



Economics and Financial Policymaking

Journal Homepage: www.journalefp.com



ORIGINAL RESEARCH PAPER

Feasibility Study of Cat Bond and Sidecar for Emerging Markets Management Case Study: Iranian Economy

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PAPER INFO

Handling Editor: Dr Mahdi Khazaei

Paper history:

Received: 17 Feb 2026

Revised: 13 Jun 2026

Accepted in revised form: 07 Sep 2026

Published: 20 Jan 2027

Keywords:

Iranian Economy;
Emerging Markets;
Risk Management;
Cat Bond;
Sidecar.

This article is part of a Special Issue entitled:

Artificial Intelligence and Data-Driven Financial Policy in Economics and Financial Policymaking.

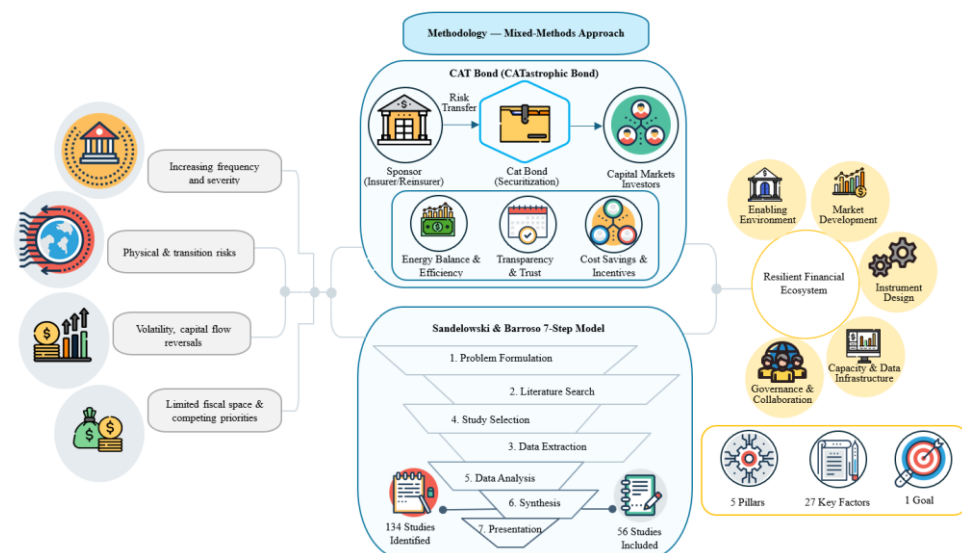
How to cite: Nouri, M., Chirani, E., & Mirbargkar, S. M., (2022). Feasibility Study of Cat Bond and Sidecar for Emerging Markets Management Case Study: Iranian Economy, *Economics and Financial Policymaking*, 3(4), 435-441.



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ABSTRACT

Abstract the spread of catastrophic events and the increase in systematic risks have doubled the need for new risk management tools, especially in emerging markets where resilience to such shocks is of vital importance. In the meantime, Cat Bond and Sidecar have been invented as risk management tools. The present article aims to assess the feasibility of these two in Iran, using a mixed approach (meta synthesis in the qualitative part and the structural transactions approach (PLS-SEM) along with t-test in SPSS software in the quantitative part). Meta synthesis was carried out with a systematic synthesis of related studies in a specific time period (domestic sources 1380-1403 and foreign sources 2000-2025) using the seven-stage model of San delowski and Baroso. The search strategy was carried out with specific criteria such as title, abstract and content, design, and sources that were not proportional to the research question and purpose were excluded from the study. From the initial 134 studies, 56 were selected as eligible for the final analysis and by identifying 77 concepts, 27 factors affecting the performance and design of this tool were jointly selected and compared in the form of 5 major categories. The interpretations indicate differences between the two tools for implementation and dissemination in Iran. The results also show that the implementation and development of this tool in emerging markets such as Iran requires management and simultaneous attention to several intervening dimensions to provide a practical guide for financial policymakers in selecting the appropriate risk transfer tool.



1. Introduction

In recent decades, the intensification of catastrophic events and the increase in systemic risks have created serious challenges for financial and insurance systems, especially in emerging markets. Insurance, as a method of dealing with risk, is a response to uncertain and risky conditions. The function of insurance is to protect national capital and the property of policyholders who suffer heavy losses due to accidents and disasters. Almost every accident is subject to some risks, but some of them are more harmful. Heavy losses and losses resulting from large-scale losses can cause any insurance company with any capital and credit anywhere in the world to face numerous problems. Therefore, companies must transfer a part of the accepted risks to an appropriate domestic or foreign reinsurer,

whereby the direct insurer participates in the financial results of its insurance obligations in various ways so that reinsurance provides similar protection to direct insurers (Liu et al., 2020). Insurance companies traditionally use reinsurance to reduce the concentration of risk losses and compensate for their limited capital reserves (Mir Motahari, 2006). However, it should be noted that reinsurance also has a limited capacity to concentrate risk and reserve capital, and the rapid increase in the value of insured assets in disaster-prone areas means that it is not able to cover all of this risk (Malcolm and Jones, 2007). More importantly, although traditional reinsurance is efficient in managing relatively small risks and in sharing information between insurance cedants and reinsurers, when the

