



Analysis of the Role of Insurance in Reducing Investment Risks and Development of the Liquefied Natural Gas Industry in Iran

Mohammad Reza Alimardan¹, Mohammad Reza Seyed Hashemi Toloun², Abbas Kazemi Najafabadi^{3*}

1. Ph.D. Student, Department of Law and Political Science, Faculty of Law, Allameh Tabataba'i University, Tehran, Iran

2. Assistant Professor, Department of Management, Sohrevardi Institute of Higher Education, Qazvin, Iran

3. Associate Professor, Department of Law and Political Science, Faculty of Law, Allameh Tabataba'i University Tehran, Iran

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ABSTRACT

The liquefied natural gas (LNG) industry, as one of the key sectors in global energy supply, plays a significant role in economic development and energy security. However, investment in this industry faces numerous risks, including global price fluctuations, technical challenges, environmental issues, and political uncertainties. Insurance, as an effective risk management tool, can play a crucial role in mitigating these risks and facilitating investment in the LNG industry. This research analyzes the role of insurance in reducing investment risks and developing Iran's liquefied natural gas industry. Using analytical methods and case studies, the impact of various insurances, such as liability insurance, property insurance, and credit insurance, on reducing investment risks in this industry is examined. The results of this study indicate that insurance can enhance the attractiveness of investments in the LNG industry by covering financial and operational risks, thereby contributing to the sustainable development of this industry in Iran. Additionally, recommendations are provided to improve insurance frameworks and government support policies to foster further growth of this industry in the future. The most important recommendations in normal conditions (No war, Sanction and other limitations) include: 1) Strengthening insurance frameworks to cover specific risks of the LNG industry, 2) Encouraging the participation of international insurance companies through consortiums, 3) Establishing investment guarantee funds, 4) Formulating supportive government policies, 5) Enhancing regional and international cooperation, 6) Developing secondary markets for risk transfer, 7) Educating and empowering stakeholders, 8) Establishing transparent and sustainable laws and regulations, 9) Developing insurance infrastructure, and 10) Continuous evaluation and updating of policies.

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* Corresponding author.

E-mail address: kazemi_najaf@atu.ac.ir, (A. Kazemi Najafabadi).

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1. Introduction

The liquefied natural gas (LNG) industry, as one of the most important energy sectors in the world, plays a key role in meeting energy needs and reducing dependence on traditional fossil fuels. With one of the largest natural gas reserves globally, Iran has significant potential for developing this industry. However, investment in this sector faces numerous challenges and risks that could limit its development. In this context, insurance, as an important risk management tool, can effectively reduce these risks and facilitate the investment process. Insurance provides the necessary security by covering those financial, technical, environmental, and political risks, thereby creating the groundwork for attracting domestic industries such as steel, Cement, ... and foreign capital in the liquefied natural gas industry, (Generally for export). This not only contributes to the sustainable development of the industry but can also lead to the country's economic growth and increase Iran's share in the global liquefied natural gas market in normal (No war, Sanction and other limitations) conditions. The aim of this research is to analyze the role of insurance in reducing investment risks and developing Iran's liquefied natural gas industry. In this regard, it examines the types of risks present in this industry, the role of insurance in managing these risks, and its impact on attracting investments and fostering industrial development. It is hoped that the results of this study will assist policymakers, investors, and players in Iran's LNG industry in utilizing insurance tools to take effective steps toward developing this industry and strengthening Iran's position in the global gas market.

2. Problem Statement

The liquefied natural gas (LNG) industry, as one of the most important energy sectors in the world, plays a vital role in providing sustainable energy and reducing greenhouse gas emissions

(EIA, 2021). With approximately 17% of the world's natural gas reserves, Iran has immense potential to become one of the main players in the global LNG market (BP Statistical Review, 2022). However, the development of this industry requires massive and long-term investments that come with numerous risks, including financial, technical, environmental, and political risks (IEA, 2020). Financial risks arising from gas price fluctuations in global markets, technical risks related to the complexity of extraction and processing technologies, and environmental risks stemming from potential pollution are among the challenges facing investors in this industry (World Bank, 2019). Additionally, political risks and international sanctions can hinder the attraction of foreign investment and technology transfer to Iran (IMF, 2021). In this context, insurance, as an effective risk management tool, can play a key role in reducing these challenges. Insurance provides the necessary security for investors by covering financial, technical, and environmental risks, facilitating the attraction of domestic and foreign investments (Cummins & Weiss, 2013). However, the main question is how insurance can help reduce investment risks in Iran's LNG industry and what impact it will have on the development of this industry? Currently, Iranian insurance companies lack the full capacity to cover large LNG projects due to their financial, technical, and sanction-related limitations. However, with the development of insurance infrastructure, increased international cooperation, and reduced sanctions, these companies can gradually build their capacity to cover such risks. To achieve this goal, government support and appropriate policies in the fields of insurance and energy are needed. This research seeks to analyze the role of insurance in reducing investment risks and developing Iran's liquefied natural gas industry. By examining the various risks present and the role of insurance in managing them, this study aims to provide solutions to facilitate investment and ensure the sustainable development of this industry.

