theory in the economic activity of the country were identified, the main of which was to increase the efficiency of industrial production, reduce energy consumption and increase the potential of the country's labour force.

Further research of the physical and economic theory in the economic activity of Azerbaijan should be based on the development of measures to increase the productivity of production of beverages and tobacco, mineral fuels, lubricants, and related materials, implementation of measures to reduce energy consumption in the production of non-metallic minerals, iron and steel, chemical and petrochemical products, non-ferrous metals and the development of methods aimed at expanding jobs, raising the qualification of workers, improving the quality of life, and improving the efficiency of the economy.

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## CONFLICT OF INTEREST

None.

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## Аналіз ефективності впровадження фізико-економічної теорії в економічну діяльність Азербайджану

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**Анотація.** Фізико-економічна теорія є недостатньо дослідженою темою і не має чіткого визначення її детермінант. Основною метою економічної діяльності будь-якої країни є формування капіталу та прогресу. Для Азербайджану характерне економічне зростання, яке супроводжується використанням матеріальних ресурсів країни і виробництвом товарів за допомогою енергетичних ресурсів і робочої сили. Досить важливим є раціональне використання матеріальних ресурсів, що є основою для формування прибутковості країни та впровадження інновацій. Саме тому питання імплементації фізико-економічної теорії в господарську діяльність Азербайджану є актуальним. Встановлення ефективного використання фізичної економії у функціонуванні країни допоможе виявити основні недоліки та встановити основні шляхи вдосконалення економічної діяльності Азербайджану. Саме тому метою роботи є дослідження та узагальнення аспектів впровадження фізико-економічної теорії в економічну діяльність Азербайджану. За допомогою методу індукції встановлено детермінанти фізичної економіки, до яких віднесено показники промисловості, енергетики, торгівлі та людського капіталу. За допомогою аналітичного методу визначено, що хоча економіка Азербайджану ефективно використовує фізичну економіку, існують проблеми з розвитком виробництва, споживанням енергії та робочої сили. У зв'язку з цим було визначено, що основними шляхами підвищення ефективності впровадження фізико-економічної теорії в господарську діяльність Азербайджану мають стати: розробка та реалізація заходів щодо підвищення ефективності виробництва напоїв та тютюнових виробів, мінерального палива, мастильних матеріалів та пов'язаних з ними матеріальних виробництв, а також застосування заходів щодо зниження енергоспоживання у виробництві неметалевих корисних копалин, чавуну та сталі, хімічної та нафтохімічної продукції, кольорових металів за рахунок запровадження інноваційних технологій. Одночасно має бути збільшена кількість робочих місць, підвищена кваліфікація робітників та покращена якість освіти в Азербайджані відповідно до міжнародних стандартів. Таким чином, практична цінність дослідження зумовлена характеристикою основних детермінант фізичної економіки країни, які можуть бути використані в подальших наукових дослідженнях для аналізу ефективності впровадження фізико-економічної теорії в господарську діяльність країн

**Ключові слова:** промисловість; енергетика; торговельний баланс; людський капітал; багатство, прогрес