importance and extent of potential losses and the correlation and interdependence of risks increase, the efficiency of the traditional reinsurance model fails and its capital cost becomes uneconomical. In this non-stationary environment, traditional science and statistical approaches, which are based solely on historical data analysis, have increasingly failed to estimate the probability of today's risks. Therefore, a paradigm shift in risk assessment methods has occurred (Chang et al., 2019). How can the insurance industry, which is primarily concerned with risks, be linked to the capital market and whether insurers can use other risk transfer methods instead of reinsurance and benefit from them? In fact, the variability of the existing reinsurance capacity and reinsurance prices has led to the consideration of capital market solutions as an alternative to insurance risk hedging. Therefore, efficient and effective tools for establishing a direct link between the insurance industry and the capital market can be provided under the concept of risk securitization. In fact, using the capacity of alternative risk transfer instruments is one of the risk management strategies before the occurrence of catastrophic events that has been recommended for financial coverage. (Hasangholipour et al., 1401). In a comprehensive definition, risk-linked securities, also known as insurance-linked securities, are innovative financing instruments that allow the sale of insurance risk in capital markets and the collection of funds that insurers and reinsurers can use to pay losses resulting from major disasters (David Rowe et al., 2012). Meanwhile, Cat Bonds are defined as financial instruments that transfer the insurer's risks to investors who share the insurer's costs by surrendering their unpaid principal or coupon after a catastrophic event. The market for these bonds covers a wide range of defined risks. These include, but are not limited to, hurricanes, wind, earthquakes, floods, and wildfires, and are often issued to cover so-called upper layers of reinsurance protection (Cummins, 2007). Because these instruments are only used in the event of a catastrophic event, they are called catastrophe bonds. They are also known by other names such as catastrophe risk bonds, catastrophe swaps, and event-linked bonds, all of which are very similar in function and definition and are developed only for use in an extreme event (Shao et al., 2017). Fixed-income instruments that are usually structured as floating-rate notes and are subject to principal risk. There are many other interpretations, however most agree on defining them as financial risk transfer mechanisms used by insurance agencies and issued by reinsurers that help to balance the financial market in the event of a catastrophic event for insurance companies (Katsuichiro Gouda, 2015). The Cat Bond market, which had a slow start in the late 1990s, has matured and become a steady source of capacity for primary insurers and reinsurers. In recent years, it has been considered the most mature financial instrument and has experienced a growing trend. Collateralized reinsurance bonds, also known as Sidecars, are also an innovative financing vehicle with some similarities to conventional reinsurance and Cat Bonds. In a general definition, a Sidecar is a reinsurance company whose founder is one or more insurance or reinsurance companies that has a limited lifespan and is an intermediary for raising capital to cover the risks of the founder company and participate in its risks. However, according to the more precise definition of A. M. Best, a true Sidecar is formed when the founder who creates and underwrites the Sidecar does not own any shares in it and does not invest because the purpose of its creation is to transfer risk outside the company and if the founder himself is one of the investors in the Sidecar, the purpose will not be achieved (Malcolm, 2007). In other words, Sidecars are intermediaries that provide excess capacity to the sponsoring insurer (or reinsurers) through a reinsurance collateral contract. Typically, they have a short lifespan (a limited number of years) with a specific and predetermined investment transfer method (Mazlouni, 2011). Sidecars date back to at least 2002. However, they became much more prominent after the 2005 hurricane season. After Katrina, when the reinsurance industry attracted about \$30 billion in new capital, including new entrants and existing reinsurers, the industry raised about \$5 billion in sidecars and another \$5 billion through bond issuance (Sweess Ray, 2007). Meanwhile, both Cat Bonds and Sidecars, as alternative reinsurance funds and dominant instruments, have continued to expand and influence the global reinsurance space. The insurance securities market, which began operating in the 1990s, has experienced a growing trend in recent years, such that by the end of 2023, the capital of bonds issued this year and bonds The amount of unredeemed issued in recent years reached \$1.43 billion, which can also be seen in figure 1.

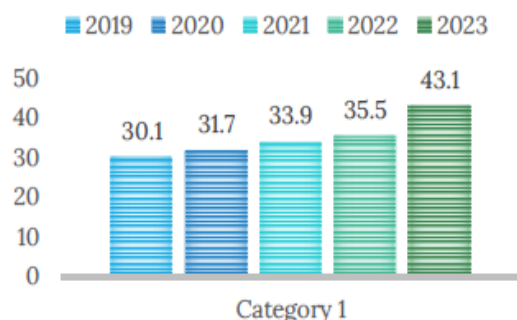


Figure 1. Volume of insurance securities capital in the global market

Source: Swiss Re, 2024

From the perspective of the cedant, there are several incentives, such as access to long-term and stable capital market capacity, the ability to take on specific commitments and conditions over multiple periods, and diversification into

reinsurance recoverables outside the insurance market and into a broad, fixed-income market that is not vulnerable to traditional market cycles, that pursue a securitization-to-risk strategy along with conventional reinsurance strategies. Thus, these securities provide an attractive alternative to traditional asset-backed and fixed-income securities (McBright and Lesturgeon, 2008). In this way, the risk of catastrophic events is converted into securities by insurance companies and sold to investors in the capital market with two special and major functions: first, it transfers risks from insurance and reinsurance companies to capital market investors, and second, it is a way to finance insurance companies and compensate for their capital reserve deficit (Cox et al., 2000).

