THE EFFECT OF COVID-19 ON THE STABILITY OF THE FINANCIAL INDUSTRY

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ABSTRACT

Objective: The main aim of this study is to investigate how natural disasters and epidemics impact the ability of banks and insurance companies to maintain financial strength and stability.

Theoretical Framework: The theoretical framework of this study is centered around defining financial stability and exploring the potential impacts of natural disasters and epidemics on the financial stability of banks and insurance companies. This research also examines strategies these institutions can employ to mitigate the risks associated with natural disasters and epidemics.

Method: This study employs a fixed effects model to estimate and assess the impact of natural disasters and epidemics using z-scores and SRISK. The utilized dataset encompasses information regarding natural disasters, epidemics, and financial data for banks and insurance companies.

Results and Discussion: The research results suggest that natural disasters have a limited impact on the financial stability of banks, as demonstrated by z-score and SRISK analyses. Moreover, the extent of this impact varies depending on the type of disaster and the geographical location of the company.

Research Implications: The study provides new insights into how natural disasters and epidemics affect financial stability in banks and insurance companies. Using quantitative analysis, helps policymakers develop strategies to reduce risks from these events. It also advises banks and insurers to adopt practical measures such as portfolio diversification and risk management tools. Additionally, the study highlights the importance of financial stability during such events, emphasizing the pivotal role of banks and insurers. It calls on policymakers and regulators to ensure preparedness in managing related risks.

Originality/Value: This study employs z-scores and SRISK to compare the effects of natural disasters and epidemics on the financial stability of both banks and insurance companies. The value of this research lies in providing insights into the risks and challenges that arise from natural disasters and epidemics for the financial sector.

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O EFEITO DA COVID-19 NA ESTABILIDADE DA INDÚSTRIA FINANCEIRA

RESUMO

Objetivo: O principal objetivo deste estudo é investigar como desastres naturais e epidemias impactam a capacidade de bancos e companhias de seguros de manter a força financeira e estabilidade.

Referencial Teórico: O referencial teórico deste estudo está centrado em definir a estabilidade financeira e explorar os potenciais impactos de desastres naturais e epidemias na estabilidade financeira de bancos e

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companhias de seguros. Esta pesquisa também examina estratégias que essas instituições podem empregar para mitigar os riscos associados a desastres naturais e epidemias.

Método: Este estudo emprega um modelo de efeitos fixos para estimar e avaliar o impacto de desastres naturais e epidemias usando z-scores e SRISK. O conjunto de dados utilizado abrange informações sobre desastres naturais e epidemias, bem como dados financeiros de bancos e companhias de seguro.

Resultados e Discussão: As conclusões do estudo indicam que desastres naturais não afetam notavelmente a estabilidade financeira dos bancos, conforme evidenciado pela análise de z-score e SRISK. Além disso, o impacto varia conforme o tipo de desastre e a localização da empresa.

Implicações da Pesquisa: estudo oferece novos insights sobre como desastres naturais e epidemias afetam a estabilidade financeira em bancos e companhias de seguros. Usando análise quantitativa, ajuda os formuladores de políticas a desenvolver estratégias para reduzir os riscos desses eventos. Também aconselha bancos e seguradoras a adotarem medidas práticas, como diversificação de portfólio e ferramentas de gestão de risco. Adicionalmente, o estudo destaca a importância da estabilidade financeira durante tais eventos, enfatizando o papel fundamental de bancos e seguradoras. Conclama os formuladores de políticas e reguladores a garantirem a preparação na gestão dos riscos relacionados.

Originalidade/Valor: Este estudo emprega z-scores e SRISK para comparar os efeitos de desastres naturais e epidemias na estabilidade financeira de bancos e companhias de seguros. O valor desta pesquisa reside em fornecer insights sobre os riscos e desafios que surgem de desastres naturais e epidemias para o setor financeiro.

Palavras-chave: Setor Bancário, Indústria Financeira, Estabilidade Financeira, Impacto da Covid-19, Gestão de Risco.

EL EFECTO DE COVID-19 EN LA ESTABILIDAD DE LA INDUSTRIA FINANCIERA

RESUMEN

Objetivo: El objetivo principal de este estudio es investigar cómo los desastres naturales y las epidemias afectan la capacidad de los bancos y las compañías de seguros para mantener la fortaleza financiera y la estabilidad.

