

REVIEW
of the official reviewer

Arupov Akinzhan Arupovich for dissertation work of Zhai Xuan on the topic « Current state and prospects of cooperation between Kazakhstan and China in the natural gas sector» presented for the degree of Doctor of Philosophy (PhD) in the educational program «8D04101 – World Economy»

№	Criteria	Eligibility (one of the options must be checked)	Justification of the position of the official reviewer
1.	The topic of the thesis (as of the date of its approval) corresponds to the directions of development of science and /or state	1.1 Compliance with priority areas of science development or government programs: 1) The thesis was completed within the framework of a project or target program financed from the state budget (indicate the name and number of the project or program); 2) The thesis was completed within the framework of another state program (indicate the name of the program); 3) The dissertation corresponds to the priority direction of the development of science, approved by the Higher Scientific and Technical Commission under the Government of the Republic of Kazakhstan (indicate the direction).	The dissertation work of Zhai Xuan named «The current state and prospects of cooperation between Kazakhstan and China in the gas industry», carried out the educational program «8D04101 – World Economy», has undoubtedly scientific value and relevance in the light of the current challenges facing the Republic of Kazakhstan. The topic of the dissertation corresponds to the priorities defined in key government documents, including the Comprehensive Plan for the Development of the Gas Industry of the Republic of Kazakhstan for 2022-2026. It was adopted by the Government of the Republic of Kazakhstan No. 488 dated July 18, 2022. Within the framework of the outlined strategy, priority is given to cooperation with China, which is considered as a key driver for diversifying foreign trade, stimulating the development of the gas industry and modernizing the infrastructure complex. 1. Exploring the complementarity between Kazakhstan's competitive advantages in the field of natural gas resources and the steady demand for natural gas in China; 2. Developing the investment approach used by China in Kazakhstan in relation to the broader regional economic landscape;

			3. Conducting an empirical analysis of natural gas trade between Kazakhstan and China, accounting special attention to the impact of economic growth and the complementarity of gas resources. The conducted research is distinguished by its internal logical integrity, systematic presentation, high degree of theoretical and empirical study of the material, as well as the validity of the conclusions formulated. The presented dissertation work fully complies with the established requirements for qualifying research for the degree of Doctor of Philosophy (PhD) and correlates with the strategic priorities of the development of the gas industry of the Republic of Kazakhstan.
2.	Importance for science	The work makes / does not make a significant contribution to science, and its importance is well disclosed/not disclosed.	The work makes a significant contribution to the development of economics. At the same time, the theoretical and practical significance of the work has received comprehensive justification. The main value of the dissertation work lies in the substantiation of bilateral cooperation in the gas industry and is quite well disclosed. The presented conclusions and recommendations in the paper have a high potential for practical use to increase the effectiveness of joint projects in the gas industry between Kazakhstan and China. They can be useful in solving strategic tasks such as diversifying export routes of gas resources and strengthening the position of the Republic of Kazakhstan in the Chinese gas market.
3.	The principle of independence	Self-reliance level: 1) high; 2) medium; 3) low; 4) no independence.	The research results are a direct consequence of the author's scientific independence. From the formation of the theoretical foundations of energy cooperation and the application of the comparative method to the analysis of empirical data and the development of mathematical models, all the work was carried out by the author

			independently, which ensures the originality and validity of the conclusions. The level of independence is high.
4.	The principle of inner unity	4.1 Justification of the relevance of the thesis: 1) justified ; 2) partially justified; 3) not justified.	The substantiation of the relevance of the thesis topic is evidentiary. Based on a comprehensive analysis, the author identifies several key challenges for cooperation between Kazakhstan and China in the gas industry, including the limited market structure, the balance of power in negotiations, the possibility of transporting natural gas and the impact of external competition. The conducted research is characterized by internal unity. The relevance of the dissertation is justified.
		4.2 The content of the thesis reflects the topic of the thesis: 1) reflects ; 2) partially reflects; 3) does not reflect.	The structure and content of the thesis reflect a holistic and consistent disclosure of the topic under study. These research methods, such as the literature review method, data analysis methods and the empirical analysis method, reflect the author's direct contributions to solving a key problem related to the development of cooperation between Kazakhstan and China in the gas industry. The conducted research is characterized by high scientific and practical significance and priority in the context of modern energy cooperation.
		4.3. The purpose and objectives correspond to the topic of the thesis: 1) correspond ; 2) partially correspond; 3) do not correspond.	The purpose and objectives of the thesis are fully corresponded to the topic of the work. The purpose of the dissertation reflects the promising direction of the research, and the formulated tasks ensure a systematic and relevant achievement of this goal. Each task is closely related to the topic and is aimed at solving key scientific and practical problems, which ensures the value of research.
		4.4 All sections and provisions of the thesis are logically interconnected: 1) completely interconnected ; 2) the interconnection is partial;	All sections and provisions of the dissertation are completely interconnected and create an integrated research system. The structure of the work is based on the development of economic cooperation: the study begins