3. Literature Review

The advancement of Iran towards investment and capital attraction for launching Liquefied Natural Gas (LNG) production projects not only contributes to increasing Iran's share in the global gas market and creating sustainable foreign exchange revenues but also leads to the development of energy infrastructure, reduction of flaring, attraction of foreign investment, enhancement of energy security, and job creation. These actions can aid in sustainable economic growth and improve social welfare in Iran. In this regard, Iran must move towards providing the necessary insurance infrastructure to attract domestic and foreign investments into LNG production projects. Overall, insurance infrastructures can reduce investment risks and create favorable conditions for sustainable development and capital attraction, thereby strengthening national industries and the economy. On the other hand, the liquefied natural gas (LNG) industry, due to its strategic importance in the global energy market, has been the subject of extensive research. Previous studies have predominantly focused on the technical, economic, and environmental aspects of this industry, while the role of insurance in reducing investment risks and developing this sector has received less attention. This section references some studies related to the current research topic.

3.1. Studies Related to Risks in the LNG Industry

3.1.1. Main Reasons for the Importance of Studies Related to LNG Industry Riskse

Studies related to risks in the LNG industry are important for several reasons. These studies not only help in better understanding the challenges facing this industry but also provide solutions for managing these risks, which can lead to the sustainable and successful development

of LNG projects. Studies related to LNG industry risks play a crucial role in identifying, understanding, and managing risks, reducing uncertainty for investors, developing risk management strategies, supporting sustainable development, enhancing competitiveness, and aiding macro-policy formulation. These studies not only contribute to the success of LNG projects but also assist in the economic and sustainable energy development of countries. The following outlines the reasons for the importance of these studies:

1. Identification and Understanding of Risks: Studies related to LNG industry risks help identify various financial, technical, environmental, and political risks. This identification is the first step in effective risk management. For example, fluctuations in gas prices in global markets and high investment costs are among the financial risks that can impact project profitability (EIA, 2021).
2. Reducing Uncertainty for Investors: Investing in LNG projects, due to their large scale and high costs, involves significant uncertainties. Studies related to risks help investors better understand these uncertainties and use risk management tools such as insurance to create more security for their investments (Cummins & Weiss, 2013).
3. Development of Risk Management Solutions: Studies related to LNG industry risks assist in developing practical solutions for managing these risks. For instance, using specialized insurance, establishing investment guarantee funds, and collaborating with international companies can help reduce financial and technical risks (World Bank, 2019).
4. Support for Sustainable Development: The LNG industry faces environmental challenges such as greenhouse gas

emissions and water pollution. Studies related to risks help identify and manage these challenges, thereby contributing to the sustainable development of this industry (IEA, 2020).

5. **Enhancing Competitiveness in the Global Market:** Given the intense competition in the global LNG market, effective risk management can enhance the competitiveness of countries in this industry. For example, countries like Qatar and Australia have strengthened their positions in the global LNG market by utilizing risk management strategies (BP Statistical Review, 2022).
6. **Support for Macro-Policy Formulation:** Studies related to LNG industry risks assist policymakers in formulating policies and regulations that support the development of this industry and reduce associated risks. These studies can serve as a basis for major decision-making in the energy sector (IMF, 2021).

3.2. Identified Risks in Research Literature for the LNG Industry

The identified risks in research literature for the Liquefied Natural Gas (LNG) industry encompass various types of risks that can be categorized into four main groups. These risks can individually or collectively impact the development process of the LNG industry, making their identification and management highly significant:

1. **Financial and Economic Risks:** These risks relate to fluctuations in natural gas prices and changes in market supply and demand. Unexpected price changes can directly affect the profitability of LNG projects (Zhang & Yang, 2019). Studies show that LNG projects face significant financial risks, including price volatility in global markets and high investment costs (EIA, 2021; IEA, 2020; World Bank, 2019). These risks can influence investment returns and increase the need for risk management tools such as insurance. Additionally, financial risks are related to difficulties in project financing and changes in interest rates. Financing LNG projects presents specific challenges due to high initial costs and risks associated with investment returns (Cohen, 2020).
2. **Technical and Operational Risks:** LNG projects, due to the complexity of the technologies used, face numerous technical and operational risks. Studies, such as the report by the International Energy Agency (IEA, 2020), indicate that these risks can lead to project delays and increased costs. These risks pertain to technical and implementation issues, including equipment failures, inadequate maintenance, and delays caused by logistical problems. Such factors can reduce efficiency and increase costs (Nguyen et al., 2020).
3. **Environmental Risks:** The LNG industry confronts environmental challenges such as greenhouse gas emissions and water pollution. The World Bank (2019) emphasized in its report that managing these risks requires precise policies and financial tools like insurance.
4. **Legal and Regulatory Risks:** Changes in national and international laws and regulations can significantly impact the LNG industry. Uncertainty regarding energy and environmental policies may also influence investment decisions (Hassan & Ahmed, 2021).
5. **Risks Related to Sanctions and Specific Political, Economic, International, and Geopolitical Conditions of Iran:** Current conditions in Iran, rising tensions, intensified competition among Persian Gulf countries in their oil industry development, lack of surplus gas in Qatar's

North Dome field, international sanctions on Russia, and the uncertain future of the Ukraine-Russia war are among the factors affecting the willingness and presence of insurance companies in developing Iran's LNG industry.