Marco Teórico: El marco teórico de este estudio se centra en definir la estabilidad financiera y explorar los impactos potenciales de los desastres naturales y las epidemias en la estabilidad financiera de los bancos y las compañías de seguros. Esta investigación también examina las estrategias que estas instituciones pueden emplear para mitigar los riesgos asociados con los desastres naturales y las epidemias.

Método: Este estudio emplea un modelo de efectos fijos para estimar y evaluar el impacto de los desastres naturales y las epidemias utilizando z-scores y SRISK. El conjunto de datos utilizado abarca información sobre desastres naturales, epidemias, así como datos financieros de bancos y compañías de seguros.

Resultados y Discusión: Los hallazgos del estudio indican que los desastres naturales no afectan notablemente la estabilidad financiera de los bancos, como lo evidencia el análisis de z-score y SRISK. Además, el impacto varía según el tipo de desastre y la ubicación de la empresa.

Implicaciones de la investigación: El estudio ofrece nuevos conocimientos sobre cómo los desastres naturales y las epidemias afectan la estabilidad financiera de bancos y compañías de seguros. A través de análisis cuantitativos, contribuye al desarrollo de estrategias por parte de los responsables de políticas para mitigar los riesgos asociados a estos eventos. Asimismo, recomienda a bancos y aseguradoras implementar medidas prácticas como la diversificación de carteras y herramientas de gestión de riesgos. Además, resalta la importancia de mantener la estabilidad financiera durante tales circunstancias, subrayando el papel crucial de bancos y aseguradoras. Finalmente, insta a los formuladores de políticas y reguladores a garantizar una preparación adecuada en la gestión de riesgos relacionados.

Originalidad/Valor: Este estudio emplea z-scores y SRISK para comparar los efectos de los desastres naturales y las epidemias en la estabilidad financiera de bancos y compañías de seguros. El valor de esta investigación reside en proporcionar conocimientos sobre los riesgos y desafíos que surgen de los desastres naturales y las epidemias para el sector financiero.

Palabras clave: Sector Bancario, Industria Financiera, Estabilidad Financiera, Impacto de COVID-19, Gestión de Riesgos.

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1 INTRODUCTION

In 2020, total global economic losses reached USD 187 billion, with USD 175 billion attributed to natural disasters (Swiss Re, 2021). Annual economic losses due to natural disasters continue to rise because of climate change and are expected to grow in the years ahead. Despite advances in predicting certain natural disasters, it remains impossible to entirely mitigate economic losses. Moreover, the COVID-19 pandemic, triggering a worldwide health crisis, has led to significant transformations across various facets of life on a global scale. Beyond the immediate impact on public health, the outbreak has also engendered substantial instability in the worldwide financial sector. As the backbone of the economy, the financial industry has encountered unparalleled challenges. The year 2020 saw all global economies severely affected by the COVID-19 pandemic outbreak. The resultant decrease in GDP and subsequent rise in bankruptcies can yield not only negative repercussions for the economy but also affect banks due to an anticipated surge in problem loans (Serra et al., 2021). Studying the effects of natural disasters and epidemics is vital not just for the overall economy and the financial sector, but also for the financial industry, a critical part of every nation's financial system. This research aims to explore how natural disasters and epidemics affect the financial stability of the financial industry. Effective management and stability during such events can profoundly influence broader economic recovery efforts. To analyze the effects of natural disasters, this study employs panel data in conjunction with two distinct measures of financial stability. While existing literature touches on this topic, it remains relatively limited and often yields contradictory results. Therefore, this study assesses financial stability using two measures— one derived from financial records and the other based on stock market data.