In Iran, insurance as an economic institution that covers the risks of catastrophic events is far from the standards of the world's insurance industry and its penetration rate is low (Mousoyan et al., 2015). Out of 51 insurance institutions in the country, only 6 institutions have reinsurance capacity, so transferring risk to the capital market can reduce the risk saturation of the domestic insurance market (Jafari, 2014). In addition, there are limitations in using the capacity of foreign reinsurance. Therefore, transferring risk to the capital market can reduce the risk saturation in the domestic insurance market, but unfortunately, investors in the country's market have so far continued to show sensitivity to new insurance products and tools that advance the capital market. This cold attitude has plagued financial institutions. Insurers and reinsurance intermediaries have designed new tools and a lot of energy has been spent on other risk-free money-making opportunities without achieving the desired results. This is while currently in some countries of the world, the alternative risk transfer market has become the main option for insurers. In developed markets, these tools have become part of the disaster risk management structure, but in emerging markets, due to institutional, legal, structural and sometimes jurisprudential complexities, financial constraints, weak capital market depth and greater vulnerability to external shocks, they are more exposed to instability caused by catastrophic events than other economies. In addition, the limited capacity of insurance companies, pressure on government financial resources and increasing risk correlation have made the need for new risk management tools more evident than ever. In such circumstances, the development of Cat Bond and Sidecar can help reduce pressure on public budgets, increase the participation of institutional investors and promote financial stability.

Iran, as one of the emerging markets in this field, has not yet benefited from the full capacity of these instruments despite being exposed to significant risks. It seems that despite the diversity of event risks that we have faced in Iran in the past, by designing a mechanism in accordance with the country's situation for the issuance and implementation of the aforementioned bonds, the country's insurance capacity can be expanded to some extent and, as a financial innovation in the capital market, a new instrument can be added to the investors' portfolio. This is because, given the low volume of risk retention in the country, relative to the level of profit absorption, the use of these bonds will lead to the development of new transactions through the stock exchange channel and the share of profits transferred to foreign markets can be distributed within the country (Pikarjo and Rostami, 2009). Considering the above, the question that comes to mind is what factors affect the design, performance, acceptance, and dissemination of these instruments in an emerging market like Iran and what is the relative importance of each of these factors? Also, based on the recognition of these factors, in principle, if we can offer these bonds with transparency and widespread efficiency in the country, which of these two will have the potential to better eliminate insurability restrictions and ultimately contribute to economic stability by providing an effective framework for sustainable financial policymaking. Previous studies in this field have mostly examined the technical or economic dimensions of these tools, and less has a comprehensive and multidimensional approach been taken in analyzing the effective factors in the Iranian market context. Currently, our country's capital market has reached a level of development that requires the publication of advanced articles and research. Therefore, considering the issues raised and also the lack of domestic studies, there is a gap in studies related to comprehensive research to compare this new financial insurance tool for managing the risk of catastrophic events in the country. Considering the existing ambiguities and the novelty of the subject in the country's economic system, the present study, by comparing these two tools, can be a basis for the introduction and expansion of the aforementioned tool as a support tool in the capital market and helping the country's economy. Therefore, the existing research gap in the field of integrating economic, institutional, Jurisprudential, structural, and environmental factors, and the statistical measurement of their importance, justify the necessity of conducting this research. In this regard, the aim of the present study is to assess the feasibility of these new risk transfer tools in emerging markets, with an emphasis on the Iranian market, and to analyze its policy implications in order to promote financial stability and sustainability. By identifying and analyzing the factors affecting the development of Cat Bond and Sidecar in the background of the maturing bond market, it is presented as the first analysis of the efficiency of these two bonds, so that in addition to providing an accurate picture of the domestic situation, it can also provide a framework for sustainable financial policymaking in other emerging markets.

In this regard, the main innovation of the present study is the systematic study and comparison of Cat Bond and Sidecar in parallel and comparative manner in the country. Previous studies have only addressed Cat Bond, and Sidecar has remained unknown and neglected. In addition, the meta-synthesis method has been considered for the qualitative part, which allows for the synthesis of scattered

global findings and their adaptation to the Iranian context, and enhances the scientific validity of the comparison. The comparative findings have also been validated through a questionnaire, which has provided the possibility of localizing global indicators and identifying specific implementation barriers in Iran, including (Shariah, regulatory, and infrastructure restrictions), so that the research can be a basis for the entry and expansion of catastrophic event bonds as a support tool in the country's capital market. Providing a model for disaster risk management by insurance securitization, by creating an opportunity for comparison, can respond to the existing gaps in this regard and lead to the development of opportunities for investors to obtain capital market returns, as well as the possibility of increasing insurance capacities for insurance companies. Accordingly, the article is organized into four sections: introduction, methodology, results, and discussion and conclusion.