3.3. Identified Risks in Research Literature for the LNG Industry

Studies related to the role of insurance in the energy industry, particularly in different fields of gas, oil, and renewable energy, highlight the high importance of insurance in reducing investment risks and increasing attractiveness for investors (Cummins & Weiss, 2013; World Bank, 2019; IEA, 2020). Below are some of these studies:

1. Insurance as a Risk Management Tool: Studies such as the research by Cummins and Weiss (2013) demonstrate that insurance can serve as an effective tool for managing financial and operational risks in the energy industry. These studies emphasize that insurance, by covering unexpected risks, provides the necessary security for investors. Some studies have examined the experiences of leading countries in the LNG industry, such as Qatar and Australia. These studies show that the use of specialized insurance and collaboration with international insurance companies has played a significant role in reducing investment risks and developing this industry (BP Statistical Review, 2022). In another study by Khan and colleagues (2019), it was shown that insurance can help reduce capital costs and provide necessary guarantees for entering large energy projects. The study emphasized that without appropriate insurance, investing in large energy projects involves high risks.
2. Insurance as a Tool for Attracting Foreign Investments: Zhou and colleagues (2020) stated in their research that the availability of appropriate insurance can play a crucial role in attracting foreign investments in the energy sector, especially in developing countries. They emphasized that insurance guarantees can increase the confidence of foreign investors and reduce barriers to market entry.
3. Insurance as a Tool for Managing Operational Risks: Another study shows that insurance can play a significant role in managing operational risks in the energy industry. Liu and colleagues (2018) demonstrated that insurance can reduce costs resulting from unforeseen accidents and equipment failures, aiding in operational continuity and reducing downtime.
4. Insurance as a Tool for Supporting Renewable Energy Projects: In the field of renewable energy, Shah and colleagues (2021) highlighted the role of insurance in supporting renewable energy projects. According to this study, insurance can assure investors that damages will be compensated in case of problems, which can accelerate the development of green projects. Overall, insurance in the energy industry not only helps reduce risks and increase investment security but also contributes to the sustainable development and economic growth of this sector.

3.4. Research Gaps in the Role of Insurance in Reducing Investment Risks and Developing Iran's Liquefied Natural Gas (LNG) Industry

Despite extensive studies on the LNG industry and the role of insurance in risk management, limited research has focused on the role of insurance in developing this industry in Iran (IEA, 2020; World Bank, 2019; IMF, 2021). In particular, the impact of insurance on

attracting domestic and foreign investments in Iran's LNG sector and the challenges faced by domestic insurance companies in covering the risks associated with this industry require further investigation (Central Insurance of Iran, 2022; World Bank, 2019; IEA, 2020). This study aims to fill these research gaps by providing a better understanding of the role of insurance in developing Iran's LNG industry. The following outlines the key research gaps:

1. **Lack of Local Case Studies:** In general, there is a scarcity of studies examining the impact of insurance on Iran's liquefied natural gas industry. Most studies focus on general outcomes of insurance and its role in the energy sector but do not provide specific data about the Iranian market. This lack of information can hinder a comprehensive understanding of how insurance affects the development of the LNG industry in Iran (Gholami et al., 2021). Existing studies primarily focus on general risks in the LNG industry and pay insufficient attention to Iran-specific risks, such as international sanctions, limited access to advanced technologies, and domestic environmental challenges (IMF, 2021). These risks significantly impact investment attraction and the development of Iran's LNG industry.
2. **Limited Studies on Domestic Insurance Companies:** Although some studies have explored the role of insurance in the energy sector, few have examined the capacities and challenges of domestic insurance companies in Iran in covering the risks of LNG projects (Central Insurance of Iran, 2022). This issue is particularly important given the financial limitations and international sanctions imposed on Iranian insurance companies.
3. **Lack of Analysis on Legal and Regulatory Frameworks:** Many studies have examined

the role of insurance in the energy sector but have not adequately addressed the legal and regulatory frameworks that interact with insurance in Iran's LNG industry. Understanding the impact of restrictive or facilitating laws and regulations on insurance and investment in this sector is especially significant (Rezazadeh & Zare, 2020).

4. **Cultural and Social Analysis:** Research related to the role of insurance in reducing investment risks generally focuses on economic and technical aspects, while less attention has been paid to cultural and social factors that may influence the acceptance of insurance in the LNG industry. Understanding these factors can help improve insurance and investment strategies (Mohammadi & Aghaei, 2022).
5. **Diversity of Insurance Products and New Offerings:** There has been no detailed analysis of the diversity of existing insurance products and the specific needs of Iran's LNG industry. Developing insurance products specifically designed to cover the unique risks of this industry can help attract more investments (Jafari & Tavakoli, 2021).
6. **Lack of Practical Solutions for Developing the Insurance Industry:** Existing studies often describe risks and the role of insurance but do not provide practical solutions for developing the insurance industry in Iran and enhancing its ability to cover the risks of LNG projects (IEA, 2020). This research gap requires further exploration.

3.4.1. Addressing Research Gaps in the Current Study

This research focuses on the role of insurance in reducing investment risks and developing Iran's LNG industry, addressing several key research gaps. Not only does it

contribute to a better understanding of how insurance impacts investment attraction and risk management, but it also provides practical solutions for developing the insurance industry and enhancing its capacity to cover major risks. The following aspects of the research gaps will be addressed:

1. **Impact of Insurance on Attracting Domestic and Foreign Investments:** This study analyzes the role of insurance in increasing the attractiveness of LNG projects for domestic and foreign investors. Given the lack of research in this area, the current study can help better understand how insurance can be used as a tool to reduce financial and political risks and attract investments (World Bank, 2019; IMF, 2021).
2. **Evaluation of Challenges Faced by Domestic Insurance Companies:** This research examines the challenges faced by domestic insurance companies in Iran in covering the risks of LNG projects. This is particularly relevant given the financial, technical, and international sanctions- related limitations, which constitute a significant research gap (Central Insurance of Iran, 2022).
3. **Practical Solutions for Developing the Insurance Industry:** The present study provides practical solutions for developing the insurance industry in Iran by analyzing the role of insurance in reducing investment risks. This addresses the research gap regarding applied strategies to enhance the capacity of domestic insurance companies in covering major risks (IEA, 2020).
4. **Analysis of Iran-Specific Risks:** This research examines Iran-specific risks, such as international sanctions, limited access to advanced technologies, and domestic environmental challenges. This aspect has received less attention in previous studies (IMF, 2021).