2 LITERATURE REVIEW

2.1 FINANCIAL STABILITY

Financial stability encompasses the conditions under which a nation's or region's financial system operates seamlessly and without disruption. This entails the ability of the financial system to navigate risk, uphold economic equilibrium and coherence, and forestall the emergence of far-reaching financial crises that could yield adverse effects. Given its significant ramifications for economic advancement, investment, price consistency, and general well-

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being, financial stability holds immense importance (Crockett, 1996). On a broader scale, it fosters public trust, diminishes uncertainty, and fosters sustainable, long-term growth. The concept of financial stability is intricate and can be broadly classified into two conceptual frameworks. The first category's perspective on financial stability centers on the financial system's capacity to withstand and remain resilient in the face of external shocks. While external shocks can indeed trigger financial instability, they are not the exclusive instigators of such turbulence. Conversely, the second category integrates endogenous factors into its understanding. In the first category, the notion of financial stability is often linked with the occurrence of financial crises. For instance, (Noth & Schüwer, 2023) defines financial stability as a condition where the financial system can withstand shocks without experiencing cumulative processes that disrupt the allocation of savings for investment opportunities and the execution of asset transactions within the economy.

2.2 MEASURES AND INDICATOR OF FINANCIAL STABILITY

The measure of financial stability is divided into two groups, namely the first group relies on financial and accounting data (Z-score), as well as market-based data (distance-to-default). Despite criticism by experts for its lack of certainty, these measures have proven to be invaluable in situations where market-based approaches cannot be implemented. Z-score, commonly used to measure financial stability at the institutional level, offers an easily interpretable calculation relying solely on accounting data. Its popularity stems from the inverse correlation demonstrated with the likelihood of bank insolvency. Calculating the Z-score involves comparing the market value of institutional assets with the likelihood of institutional bankruptcy. This metric plays a crucial role in research focusing on bank stability or vulnerability. The application of Z-score in the context of insurance companies has not been widely researched. However, (Blanco et al., 2023) conducted a comparative assessment of six different methods for calculating Z-score to identify the most accurate approach for evaluating insurance companies. Equation (1) is used to calculate the Z-score. Assuming asset returns are normally distributed, we can define the Z-score as the number of standard deviations below the average asset return that must be reduced to deplete equity (Klomp, 2014). As a result, a higher Z-score may indicate better stability.

$$Z = \frac{\mu ROA + \frac{Eq}{TA}}{\sigma ROA} \qquad (1)$$

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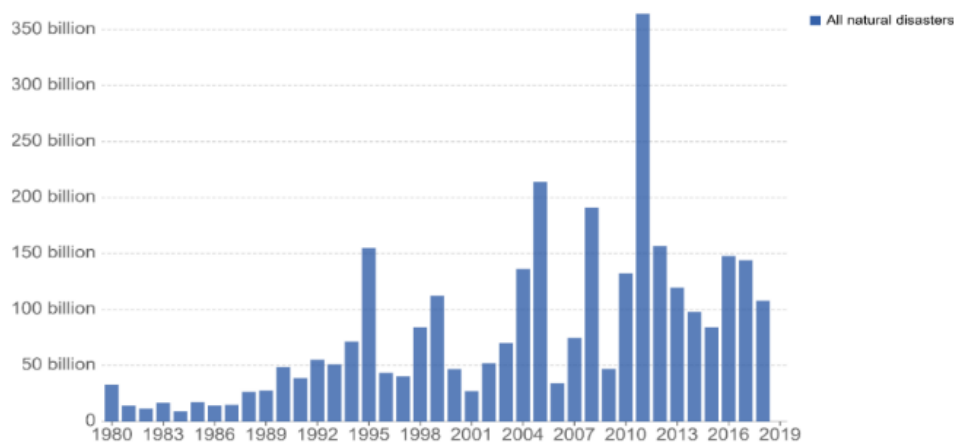
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The second category involves measures based on market data. These indicators typically utilize market prices of underlying assets, usually stocks, to assess company stability. Market-based metrics offer a forward-looking perspective as they reflect investor anticipation of a bank's future health. Market-based measurements benefit from the timeliness of short-term data observations. However, these metrics are not widely known among private enterprises. Common market-based metrics include MES (Marginal Expected Shortfall) and SRISK. MES measures how much specific companies are exposed to shocks within the aggregate system, while SRISK estimates the financial entity's capital needs in case of a crisis.