			independently, which ensures the originality and validity of the conclusions. The level of independence is high.
4.	The principle of inner unity	4.1 Justification of the relevance of the thesis: 1) justified ; 2) partially justified; 3) not justified.	The substantiation of the relevance of the thesis topic is evidentiary. Based on a comprehensive analysis, the author identifies several key challenges for cooperation between Kazakhstan and China in the gas industry, including the limited market structure, the balance of power in negotiations, the possibility of transporting natural gas and the impact of external competition. The conducted research is characterized by internal unity. The relevance of the dissertation is justified.
		4.2 The content of the thesis reflects the topic of the thesis: 1) reflects ; 2) partially reflects; 3) does not reflect.	The structure and content of the thesis reflect a holistic and consistent disclosure of the topic under study. These research methods, such as the literature review method, data analysis methods and the empirical analysis method, reflect the author's direct contributions to solving a key problem related to the development of cooperation between Kazakhstan and China in the gas industry. The conducted research is characterized by high scientific and practical significance and priority in the context of modern energy cooperation.
		4.3. The purpose and objectives correspond to the topic of the thesis: 1) correspond ; 2) partially correspond; 3) do not correspond.	The purpose and objectives of the thesis are fully corresponded to the topic of the work. The purpose of the dissertation reflects the promising direction of the research, and the formulated tasks ensure a systematic and relevant achievement of this goal. Each task is closely related to the topic and is aimed at solving key scientific and practical problems, which ensures the value of research.
		4.4 All sections and provisions of the thesis are logically interconnected: 1) completely interconnected ; 2) the interconnection is partial;	All sections and provisions of the dissertation are completely interconnected and create an integrated research system. The structure of the work is based on the development of economic cooperation: the study begins

		3) there is no interconnection.	with an analysis of the theoretical foundations of energy cooperation, then current issues are considered and an empirical analysis of the gas trade between Kazakhstan and China is carried out, culminating in the development of promising models and specific recommendations. This approach ensures the integrity and scientific consistency of the thesis.
		4.5 The new solutions (principles, methods) proposed by the author are reasoned and evaluated in comparison with the known solutions:	The proposed new solutions have been reasoned and evaluated by the author. The author has carried out systematic and comprehensive work to substantiate the scientific novelty of the study. The work develops original methodological tools and mathematical models that ensure the solution of tasks at a high scientific level.
		1) there is a critical analysis;	In conducting a specific analysis of existing approaches and theories, which indicates an understanding of scientific discussions in the field of research with relevant aspects. There is a critical analysis.
		2) partial analysis;	
		3) the analysis does not represent one's own opinions, but quotes from other authors;	
		4) there is no analysis.	
5.	Scientific novelty principle	5.1 Are the scientific results and provisions new?	The scientific results and provisions of the thesis are partially new and make a significant contribution to the study of modern gas cooperation. This paper is the first to formulate a study of the complementarity of gas resources based on the theories of comparative advantages and availability of production factors. At the same time, the original concept of "investment in exchange for natural gas supplies" is presented as the basis of the author's approach to cooperation in the gas industry.
		1) completely new;	The proposed applied solutions have signs of scientific novelty and are aimed at a systematic study of promising approaches to improving the efficiency of gas cooperation between Kazakhstan and China. In particular, competitive scenarios and mathematical models have been developed for modeling gas
		2) partially new (25-75% are new);	
		3) not new (less than 25% are new).	

	5.2 Are the dissertation findings new? 1) completely new; 2) partially new (25-75% are new); 3) not new (less than 25% are new).	transportation profits. In addition, a new concept, the Central Asian Gas Hub, has been introduced, which together creates the basis for connecting the gas resources of Central Asia and increasing the efficiency of gas cooperation with China. The results of the study are of fairly high practical and strategic importance, provide scientifically sound support for the state plan for the development of the gas industry and contribute to strengthening energy cooperation between Kazakhstan and China.
5.3 Technical, technological, economic or management decisions are new and reasonable:	1) completely new; 2) partially new (25-75% are new); 3) not new (less than 25% are new).	All the main conclusions formulated based on the results of the study are characterized by a fairly high scientific novelty, originality and the absence of direct analogues in existing academic publications. They reflect a comprehensive and systematic understanding of the problem under study, identify previously undeveloped patterns, and offer partially new approaches to studying gas cooperation between Kazakhstan and China. These results form a new aspect for further research in the relevant scientific field and have a high potential applicability in the practical cooperation of state oil and gas enterprises, which underlines their importance and strategic relevance.
		The managerial and economic decisions presented in the thesis are partially new and well-founded. The concepts and models developed by the author form practical approaches to increase the effectiveness of cooperation between Kazakhstan and China in the gas industry, which have no direct analogues in modern scientific literature and practice. These solutions combine theoretical concepts with practical approaches, creating a methodological basis for increasing economic profits in gas cooperation.