By addressing these gaps, this study aims

to contribute to both academic knowledge and practical policymaking in the field of insurance and investment in Iran's LNG industry. It provides insights into how tailored insurance solutions, supportive government policies, and international collaborations can foster sustainable development and attract investments to this critical sector.

4. Field Study and Data Collection Process

The field study and data collection process in this research were conducted using a mixed- methods approach (quantitative and qualitative). This approach allows the researcher to gain a comprehensive understanding of the role of insurance in reducing investment risks and developing the LNG industry in Iran. The following steps outline the data collection process:

4.1. Defining the Statistical Population and Sampling

The statistical population of this research includes a wide range of stakeholders directly or indirectly involved in the LNG and insurance industries in Iran. This population enables the researcher to collect comprehensive and diverse data and provide a detailed analysis of the role of insurance in reducing investment risks and developing the LNG industry. To achieve this, the researcher selected the statistical population from among the following groups:

- Players in Iran's liquefied natural gas (LNG) industry,
- Insurance companies active in the energy sector,
- Domestic and foreign investors,
- Experts in the fields of energy and insurance.

Based on the structure of the LNG and insurance industries in Iran, the statistical

population was estimated to include approximately 200 to 400 individuals or entities. This number encompasses companies, organizations, government institutions, and specialized individuals.

- **Qualitative Sampling:** In the qualitative phase, purposive sampling (Purposive Sampling) was used to select participants who could provide the most relevant and insightful information for the study. The sample size was determined based on theoretical saturation (Theoretical Saturation), which was achieved after conducting 15 interviews with key informants (Creswell & Creswell, 2018).
- **Quantitative Sampling:** In the quantitative phase, stratified random sampling (Stratified Random Sampling) was used due to the heterogeneity of the statistical population (including LNG companies, insurance companies, investors, government institutions, and experts). The population was divided into homogeneous subgroups, and random sampling was conducted within each subgroup. The sample size was calculated using Cochran's formula, considering a 5% margin of error and a 95% confidence level, resulting in an estimated sample size of 132 to 196 participants for a population of 200 to 400 individuals (Cochran, 1977).

4.2. Data Collection Tools

To gather qualitative data, semi-structured interviews were conducted with experts in the LNG industry, managers of insurance companies, and investors. These interviews provided deeper insights into various aspects of the topic and helped uncover stakeholders' perspectives. Additionally, secondary data sources such as industry reports, insurance company documents, and data published by international organizations like the International Energy Agency (IEA) and the World Bank were utilized. For quantitative

data collection, structured questionnaires were designed. These questionnaires included questions about the role of insurance in reducing investment risks, the challenges faced by insurance companies, and the impact of insurance on the development of the LNG industry. The questionnaire was informed by the findings of the qualitative phase.

4.3. The Process of Conducting the Field Study:

In this research, key stakeholders, including companies active in the LNG industry, insurance companies, and investors, were first identified. Then, the qualitative section of the questionnaire was distributed both electronically and in person, and interviews were conducted with the stakeholders. The qualitative data were analyzed using the content analysis method, and finally, the quantitative section of the questionnaire was designed based on the results of the qualitative section. It was distributed among the members of the statistical sample, and the completed questionnaires were collected. The quantitative data were analyzed using SPSS and PLS statistical software. To ensure the validity of the qualitative data, triangulation (the use of multiple data sources) and member checking (review by participants) were employed. For the generalizability of the results, sampling was conducted in a way that represented the statistical population.

5. Inferential Analysis of Research Data

In the qualitative section of the research, semi-structured interviews were conducted with 15 participants. These interviewees included managers of companies active in the liquefied natural gas (LNG) industry, insurance experts, investors, and policymakers. After collecting the data, a content analysis was performed, and the results were summarized as shown in (Table 1).

Table 1. Summary of Content Analysis of Interview Results with Experts on the Analysis of the Role of Insurance in Reducing Investment Risks and the Development of the Liquefied Natural Gas Industry in Iran

Row	Key Concept	Frequency	Statements Expressed by Interviewees	Interpretation and Analysis
1	The Role of Insurance in Reducing Financial Risk	12	Insurance assures investors that in the event of incidents, part of the losses will be compensated. Insurance enables risk-taking in large investments such as LNG.	Insurance, as a tool for reducing financial risks, increases investment attractiveness.
2	Insurance Challenges in the LNG Industry	10	High insurance rates and incomplete risk coverage are the main challenges.	High insurance costs and coverage limitations hinder the development of the LNG industry.
3	The Impact of Insurance on Attracting Investment	11	Foreign investors require strong insurance coverage due to political and economic risks.	Insurance acts as a factor in attracting foreign investment, especially in high-risk industries such as LNG.
4	The Need for Specialized Insurance	9	The LNG industry requires specialized insurance that covers the specific risks of this sector.	The absence of specialized insurance is one of the primary barriers to the development of the LNG industry.
5	The Role of Government in Developing Insurance	8	The government should strengthen the insurance industry by offering tax incentives and government guarantees.	Government support for the insurance industry plays a key role in the development of the LNG industry.
6	Political Risks and Insurance	7	Political risks such as sanctions make insurance coverage more complex.	Political risks increase the need for international insurance and cooperation with global institutions through consortia.
7	The Impact of Insurance on Sustainable Development	6	Insurance contributes to the sustainable development of the LNG industry by reducing risks.	Insurance, as a tool for the sustainable development of the LNG industry, plays an important role.