2.3 THE EFFECT OF NATURAL DISASTERS ON THE FINANCIAL INDUSTRY

In recent decades, scholars have significantly focused on unraveling the implications of natural disasters for the financial system. This intensified attention stems from the heightened frequency of natural disasters in the past decade and the subsequent surge in economic costs compared to previous eras. The escalating global costs of damage are vividly illustrated in Figure 1. Moreover, the frequency of natural disasters has experienced a rapid ascent. As depicted in the graph (Figure 2), approximately 75 natural disasters were recorded in 1970, whereas the number surged to approximately 360 in 2019 (EM-DAT, 2023).
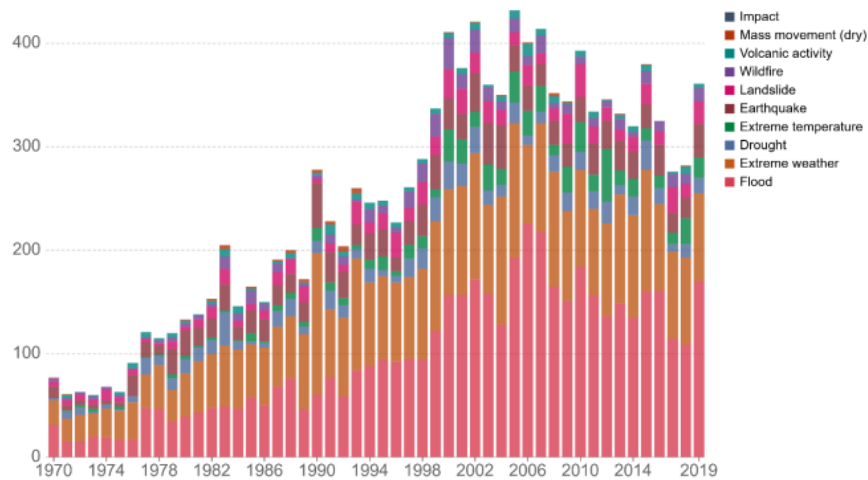
Figure 1

Global damage costs due to natural disasters (1980-2019)

Source: Adapted from (EM-DAT et al., 2022).

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Figure 2

Number of natural disasters reported annually (1970-2019).

Source: Adapted from (EM-DAT et al., 2022)

Natural disasters have varying impacts in each country. According to (Collier & Skees, 2012), both developed and developing countries manage increased exposure due to financial institutions and investors often concentrating their portfolios in specific geographic and economic sectors. While numerous studies explore how natural disasters affect the financial well-being of banking sectors, there is scarce literature addressing their impact on insurance sectors. Yet, the potential of natural disasters in any country certainly disrupts the economy significantly. When disasters occur, restoration and improvement efforts require quick access to funding. (Benali & Feki, 2017; Collier & Skees, 2012; EM-DAT, 2023) emphasize that losses from disasters tend to stimulate investment demand. As physical capital diminishes, its marginal productivity increases, thereby a country's ability to mobilize financing for reinvestment determines the net economic impact of a disaster. Therefore, after a natural disaster, credit providers such as banks play a crucial role in facilitating economic recovery and continuing the trajectory of previous growth paths.

However, the rising frequency and severity of natural disasters pose a risk to banking stability, potentially resulting in bankruptcies. One negative consequence of natural disasters on banking stability is the rise in non-performing loans within the banking sector (Albuquerque & Rajhi, 2019; Lagoarde-Segot & Leoni, 2013). Additionally, these disasters cause outflows of foreign capital due to heightened payment uncertainties, further endangering bank survival. Moreover, the extensive interconnectivity among banks through lending activities can trigger a contagion effect, where disturbances originating from interbank markets affect many other banks or a significant portion of the banking sector. Natural disasters can trigger various forms

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of systemic risks within the financial system (Billio et al., 2012; Leong et al., 2020). Major disasters can significantly reduce banks' foreign exchange reserves, leading to excessive leverage or even bankruptcy due to disrupted bank assets. Bank borrowers are also affected by major disasters, making them unable to meet their loan obligations, thereby leading to a decline in the quality of bank credit portfolios and increased vulnerability.