2. Methods

This research was conducted in a mixed qualitative and quantitative manner. The mixed method allows the research to utilize quantitative results in addition to qualitative analysis of factors to provide practical solutions and sustainable financial policymaking. Based on Figure 1, the mixed model is fully displayed according to the research methodology. In the qualitative section, the population includes all scientific-research documents published in domestic databases between the years (1380-1403 and foreign 2000-2025) that have addressed risk management through Cat Bond and Sidecar insurance bonds. The acceptance and non-acceptance criteria for the aforementioned articles and databases are presented in Tables 1 and 2. It is worth noting that all articles were collected from reputable Persian and English-language databases. At this stage, in order to determine whether the selected studies were selected in accordance with the research question, 134 articles were reviewed and the selected studies were reviewed several times. In the screening process, 56 leading sources were finally extracted and selected. This process is also shown in Figure 2. In order to analyze the findings, first-level concepts (primary concepts) were extracted from meaningful texts. Then, these primary concepts were labeled, given meaning, and compiled in the form of first-order structures (conceptual categories) based on methodology (in the form of structures derived from concepts). First-order conceptual structures were extracted from recurring concepts in previous studies. Therefore, each of them represents a financial or institutional dimension that has been repeatedly raised in the research literature as a factor affecting the design and performance of risk transfer instruments. This approach has increased the

conceptual validity of the structures and reduced bias in identifying factors affecting the performance of risk transfer instruments. As a result of combining the findings with the review and analysis of data extracted from related research using the content analysis method, 27 first-order structures were identified to provide answers to the questions of the first stage of the research. Then, in order to improve analytical coherence and reduce Conceptual dispersion, a macro-categorization process was carried out. Factors with semantic affinity, functional overlap, and similar analytical orientation were aggregated into conceptual clusters. The result of this process was the formation of five categories including legal and regulatory factors, technical and risk management, market and technology, financial and investment, and behavioral and psychological factors. Therefore, the 77 identified concepts were classified into 27 key factors and five general categories. This classification allowed for multidimensional analysis and identification of interrelationships between factors. In the quantitative part, using field research, information was collected using a questionnaire that was developed based on the findings of the qualitative phase and distributed electronically within a specified period of time among members of the statistical community, including experts, active specialists in the field of insurance and stock exchange, including managers, experts, and employees of the Central Insurance and Securities and Exchange Organization, members of insurance and reinsurance companies, as well as professional capital market activists and financial institutions, including official stock exchange brokerages, capital supply companies, asset management companies, investment funds, investment advisory companies, and others. Financial intermediaries licensed to operate in the capital market were distributed. In order to test the empirical findings, the structural equation modeling method based on partial least squares (PLS-SEM) was used, which was selected for the purposes of the present study due to its flexibility in sample size, no requirement for data normality, and theoretical development. This method was also considered appropriate for the purpose of the study due to its ability to examine complex relationships between latent variables and observed indicators and to achieve the research goal. In order to examine the overall status of the research variables, descriptive statistics indicators including mean, standard deviation, minimum and maximum values were calculated for each of the structures in SPSS software. The means indicate the overall level of respondents' perception of each factor, and the standard deviation indicates the degree of dispersion of opinions, which allows for initial comparison of variables and detection of the overall trend of responses in order to provide more accurate conclusions about the structural or functional differences between the two instruments.

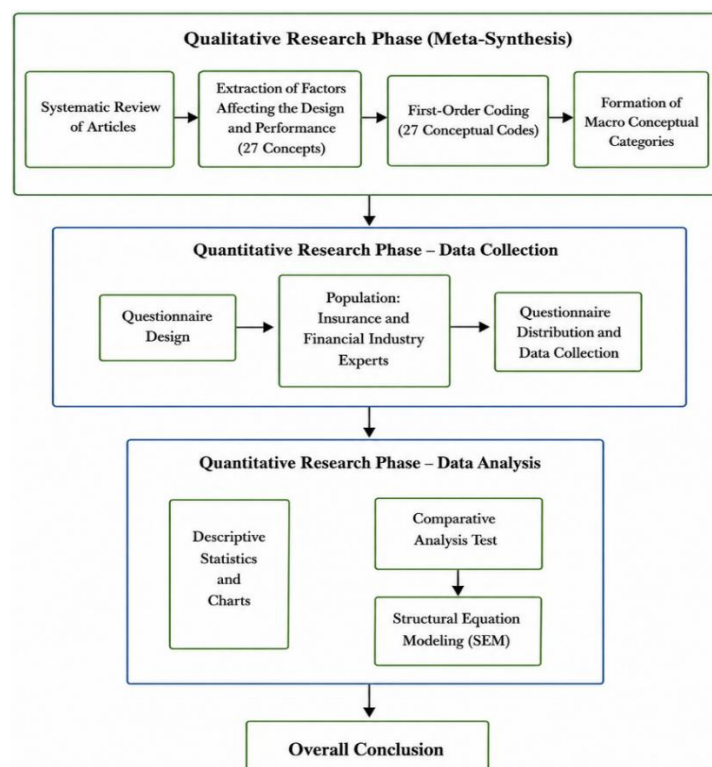


Figure 1: Mixed model according to research methodology

Source: Research Findings

Table 1: Criteria for acceptance and rejection of articles (Source: Researcher's findings)