To design the conceptual model of the research based on the findings obtained from the qualitative section, the following steps were carried out:

5.1. Definition of Key Variables

First, the key variables were determined based on the seven themes summarized in the qualitative section of the research. These variables are considered as the main constructs in the conceptual model.

5.2. Determination of Relationships Between Variables

Based on the content analysis of the interviews, the relationships between the variables were identified as assumptions. For example:

- The role of insurance in reducing financial risk may have a direct impact on attracting investment.
- Insurance challenges may act as a barrier to sustainable development.

- The role of the government may influence the development of specialized insurance.
- Political risks may affect insurance challenges and the attraction of investment.

5.3. Drawing the Conceptual Model

The conceptual model of the research was drawn based on the findings of the qualitative section as shown in (Figure 1). In this figure, the variables are represented as nodes, and the relationships between them

are shown as arrows. The direction of the arrows indicates the direction of influence. For example:

- The role of insurance in reducing financial risk → Attracting investment
- Insurance challenges → Sustainable development
- The role of government → Specialized insurance
- Political risks → Insurance challenges and attracting investment

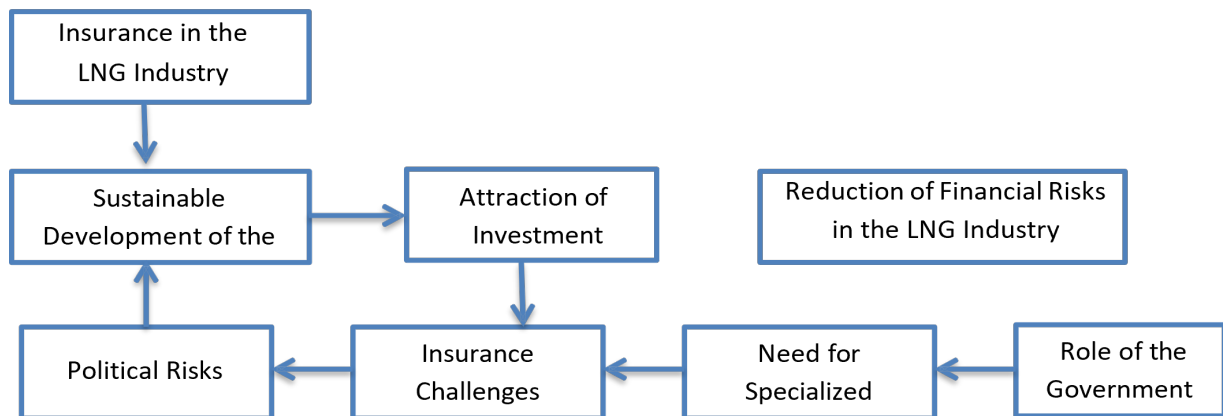


Figure 1. Conceptual Model Designed for the Research Based on the Findings of the Qualitative Section of the Research

Note: It should be noted that the above scheme is applicable under normal conditions, and under conditions of sanctions, war, etc., as we see in the only Mini LNG project currently being implemented, its implementation is not possible. There is no doubt about the Industrial LNG projects.

5.4. Model Validation

The conceptual model designed for the research was examined using quantitative methods, specifically Structural Equation Modeling (SEM), to confirm the relationships between variables. The use of Structural Equation Modeling (SEM) in this research was due to its ability to simultaneously analyze latent and observable variables,

examine multiple relationships, evaluate model fit, manage measurement errors, and provide comprehensive and accurate results. This method assists the researcher in fully and scientifically analyzing the complex conceptual model of the research and delivering valid results. The output tables of the Structural Equation Modeling (SEM) for the research topic were first processed through the steps of SEM analysis, followed by data processing, and the results are presented in standardized table formats. The output tables of the Structural Equation Modeling for the sample size of 150 in this research are presented as follows. These tables include model fit indices, path coefficients, and significance values.

Table 2. Fit Indices for the Research Conceptual Model

Result	Acceptable Limit	Value	Fit Index
Acceptable	The smaller, the better	210.56	Chi-Square (χ^2)
-	-	145	df
Acceptable	> 0.90	0.93	CFI
Acceptable	> 0.90	0.91	TLI
Acceptable	< 0.08	0.06	RMSEA
Acceptable	< 0.08	0.05	SRMR

Based on the results of (Table 2), it can be interpreted that the model has a good fit, as

the CFI, TLI, RMSEA, and SRMR indices fall within the acceptable range.

Table 3. Path Coefficients and Significance for the Research Conceptual Model

Result	p-value	t-value	Path Coefficient (β)	Factors relationship
Significant	0,000	8.34	0.72	Financial Risk Reduction → Investment Attraction
Significant	0,000	-6.12	-0.56	Insurance Challenges → Sustainable Development
Significant	0,000	7.89	0.65	Government Role → Specialized Insurance
Significant	0,000	5.23	0.48	Political Risks → Insurance Challenges
Significant	0,000	-4.56	-0.37	Political Risks → Investment Attraction
Significant	0,000	6.78	0.59	Specialized Insurance → Sustainable Development

Based on the results of (Table 3), it can be ultimately interpreted that all relationships between the constructs of the research conceptual model are significant (p -value < 0.05). Financial risk reduction has a strong positive

effect on investment attraction ($\beta = 0.72$). Insurance challenges have a negative impact on sustainable development ($\beta = -0.56$). The role of government has a positive effect on specialized insurance ($\beta = 0.65$).