6. The validity of the main findings	All main conclusions are/are not based on scientifically significant evidence or well-grounded (for qualitative research and areas of training in the arts and humanities).	All the key findings of the study have comprehensive and rigorous scientific justification. The reliability of the results obtained is ensured using a suitable methodological apparatus, including: - The security index of imported pipeline gas supplies: Kazakhstan has received a higher potential in terms of the political security of the supplier country (SCi) and the security of gas transportation (TSi) in the Chinese gas market. - Empirical analysis method: as a result of the trade attraction model, the R^2 value is 0.9281, which means that the GDP figures of China and Kazakhstan, the volume of oil and gas production in Kazakhstan, the population of China, the population of Kazakhstan and the energy consumption levels in both countries together account for 92.8% of the differences observed in oil and gas trade between Kazakhstan and China. - Game theory methods: The game theory model is used to develop three scenarios for Kazakh gas exports, and the transport model is used to calculate transport revenues for each scenario. The calculation results confirm the conclusion about the construction of a game theory model. - Statistical method of data from representative sources such as the Bureau of National Statistics of the Republic of Kazakhstan, the National Bureau of Statistics of China, the Ministry of Energy of Kazakhstan, the General Administration of Customs of the People's Republic of China. The use of systemically integrated methods in the work has ensured high validity, strategic importance and reproducibility of the results, which confirms the
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		scientific reliability and practical applicability of the findings.
7.	The main provisions for the defense It is necessary to answer the following questions for each provision separately: 7.1 Is the provision proven? 1) proven; 2) rather proven; 3) rather not proven; 4) not proven; 5) in the current formulation, it is impossible to verify the validity of the statement. 7.2 Is it trivial? 1) yes; 2) not; 3) in the current formulation, it is impossible to verify the validity of the statement. 7.3 Is it new? 1) yes; 2) no; 3) in the current formulation, it is impossible to verify the validity of the statement. 7.4 Application level: 1) narrow; 2) medium; 3) wide;	The first provision for defense is the theoretical basis of energy cooperation. The expansion of cooperation in the gas sector contributes to strengthening regional economic integration and meets the development needs of both countries. Cooperation in the field of natural gas helps Kazakhstan to increase export revenues and diversify exports. It also enhances China's energy security. The proposed provision has high practical potential, as it contributes to the unification of scientific discourse in the field of gas cooperation. The second provision for defense is the key factors affecting the supply and demand for natural gas. Kazakhstan and China are making joint investments in pipeline infrastructure and gas production. Both sides are increasing production capacity and transportation efficiency. The study examines China's model, which uses investments to secure natural gas supplies. The developed methodology is focused on practical application in the framework of energy cooperation, regional economic cooperation and management decision-making, which increases the applied importance and contributes to improving the investment strategy of Chinese enterprises in the gas industry of Kazakhstan. The third provision for defense is the analysis of the key elements influencing the determination of natural