Criterion	Inclusion Criterion	Exclusion Criterion
Research Language	English and Persian	Other languages
Publication Time	Published between 2000 and 2025	Published before 2000

Time of Persian Studies Article Selection Criteria	Published between 1380 and 1403 (in the Iranian calendar) Sources, books, and reports published in reputable and valid databases	Published before 1380 Reports from non-reputable sources and non-valid databases
Research Scope	Dimensions, concepts, and definitions	Out of the scope of the study

Table 2: Internal and external databases used (Source: Researcher's findings)

Source	Website Address	Source	Website Address
SID Scientific Information Database	https://www.sid.ir	Journal of Financial Research (University of Tehran) Financial Accounting and Auditing Research Journal	https://jfr.ut.ac.ir
Magiran Database	https://www.magiran.com	Journal of Investment Knowledge Journal of Financial Engineering and Securities Management	https://sanad.iau.ir/journal/faar
Noormags Database	https://www.noormags.ir/view/fa/default	Journal of Financial Economics Financial Accounting and Auditing Research Journal	http://www.jik-ifea.ir
Google Scholar	https://scholar.google.com	Journal of Macroeconomic Research Journal of Monetary and Financial Economics Research Journal of Islamic Economic Studies Iranian Energy Economics Journal	https://sanad.iau.ir/journal/fej
ScienceDirect	https://www.sciencedirect.com		https://sanad.iau.ir/journal/ecj
Elsevier	https://www.elsevier.com		https://sanad.iau.ir/journal/faar
Scopus	https://www.scopus.com		https://jes.journals.umz.ac.ir
Sci-Hub	https://sci-hub.ir		https://danesh24.um.ac.ir
IranPaper	https://iranpaper.ir		https://ies.isu.ac.ir
Emerald Insight	https://www.emerald.com/insight		https://jee.atu.ac.ir

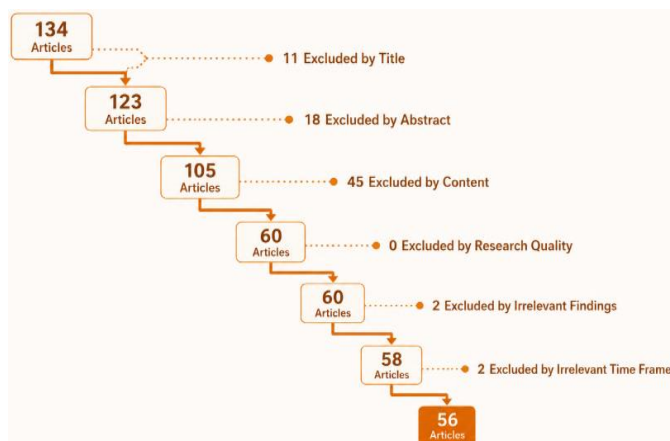
information can be seen in Table 3. Also, the logic of macro-categories (conceptual clusters) is given in Table 4:

Table 3: Classification of conceptual clusters in the meta-composition table (Source: Researcher's findings)

First-order structures (conceptual categories)	Macrocategories (conceptual clusters)
Legal and regulatory factors	Laws and Regulations Admission Process Stock Exchange Structure Threshold Conditions Incentive Policy Risk Management Risk Identification Damage Assessment Monitoring and Supervision Insurance Adequacy Capital Market Empowerment Securities Localization IT Empowerment Related Information International Partnership Organizational Cooperation Insurance Positioning Reinsurance Strengthening Arbitrage
Technical factors and risk management	Investment Return Financing Liquidity Institutional Investors Investor Psychology Culture Building Investor Empowerment Stakeholder Benefits
Market and technology factors	
Financial and investment factors	
Behavioral and psychological factors	

Table 4: Macro-Category Logic Table (Conceptual Clusters) in the Meta-Composition Table (Source: Researcher's Findings)

1. Legal and regulatory factors: (directly regulated by governing bodies)
Laws and regulations: by the parliament and the Central Insurance
Admission process: by the Stock Exchange Organization
Stock exchange structure: by supervisory bodies
Threshold conditions: mandatory standards
Incentive policy: government tool to guide the market
2. Technical factors and risk management: (technical-engineering variables of the insurance industry)
Risk management: technical process of risk assessment
Risk identification: specialized methods of risk identification
Damage assessment: technical calculations of damage
Monitoring and supervision: monitoring system
Insurance adequacy: financial solvency calculation index
3. Market and technology factors: (infrastructure and operational capabilities)
Capital market capability: market maturity
Securities localization: adaptation to domestic conditions
IT capability: digital infrastructure
Related information: market transparency
International cooperation: interaction with global markets
Organizational cooperation: coordination Institutions
Insurance positioning: Market positioning
Reinsurance strengthening: Specialized networking
4. Financial and investment factors: (Financial and investment variables)
Arbitrage: Financial profitability
Return on investment: Financial attractiveness
Financing: Financial resources
Liquidity: Liquidity capability
Institutional investors: Financial actors
5. Behavioral and psychological factors: (Behavioral and psychological dimensions)
Investor psychology: Emotional behaviors
Culturation: Beliefs and attitudes
Investor empowerment: Knowledge and skills
Stakeholder interests: Preferences and expectations