Table 4. Results of Confirmatory Factor Analysis (CFA) for the Research Conceptual Model

AVE	CR	Factor Loading	Indicators (Observable Variables)	Construct
0.72	0.91	0.85	Insurance reduces financial risk	Financial Risk Reduction
		0.88	Insurance provides peace of mind	
0.68	0.89	0.79	High insurance premiums	Insurance Challenges
		0.82	Inadequate insurance coverage	
0.75	0.92	0.87	Insurance increases the attraction of investors	Investment Attraction
0.70	0.90	0.84	Need for specialized insurance	Specialized Insurance
0.73	0.91	0.86	The government supports the insurance industry	Government Role
0.65	0.88	0.81	Sanctions impact insurance	Political Risks
0.76	0.93	0.89	Insurance contributes to sustainable development	Sustainable Development

Based on the results of (Table 4), it can be ultimately interpreted that the factor loadings of all indicators are above 0.7, which demonstrates good convergence of the indicators with the constructs. Additionally, the construct reliability (CR) is above 0.7 and the AVE is above 0.5, indicating good reliability and convergent validity of the constructs.

5.5. Recommendations

Based on the conceptual model of the research and the results obtained from the qualitative and quantitative sections of the study, several recommendations have been proposed for policymakers, insurance companies, and investors to enhance the role of insurance in reducing investment risks and developing the liquefied natural gas (LNG) industry in Iran.

Table 6. Strategies for Enhancing the Role of Insurance in Reducing Investment Risks and Developing the LNG Industry in Iran

Row	Key Concept	Number of Mentions	Statements Expressed by Interviewees	Interpretation and Analysis
1	Coverage of Specific LNG Industry Risks	12	1. Coverage of technical and operational risks 2. Coverage of environmental risks 3. Coverage of political risks	The majority of experts emphasized the necessity of designing specialized insurance products for the unique risks of the LNG industry.
2	Engagement of International Insurers	10	1. Attracting international insurance companies 2. Government guarantees for foreign insurers	Experts believe that the participation of international insurers can increase the capacity to cover large risks.
3	Establishment of Investment Guarantee Funds	9	1. Joint funds by government and private sector 2. Loan repayment guarantees	The establishment of investment guarantee funds was proposed as a solution to reduce investors' concerns.
4	Government Supportive Policies	14	1. Tax exemptions 2. Government subsidies 3. Currency facilities	The majority of experts emphasized the key role of the government in providing financial and legal support.
5	Regional and International Cooperation	8	1. Bilateral and multilateral agreements 2. Collaboration with international organizations	Collaboration with international institutions was proposed as a solution to reduce export-related risks.
6	Development of Secondary Markets	7	1. Secondary insurance markets 2. Use of modern financial instruments	The development of secondary markets for transferring large risks was suggested as an effective solution.
7	Training and Empowerment of Stakeholders	6	1. Training managers and investors 2. Promoting a culture of insurability	Increasing stakeholders' awareness of the benefits of insurance was proposed as a solution for the development of the LNG industry.
8	Transparency and Updating of Laws and Regulations	11	1. Updating and ensuring the stability of laws 2. Effective supervision over the interpretation and enforcement of laws	Experts emphasized the need to establish transparent and sustainable legal frameworks to attract investors.
9	Development of Insurance Infrastructure	5	1. Establishing specialized data centers 2. Utilizing modern technologies	The development of technology-driven infrastructure was proposed as a solution to improve insurance processes.
10	Continuous Evaluation and Updating of Policies and Regulations	4	1. Periodic evaluations 2. Policy flexibility	Continuous evaluation of laws and policies was suggested as a way to adapt to market and technological changes.

6. Conclusion and Suggestions

The present study analyzed the role of insurance in reducing investment risks and developing the liquefied natural gas (LNG) industry in Iran. The findings confirm that insurance can serve as an effective mechanism for mitigating financial risks, enhancing investor confidence, and promoting sustainable development in the LNG sector. However, the practical realization of this potential depends on a realistic understanding of Iran's institutional, financial, and international constraints. Currently, the Iranian LNG industry faces multiple challenges, including limited access to international capital and technology, restricted cooperation with global insurers due to sanctions, and the insufficient capacity of domestic insurance companies to provide specialized coverage for large-scale and high-risk industrial projects. Therefore, while insurance has theoretical potential to reduce investment risks, its practical impact requires a phased, localized, and well-prioritized policy framework. Beyond these structural issues, two emerging geopolitical factors have significantly increased insurance-related risks:

1. The potential activation of the Snapback mechanism: The reactivation of the Snapback mechanism, which automatically reinstates United Nations sanctions in case of alleged non-compliance with the nuclear agreement, would severely constrain Iran's access to international insurance and financial services. This would:
 - A: sharply increase political and sovereign risk premiums,
 - B: Trigger the withdrawal of international reinsurers from Iranian markets,
 - C: Reduce the creditworthiness and operational capacity of domestic

insurers, and

- D: Create a climate of uncertainty that discourages both domestic and foreign investment in LNG projects.