	4) in the current formulation, it is impossible to verify the validity of the statement. 7.5 Is it proven in the article? 1) yes; 2) no; 3) in the current formulation, it is impossible to verify the validity of the statement.	gas prices in gas cooperation. The higher the strategic importance of a country supplying natural gas, the more significant its geopolitical power becomes, and the more stable its supplies, the stronger its dominant position in natural gas pricing negotiations. The scientific novelty of the gas supply index and the price negotiation model is manifested in its ability to take into account the advantages and disadvantages of natural gas supplier countries in the Chinese market, which makes it possible to form more relevant and effective measures to improve cooperation. The fourth provision for defense is the development of the main factors of natural gas trade between Kazakhstan and China. The evidence base of this provision is formed through the application of the trade attraction model and empirical analysis, which allows us to identify key factors for assessing economic profits in the natural gas trade. The scientific and practical novelty of the result lies in its systematization, which identifies economic factors and factors of supply and demand in the natural gas trade. The developed model is designed to study the factors affecting bilateral trade in oil and gas. The results show that economic growth significantly increases the volume of trade. China's growing economy consumes more energy. This contributes to the growth of oil and gas trade between the two countries. The increase in natural gas production in Kazakhstan does not lead to an increase in bilateral trade. The country needs to further expand its natural gas exports. The fifth provision for defense is the development of a theoretical and methodological model for assessing investment opportunities in the gas industry. The
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		rationale for the provision contributes to the need to adjust tax policies and operating models in accordance with the development status of various gas projects in order to ensure stable income from projects and natural gas production. The sixth provision for defense is the development of a competitive model and a mathematical model for gas transportation from Kazakhstan to China. The scientific novelty of the models shows that the best option for Kazakhstan is to continue exporting natural gas from Chinese oil companies in order to maintain its competitiveness in the market and use its geographical advantages to create a hub for exporting natural gas from Russia and Central Asia to China. The seventh provision for defense is the development of practical proposals aimed at improving the effectiveness of cooperation between Kazakhstan and China in the gas industry. The provided suggestions open prospects for increasing the effectiveness of cooperation between Kazakhstan and China in the gas industry. Both countries need to modernize their infrastructure and apply new technologies in gas projects. These are the main objectives of future cooperation in the gas sector. The two countries can work together on gas chemical production for domestic gas supply. They increase the added value of gas products and increase profits from oil and gas projects.
8.	The principle of reliability.	Yes. The methodological basis of the conducted research is complex and systematic. The work implements a synthesis of classical theoretical heritage (Theory of comparative advantage of D. Ricardo; Heckscher-Ohlin
Reliability of sources and information provided	8.1 Choice of methodology – is justified or the methodology is described in sufficient detail: 1) yes;	

	2) no.	theory; Stackelberg game model; Cournot competition model) with modern analytical tools, including: - Security index of imported pipeline gas supplies; - The method of the pricing mechanism based on the theory of negotiations; - The method of empirical analysis; - Methods of mathematical models of gas transportation. The integration of classical theoretical approaches with modern methods ensures the methodological relevance of research, increases the reliability of the results obtained, and fully complies with the standards of economics.
	8.2 The results of the thesis were obtained using modern methods of scientific research and methods of processing and interpreting data using computer technologies:	Yes. The results of the dissertation work were obtained using modern analytical tools that meet the relevant standards of economics. The methodological base of the study includes: - Analysis of the coefficient of elasticity of energy consumption, which makes it possible to identify the importance of natural gas in China's energy system; - The Safety index of imported pipeline gas supplies, which allows analyzing safety factors, critical risk elements and components that can improve future cooperation in the gas sector; - Trade attraction models that facilitate regression analysis of energy trade between Kazakhstan and China; - Methods of multidimensional statistics, including comparative analysis, used to identify hidden structures and patterns in data. All calculations were performed using specialized software (for example, QSB, Stata, EViews), which ensures the integration of theoretical provisions with empirical analysis and forms the basis for significant recommendations to improve energy cooperation with practical significance.
	1) yes; 2) no.	

	8.3 Theoretical conclusions, models, identified relationships and patterns have been proven and confirmed by experimental research (for areas of training in pedagogical sciences, the results have been proven on the basis of a pedagogical experiment):	Yes. All theoretical foundations and developed models have undergone comprehensive empirical verification. During the study, the following were carried out: - Optimized energy consumption elasticity coefficient model: This model indicates a transformation in China's energy consumption structure (from high-intensive to high-stable) and verifies the importance of natural gas. - The security index of imported pipeline gas supply: This study qualifies economic and transportation stability of Kazakhstan throughout the gas supply chain. - Economic impact of bilateral energy trade: This study quantifies how GDP growth, energy production and consumption influence bilateral oil and gas trade. - The Stackelberg game model and the Cournot competition model: This research introduces three scenarios to predict the formation of cooperative alliances and the possibility of profit distribution. The results obtained provide reliable theoretical and empirical substantiation, confirm the validity of the identified patterns and create a solid basis for the development of practical recommendations for improving energy cooperation with practical significance.
	1) yes; 2) no.	
	8.4 Important statements are confirmed / partially confirmed / not confirmed by references to current and reliable scientific literature.	Confirmed. The key conclusions and arguments presented in the thesis have a reliable and systematic scientific basis. The evidence base of the study was formed using trusted and reputable sources: - modern scientific publications related to the topic of the dissertation at the level of economics and reflecting the development of the subject area under study; - official statistical data, such as published materials from the Bureau of National Statistics of the Republic of