**Figure 2.** Screening steps for selected articles (Source: Researcher's findings)

3. Results and Discussion

3.1. Analysis of the output of the qualitative section (meta synthesis)

Meta synthesis is a qualitative method based on a systematic review of library studies for in-depth knowledge of the phenomenon under study, the data collection tool of which is library studies and research background review. With this method, researchers improve current knowledge on the subject and create a comprehensive and broad view of the issues. Also, instead of providing a comprehensive summary of the findings, it produces an interpretative synthesis of the findings. Accordingly, in this study, as a result of combining the findings with the review and analysis of data extracted from related research using the content analysis method, 27 first-order structures (conceptual categories) were identified in the form of 5 macro-categories, categories. This

3.2. Quantitative data analysis

1. Descriptive statistics:

Reporting the frequency of demographic variables

Using frequency tables and charts and indicators of central tendency such as mean and median, as well as using indicators of dispersion such as standard deviation, the objective status of the variables has been determined, as shown in Table 5.

Table 5. Frequency table by demographic variables (Source: Researcher's findings)

Variable	Categories	Frequency	Frequency Percentage
Organization Type	Central Insurance	45	11/7
	Stock Exchange Organization	98	25/5
	Insurance Company	107	27/9
	Financial Institutions	104	27/1
	Other	30	7/8
Organizational History	Less than 5 years	46	12
	5 to 10 years	117	30/5
	11 to 15 years	135	35/2
	16 to 20 years	65	16/9
	More than 20 years	21	5/5
Educational Qualifications	Under Diploma	0	0
	Diploma	1	0/3
	Bachelor's Degree	19	4/9
	Master's Degree	186	48/4
	PhD	178	46/4
Assessment (Understanding, Experience/Familiarity) of Your Ability to Operate and Design Cat Bonds	Very little	6	1/6
	Little	51	13/3
	Average	122	31/8
	High	187	48/7
	Very much	18	4/7
Assessment (Understanding, Experience/Familiarity) of Your Ability to Operate and Design Sidecar Bonds	Very little	49	12/8
	Little	107	27/9
	Average	164	42/7
	High	62	16/1
	Very much	2	0/5
Age	Average	42/14	
	Minimum	22	
	Maximum	61	

Source: Research Findings

Difference of Means Test:

In order to examine the existence of a significant difference between the views on the two bonds under study, a comparative analysis of the effect of each factor on Cat Bond and Sidecar was performed using the difference of means test (t-test). This test shows whether the average evaluation of factors in Cat Bond and Sidecar is statistically significantly different or not. This analysis, which can be seen in the form of Table (6) and Chart (3), shows that Cat Bond, as an

innovative and structured financial instrument, is responsive and effective against most of the improving variables. In contrast, the Sidecar group seems to be ineffective or resistant to the same factors. Both groups agree only on the importance of “insurance adequacy” (and to some extent insurance reinforcement). This shows that the health of the insurance base is important in both cases, but in Cat Bond this factor is reinforced by other factors, while in Sidecar it may be one of the few strengths.

Table 5. Frequency table by demographic variables (Source: Researcher's findings)

Variable	Comparison of two groups: Cat Bond and Sidecar				
	Mean difference	Standard error	t	sig	Result
Arbitrage	-0/31	0/084	-3/81	0/00	Confirming a significant difference
Loss assessment	0/66	0/079	8/29	0/00	Confirming a significant difference
Relevant information	1/01	0/065	15/38	0/00	Confirming a significant difference
Investment return	1/74	0/059	29/53	0/00	Confirming a significant difference
Securities localization	1/1	0/07	4/15	0/00	Confirming a significant difference
Monitoring and supervision	1/55	0/053	28/84	0/00	Confirming a significant difference
Financing	1/05	0/052	20/33	0/00	Confirming a significant difference
Risk identification	1/06	0/056	18/82	0/00	Confirming a significant difference
Insurance strengthening	0/74	0/065	11/36	0/00	Confirming a significant difference
Investor empowerment	1/13	0/08	14/05	0/00	Confirming a significant difference
IT empowerment	1/1	0/076	14/48	0/00	Confirming a significant difference
Capital market empowerment	1/53	0/064	23/9	0/00	Confirming a significant difference
Positioning for the role of insurance	0/79	0/064	12/31	0/00	Confirming a significant difference
Investor psychology	1/46	0/057	25/61	0/00	Confirming a significant difference
Stock exchange structure	1/15	0/04	28/89	0/00	Confirming a significant difference
Institutional investors	-0/70	0/077	-9/099	0/00	Confirming a significant difference
Incentive policy	1/41	0/071	19/85	0/00	Confirming a significant difference
Threshold conditions	1/56	0/061	25/48	0/00	Confirming a significant difference
Acceptance process	1/74	0/077	22/41	0/00	Confirming a significant difference
Culture building	1/43	0/075	18/93	0/00	Confirming a significant difference
Laws and regulations	1/62	0/075	21/59	0/00	Confirming a significant difference
Insurance adequacy	0/20	0/07	2/92	0/00	Confirming a significant difference
Risk management	0/68	0/035	19/03	0/00	Confirming a significant difference
International partnership	2/53	0/06	41/71	0/00	Confirming a significant difference
Stakeholder benefits	0/45	0/041	10/99	0/00	Confirming a significant difference
Liquidity	2/42	0/058	41/27	0/00	Confirming a significant difference
Organizational cooperation	1/4	0/057	24/58	0/00	Confirming a significant difference