Under such conditions, reliance on domestic insurance mechanisms, national investment guarantee funds, and regional reinsurance partnerships becomes not only a necessity but a strategic priority for maintaining risk coverage.

2. The rising geopolitical tensions between Iran and the United States, as well as between Iran and Israel. Impact of the Snapback Mechanism: The escalation of geopolitical tensions between Iran, the United States, and Israel has also intensified political and security risks affecting the LNG value chain—from production and transportation to export logistics. Such tensions increase:

- A: the cost of marine and energy insurance,
- B: The probability of project delays or force majeure events, and
- C: The difficulty of obtaining reinsurance coverage in global markets.

Consequently, overall project costs rise, and investor confidence diminishes. To mitigate these impacts, Iran must focus on developing localized political risk insurance schemes, enhancing transparency in public-private insurance partnerships, and strengthening regional cooperation with neighboring countries to share and distribute risks.

Based on the findings of this research, the following recommendations are proposed, emphasizing feasibility, prioritization, and adaptation to Iran's current realities:

6.1. Short-Term and Realistic Recommendations (Immediate Implementation)

- A) Strengthening Domestic Insurance

Capacity: Develop targeted training programs to enhance the technical expertise of Iranian insurers in energy and industrial risk assessment. Encourage cooperation between domestic insurers and local universities or research centers to design semi-specialized insurance models suited to LNG operations.

- B) Gradual Introduction of Specialized Insurance Products: Begin with modular insurance packages covering manageable operational and environmental risks, before expanding to more complex risks such as political or market risks. Leverage existing reinsurance networks within the region (e.g., with neighboring countries) instead of relying solely on Western or global markets.
- C) Enhancing Governmental and Regulatory Support: Reform existing laws such as the Foreign Investment Promotion and Protection Act (FIPPA) and the Law on Maximizing Domestic Production and Services to clarify insurance-related provisions for energy projects. Introduce transparent mechanisms for oversight to minimize rent-seeking, corruption, and conflicts of interest in insurance-related subsidies or guarantees.

6.2. Medium-Term Recommendations (Requiring Institutional Development)

- A) Establishment of a National Investment Guarantee Fund: Create a government-backed but professionally managed fund to provide partial guarantees for LNG investments. The fund's design should prioritize transparency, limit bureaucratic interference, and operate under strict auditing standards.
- B) Digital Transformation of the Insurance Sector (with Caution): Implement gradual digitalization of insurance operations—starting with data integration, electronic

claim management, and basic risk modeling. Adoption of advanced technologies such as blockchain or parametric insurance should only follow after a comprehensive assessment of digital infrastructure readiness.

- C) Development of a Legal and Supervisory Framework: Regularly update insurance and investment-related regulations to align with global standards while maintaining local relevance. Strengthen the supervisory role of the Central Insurance of Iran to ensure compliance and reduce policy ambiguity.

6.3. Long-Term and Strategic Recommendations (Conditional on Future Reforms)

- A) International Cooperation and Re-engagement: Prepare long-term strategies for engaging with regional and global insurance markets after easing of sanctions or political normalization. Establish regional alliances or multilateral frameworks (e.g., with Gulf or Asian partners) to share LNG project risks and insurance know-how.
- B) Development of Secondary and Reinsurance Markets: Explore the formation of a regional reinsurance pool or secondary risk market in collaboration with Middle Eastern partners to expand coverage capacity. Introduce financial instruments such as energy bonds or Sukuk cautiously, following the establishment of a strong regulatory foundation.

Table 7. Summary and Recommendations on the Role of Insurance in LNG Industry Development in Iran

Timeframe	Recommendation Title	Proposed Action
Short-term and Realistic	Strengthening domestic insurers	Develop specialized training programs to enhance technical capacity of Iranian insurers in industrial and energy risk assessment. Foster collaboration between insurers and academic/research institutions to design semi-specialized insurance models tailored to LNG industry characteristics.
	Gradual development of LNG-specific insurance policies	Begin with modular insurance policies covering operational and environmental risks, before expanding to complex risks such as political or market risks. Leverage regional insurers and reinsurers (especially in neighboring countries) instead of relying solely on Western international markets.
	Targeted and transparent government support	Revise existing laws such as the "Foreign Investment Promotion and Protection Act" and the "Maximum Use of Domestic Production and Services Act" to clarify the role of insurance in energy projects. Establish transparent oversight mechanisms to prevent rent-seeking, corruption, and conflicts of interest in allocating subsidies or state-backed guarantees.
Medium-term (Requires Institutional Development)	Establishment of a National Investment Guarantee Fund	Create a government-backed but professionally managed fund to provide partial guarantees to LNG investors. Design the fund with emphasis on transparency, financial accountability, and strict oversight to avoid bureaucracy and inefficiency.
	Gradual digitalization of the insurance sector	Implement digital processes such as data integration, electronic claims management, and statistical risk analysis. Use advanced technologies like blockchain or parametric insurance only after thorough evaluation of technical infrastructure.
	Legal and regulatory framework updates	Continuously revise insurance and investment regulations to align with international standards and domestic conditions. Strengthen the supervisory role of Iran's Central Insurance to enhance transparency, trust, and legal clarity.
Long-term and Strategic (Conditional on Macro Reforms)	Expansion of international and regional cooperation	Design a long-term roadmap for re-entry into global insurance markets if sanctions are lifted or political relations improve. Build regional alliances (e.g., with Gulf or East Asian countries) to share technical knowledge, insurance risks, and LNG development experience.
	Development of secondary markets and reinsurance mechanisms	Explore and design regional reinsurance markets or establish a "Joint Risk Fund" to increase coverage capacity for large-scale projects. Utilize Islamic financial instruments such as energy participation bonds or sukuk after strengthening regulatory systems and ensuring financial transparency.