			Kazakhstan, the National Bureau of Statistics of China, the Ministry of Energy of Kazakhstan, and the General Administration of Customs of the People's Republic of China. - current regulatory legal acts reflecting the relevance of the study. The extensive bibliography, which includes 161 sources, is designed in strict accordance with the established citation rules, which makes it possible to verify and confirm all the statements made in the work.
		8.5 Used literature sources are sufficient / not sufficient for a literature review.	Sufficient. The bibliographic database of the study is representative and includes 161 sources covering fundamental theoretical works, verified scientific publications and official statistical materials. This approach provides a systematic literary review and conforms to academic standards for dissertation studies.
9	Practical value principle	9.1 The thesis has theoretical value: 1) yes; 2) no.	This dissertation provides substantial theoretical contributions in the fields of international energy cooperation, regional economic cooperation, and economic evaluation analysis. This research: - identifies conceptual methodologies and theoretical approaches to the establishment and growth of international energy cooperation. - examines the complementarity between the gas resource advantages of Kazakhstan and the natural gas demand of China based on the theory of comparative advantages. - evaluates the way Kazakhstan and China's natural gas collaboration has evolved historically and assess how national energy laws and policies have influenced this cooperation. This dissertation advances economic and geopolitical theory by creating new models and assessment methodologies.

		9.2 The thesis is of practical importance and there is a high probability of applying the results obtained in practice: 1) yes; 2) no	Yes. The dissertation research has pronounced practical significance. The tools developed during the study, including the gas import safety index, models of the gas resource pricing mechanism and mathematical models of competitiveness in the gas market, are intended for use by key state-owned oil and gas enterprises such as KazMunayGas JSC, Qazagaz and CNPC. The proposed solutions have high potential for implementation in the strategic plan for the development of the gas industry, contributing to the optimization of the gas-related investment environment and strengthening the base of gas infrastructures.
		9.3 Are the practice suggestions new? 1) completely new; 2) partially new (25-75% are new); 3) not new (less than 25% are new).	Partially new. The practical conceptions proposed in the dissertation, such as "investment in exchange for natural gas supplies" and "Central Asian gas Hub", are characterized by a comprehensive novelty. The developed differentiated approaches to regulating gas cooperation with China and mathematical models create a new strategy for Kazakhstan's energy cooperation policy.
10.	The quality of writing and design	Academic writing quality: 1) high; 2) average; 3) below average; 4) low.	High. The thesis meets the standards of academic writing, demonstrating a strict logical structure, terminological accuracy and consistency of the scientific apparatus. The principles of objectivity, reasonableness and neutrality are observed in the work.
11.	Comments on a thesis	<i>This dissertation successfully combines economic theories and principles of competition to develop a comprehensive model of cooperation between Kazakhstan and China in the natural gas sector. The dissertation bridges the gap between energy policy and the practical economic benefits of invested gas projects in Kazakhstan. Despite the fact that the research effectively uses economic and mathematical modeling and comparative analysis, further quantitative verification and competitive scenarios can improve its conclusions. Potential Areas for Improvement:</i>	

		- Stimulation of the security index of imported pipeline gas supply: while the dissertation references main gas supplier-countries (Turkmenistan, Russia, Myanmar), a more detailed description of the gas supplier countries could provide a deeper understanding. - Expansion of trade gravity model: More robust econometric modeling to assess the impact of natural gas production, consumption, and infrastructure on bilateral oil and gas trade. - The issue of increasing the investment of gas infrastructures in Kazakhstan requires in-depth study, which limits the possibilities of expanding Kazakhstan's importance in terms of the "Central Asian Gas Hub". The application of these comments will strengthen the analytical component of the work and increase the practical significance of the developed recommendations for governments and state-owned oil and gas enterprises.
12.	Scientific level of the doctoral student's articles on the topic of research	The approbation of the research results meets the established requirements for PhD applicants. The main theoretical provisions, important conclusions and practical recommendations of the thesis were found in the author's scientific publications, including six articles published in international journals indexed in the Scopus database, and four articles in publications recommended by the Committee for Quality Assurance in Science and Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan.
13.	Decision of the official reviewer (pursuant to paragraph 28 of the present Model Regulations)	The dissertation of Zhai Xuan meets the established requirements for dissertations for the degree of Doctor of Philosophy (PhD) in in the educational program «8D04101 – World Economy».

Official Reviewer:

Turan University,
Institute of World Economy and
International Relations,
Doctor of Economics, Professor,
Academician of the Academy of
Economic Sciences of Kazakhstan
(place of work, academic title)

Дастаймын, «Тұрда»
Университетінің Халық
Әлемдік Экономикасы
Институтының профессоры

(signature)



Arupov A. A.
(Full Name)