Source: Research Findings

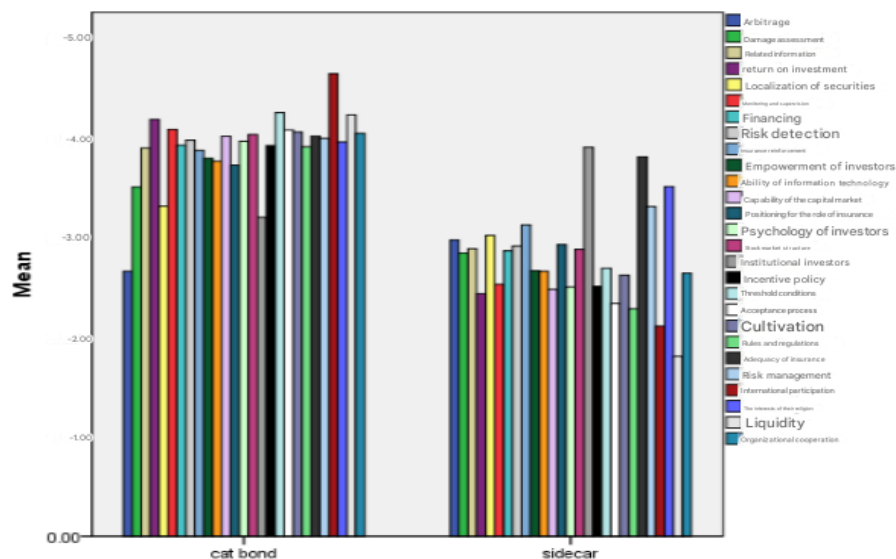


Figure 3. Bar chart comparing two groups according to variables (Source: Researcher's findings)

2. Inferential statistics

Testing the impact of factors affecting the performance of Cat Bond and Sidecar

The main focus of the quantitative section, according to the main objective, was to measure the effects of each structure separately and directly on Cat Bond and Sidecar in order to determine which ones have the greatest impact and which factors do not have a significant impact. This numerical approach, based on the collected data, allows for a precise comparison and analysis of the effects of variables on the structure of bonds and ensures that the analyses are carried out without the interference of subjective perceptions and solely based on statistical evidence, because presenting the results of the impact test provides a scientific basis for the design and improvement of bonds and financial policymaking. In order to answer the research question, the structural model has estimated the factors affecting the design and performance of Cat Bond and Sidecar separately. Then, the intensity and direction of the effect of each structure in the two models were compared to determine the difference in the impact pattern, which is as follows.

In the Cat Bond study, the path coefficients and test significance values along with the calculated t are included in Table (7). Considering the significance levels for the variables of arbitrage, localization of bonds, capital market capability, positioning for the role of insurance, stock exchange structure, admission process, international participation, liquidity, investor psychology, culture building, incentive policy, investor empowerment, organizational cooperation, threshold conditions, laws and regulations, monitoring and supervision, and information technology capability, which have values less than 0.05 ($p\text{-value} > \alpha=0.05$), it can be acknowledged that the impact of these variables on the performance and design of Cat Bond is significant and confirmed, and in other variables, the impact is not confirmed due to the significance level being greater than 0.05. In the Sidecar study, which can be seen in Table (8), the path coefficients and test significance values along with the calculated t are included. Considering the significance level for the variables of investment return, financing, institutional investment, stakeholder benefits, reinsurance reinforcement, loss assessment, related information, risk identification, risk management, and insurance adequacy, which have values less than 0.05 ($p\text{-value} > \alpha=0.05$), it can be acknowledged that the impact of these variables on the performance and design of Sidecar is significant and confirmed, and in other variables, the impact is not confirmed due to the significance level being greater than 0.05. Also, regarding the impact factors, it can be noted that the t values for the aforementioned factors are outside the range (1.98, -1.98), so these impacts are significant with 95% confidence.

The results of combining qualitative and quantitative methods provide a clear picture of the impact of effective factors on the two disaster risk management tools. The output of the tables clearly confirms the existence of a statistically significant difference between the attitude and performance of the two groups on all variables. The difference in the means is confirmed in all factors, which indicates that the statistical community evaluates the two significantly differently in terms of their nature, function, and acceptance requirements, which shows them to be different both in terms of the intensity of the factors' impact and in terms of the functional nature. It seems that the acceptance of Cat Bond requires a wide set of legal, financial, and market-oriented requirements, while Sidecar is considered more as a complementary, flexible, and operational tool, and the requirements for accepting Cat Bond cannot be directly generalized to Sidecar, and each requires a different policy and implementation approach. The findings from the structural equation testing based on evaluating

the impact of each of the extracted factors also show that the impact of factors in Cat Bond is mainly focused in three categories (legal and regulatory factors, market and technology factors, behavioral and psychological factors) and in Sidecar in two categories (technical and risk management factors, and financial and investment factors).