6.4. Policy Prioritization Framework

To ensure effectiveness and resource efficiency, the proposed recommendations should be prioritized based on three key criteria:

Priority Level	Focus Area	Time Horizon	Feasibility	Expected Impact
High	Strengthening domestic insurers and legal reforms	Short-term	High	High
Medium	Establishment of investment guarantee fund and gradual digitalization	Medium-term	Moderate	High
Low	International cooperation and advanced financial instruments	Long-term	Low (under current conditions)	Very High (conditional)

7. Concluding Remarks

In conclusion, insurance can play a pivotal role in mitigating investment risks and facilitating the sustainable growth of Iran's LNG industry, but its success depends on institutional maturity, regulatory transparency, and gradual reform rather than immediate large-scale initiatives. Unrealistic expectations—such as full participation of global insurers under ongoing sanctions or rapid digital transformation without infrastructure—should be avoided. Future research should therefore focus on developing localized insurance models, assessing the real financial capacity of domestic insurers, and examining governance mechanisms to minimize political and economic inefficiencies. Such studies can provide policymakers with practical insights to progressively integrate insurance-based risk management into Iran's energy investment strategies. By aligning policy recommendations with economic realities and institutional capacities, Iran can gradually strengthen the resilience and attractiveness of its LNG industry in both domestic and international contexts. Also, the potential activation of the Snapback mechanism and the escalation of geopolitical tensions significantly amplify political and insurance risks, making domestic resilience, regional partnerships, and locally adapted insurance solutions the most viable pathways forward.

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تحلیل نقش بیمه در کاهش ریسک‌های سرمایه‌گذاری و توسعه صنعت گاز طبیعی مایع‌شده در ایران

• محمدرضا علیمردان^۱، محمدرضا سیدهاشمی تولون^۲، عباس کاظمی نجف‌آبادی^{۳*}

۱. دانشجوی دکترا، گروه حقوق خصوصی، دانشکده حقوق و علوم سیاسی، دانشگاه علامه طباطبائی، تهران، ایران

۲. استادیار، گروه مدیریت، موسسه آموزش عالی سهروردی، قزوین، ایران

۳. دانشیار، گروه حقوق خصوصی، دانشکده حقوق و علوم سیاسی، دانشگاه علامه طباطبائی، تهران، ایران

(ایمیل نویسنده مسئول: kazemi_najaf@atu.ac.ir)

چکیده

صنعت گاز طبیعی مایع‌شده (LNG) به‌عنوان یکی از بخش‌های کلیدی در تأمین انرژی جهانی، نقش بسزایی در توسعه اقتصادی و امنیت انرژی ایفا می‌کند. با این حال، سرمایه‌گذاری در این صنعت با ریسک‌های متعددی از جمله نوسانات قیمت‌های جهانی، چالش‌های فنی، مسائل زیست‌محیطی و عدم اطمینان‌های سیاسی مواجه است. بیمه به‌عنوان ابزاری کارآمد در مدیریت ریسک، می‌تواند نقش مهمی در کاهش این ریسک‌ها و تسهیل سرمایه‌گذاری در صنعت LNG ایفا کند. این پژوهش به تحلیل نقش بیمه در کاهش ریسک‌های سرمایه‌گذاری و توسعه صنعت گاز طبیعی مایع‌شده در ایران می‌پردازد. با استفاده از روش‌های تحلیلی و مطالعه موردی، تأثیر بیمه‌های مختلف از جمله بیمه‌های مسئولیت، بیمه‌های اموال و بیمه‌های اعتباری بر کاهش ریسک‌های سرمایه‌گذاری در این صنعت بررسی می‌شود. نتایج این پژوهش نشان می‌دهد که بیمه‌ها می‌توانند با پوشش ریسک‌های مالی و عملیاتی، جذابیت سرمایه‌گذاری در صنعت LNG را افزایش داده و به توسعه پایدار این صنعت در ایران کمک کنند. همچنین، پیشنهادهای برای بهبود چارچوب‌های بیمه‌ای و سیاست‌های حمایتی دولت ارائه می‌شود تا زمینه‌ساز رشد بیشتر این صنعت در آینده باشد. مهم‌ترین این پیشنهادات در شرایط عادی (نبود جنگ، تحریم و محدودیت‌های دیگر) عبارتند از: (۱) تقویت چارچوب‌های بیمه‌ای برای پوشش ریسک‌های خاص صنعت گاز طبیعی مایع‌شده، (۲) تشویق مشارکت شرکت‌های بیمه‌ای بین‌المللی در قالب کنسرسیوم، (۳) ایجاد صندوق‌های تضمین سرمایه‌گذاری، (۴) تدوین سیاست‌های حمایتی دولت، (۵) ارتقای همکاری‌های منطقه‌ای و بین‌المللی، (۶) توسعه بازارهای ثانویه برای انتقال ریسک، (۷) آموزش و توانمندسازی ذی‌نفعان، (۸) تدوین قوانین و مقررات شفاف و پایدار، (۹) توسعه زیرساخت‌های بیمه‌ای، (۱۰) ارزیابی مستمر و به‌روزرسانی سیاست‌ها.

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