4. Conclusion

Based on the tests conducted, the results show that the existence of Cat Bond as a stable and systematic financial infrastructure is an undeniable necessity. Risks such as large earthquakes in a metropolis, in terms of the scale of damage, are beyond the capacity of limited Sidecar contracts. With the mechanism of dissemination in the capital market and the transfer of risk to a wide range of investors, Cat Bond actually creates a market-based national emergency fund that can mobilize large financial resources as soon as possible after disasters occur, the success of which is conditional on the realization of 17 macro factors, especially in the field of financial governance (rules, supervision, transparency) and integration with global financial markets. Therefore, the development of this tool is not a choice, but a strategic investment in the financial security and economic sovereignty of the country. In contrast, in the current economic conditions of Iran and given the relatively high expected rates of return in domestic markets, designing a Sidecar with competitive and attractive returns, for example, by linking to bond rates or capital market indices, is quite possible and can be attractive to the aforementioned institutions. Sidecar can serve as an intermediate step for insurance and capital market actors to familiarize themselves with the concepts of risk securitization and pave the way for a gradual move towards Cat Bond. Given international sanctions and restrictions, Sidecar, which is less dependent on the direct participation of international institutions, is considered a more resilient option and an agile and operational solution for managing existing and immediate risks that has a strategic justification as an efficient and implementable tool in the short term. While many of the macro factors affecting Cat Bond such as detailed rules, complete stock exchange structure, active international participation are optimistically in the early stages of development, the launch and development of Sidecar contracts relying on the 10 identified focal factors is considered a more practical, faster and less costly strategy. These findings indicate that the choice between Sidecar and Cat Bond is a logical and necessary sequence. This research emphasizes the need for national determination and immediate action by all governing institutions, capital markets and the insurance industry to deploy these life-saving tools. The findings clearly show that the choice between the two is not an absolute bipolar option, but a strategic choice based on the time horizon, the level of institutional maturity, and the target risk characteristics. Therefore, the optimal strategy is to facilitate and develop Sidecar quickly as a short- and medium-term solution, while simultaneously planning and taking serious action to gradually strengthen the macro-infrastructure, especially in the areas of regulation, capital markets, and technology, in order to prepare the ground for Cat Bond. Sidecar and Cat Bond can be placed in a complementary catastrophe risk management portfolio, with Sidecar covering medium- and specific risks of insurers and Cat Bond covering macro-national risks. Overall, the results of this study suggest that in emerging markets, the sustainability of fiscal policymaking can lead to the development of new risk management tools, as long as these tools operate properly within a transparent, standardized, and robust regulatory framework.

From this perspective, taking into account the above findings and analysis, the resulting complementary portfolio can be presented as a two-stage and complementary strategy and recommendation. This optimal strategy is a gradual, two-track, and intelligent approach:

Path One (Short- and Medium-Term): Increasing Operational Resilience: Immediate and comprehensive focus on developing and institutionalizing Sidecar, prioritizing risks with data and relative infrastructure. This stage, while creating immediate coverage, will pave the way for experience-building, trust-building, and strengthening risk modeling capabilities in the country. This practical step will both increase capacity, create technical knowledge, and gain market trust. Implementing Sidecar in Iran is feasible but conditional. The main condition is to overcome the challenge of technical competency. This requires investment by insurers and oversight by the Central Insurance Agency on improving risk models and information transparency. If this condition is met, other components will be available in the Iranian market due to their contractual and limited nature. Therefore, we can be optimistic that operational prototypes can be achieved with a 12- to 18-month planning period.

Second path (long-term and infrastructure): Building structural resilience: Simultaneous and planned initiation of the financial and institutional engineering phase to create a Cat Bond platform, which requires a government commitment to reform and develop laws, strengthen regulatory institutions, invest in technology, and attract the participation of international financial institutions. Serious and simultaneous planning and action to gradually strengthen macro-infrastructure, especially in the area of special legislation for insurance bonds, strengthen regulatory institutions, enhance IT capabilities, and attract international participation. Implementing Cat Bond in Iran is a long-term infrastructure project. The most important obstacle is the legal vacuum and technological weakness, which are structural in nature. Removing these obstacles requires government decision-making and heavy investment in specialized lawmaking, the development of advanced technical infrastructure, and economic diplomacy to reduce international barriers, which will pave the way for the issuance of Cat Bonds in the future, which realistically requires a 5- to 10-year horizon.

Author Contributions

All authors contributed equally to the conception, preparation, and writing of this manuscript.

Conflict of Interest

The authors, while observing publication ethics in the referencing, declare the absence of interest of conflict.

Acknowledgement

The authors gratefully acknowledge the support provided by the Islamic Azad University of Rasht in conducting this research.

Data availability

This article does not contain any Supplementary Material.

AI Used Statment

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