Regarding managerial quality and operational risk, a high ratio of expenses to total income indicates inadequate operational efficiency due to substandard management quality. Natural disasters exacerbate operational risks through physical damage, rendering offices, systems, and various operational equipment non-functional. On the other hand, bank profitability is hindered by debt write-offs, decreased efficiency, and unstable bank interest rate hikes. In addition, inadequate liquidity risk arises when significant natural disasters cause an increase in withdrawal volumes—such as bank runs—due to emergency loan demands. Turning to insurance companies, natural disasters present several challenges. Unlike predictable loss guarantees in reference periods, such as car insurance, natural disasters are unpredictable, sporadic, and cause massive damage. If insured losses exceed premiums collected for coverage, inadequately insured companies will struggle to cover these losses, potentially leading to bankruptcy (Born & Viscusi, 2006). Furthermore, risks associated with natural disasters fluctuate over time due to changes in disaster-affected locations, often caused by coastal development. Particularly, the increased frequency of natural disasters due to climate change worsens these challenges (Chen, Bagrodia, et al., 2020).

2.4 THE REPERCUSSION OF THE PANDEMIC ON THE FINANCIAL INDUSTRY

Although the impact of this pandemic can extend to a large part of a country's population and result in significant consequences, the pandemic itself does not cause physical damage. The profound impact of this pandemic is evident through the examination of data related to the COVID-19 outbreak in 2020 (Chen, Yang, et al., 2020; Elnahass et al., 2021). (Gaspar et al., 2002) demonstrate that despite the European Central Bank taking post-Great Financial Crisis measures, European banks show increased systemic risk, especially those heavily involved in official financial markets. (Elnahass et al., 2021) reveal that the COVID-19 outbreak negatively affects financial performance across various indicators, including accounting-based and market-based measures, as well as financial stability. This pandemic also impacts insurance companies; however, as of May 2021, total insured losses due to COVID-19 were estimated to

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reach nearly $37 billion (Reinsurance News, 2021). Comprehensive literature on the impact of the pandemic on insurance company stability remains limited. (Huynh et al., 2013) argue that increased mortality rates will increase insurance claims volume and thereby affect the financial stability of insurance companies. Furthermore, (Chen, Yang, et al., 2020) emphasize that the severe impact of COVID-19 on insured borrowers and insurance companies jeopardizes policyholder protection, ultimately endangering insurance stability.

3 METHODOLOGY AND DATA ANALYSIS

This research uses the panel data methodology (Baltagi et al., 2013). This approach permits the amalgamation of data across both time and various entities (countries or companies), providing a comprehensive understanding of the pandemic's effects on financial industry stability.

3.1 PANEL DATA APPROACH

The panel data approach involves the collection of data over some time from diverse entities that can be concurrently observed. Within this context, panel data encompasses financial information sourced from different countries or companies within the financial industry. Such an approach enables both individual comparative analysis and dynamic analysis across time.

3.2 FIXED EFFECT ESTIMATION PROCEDURE

The Fixed Effect estimation procedure stands as one of the prevalent methods in panel data analysis. In this procedure, the model factors in individual fixed effects, thereby considering the consistent disparities found between individuals within the panel data. Fixed Effect Estimation facilitates the identification of the pandemic's impact on each individual in the panel, irrespective of their inherent characteristics.

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3.3 OLS ESTIMATION PROCEDURE

The Ordinary Least Squares (OLS) estimation procedure is a technique that assumes individual effects can be disregarded or do not exist, treating each entity in the panel as an independent observation. In Ordinary Least Squares (OLS) regression, estimation involves minimizing the sum of squared deviations between observed values and model predictions. When assessing the effect of the COVID-19 pandemic on financial industry stability using panel data, researchers have the option to select between Fixed Effects estimation or OLS. Fixed Effects estimation allows researchers to assess the specific impact of the pandemic on each panel entity, while OLS treats each entity independently and provides overall estimates for the entire panel. Both estimation techniques provide valuable insights into the pandemic's impact on financial industry stability by accounting for fixed individual variables and recognizing variation across time and entities in panel data.

3.4 DATASET AND VARIABLES

Data on natural disasters and their impacts were obtained from the International Disaster Database (EM-DAT et al., 2022). The database contains records of over 22,000 global disasters since 1900. However, many authors emphasize that natural disasters qualifying for inclusion in the EM-DAT database tend to result in few casualties and minimal damage, thus having a limited impact on the financial stability of insurance or banking companies. Data were initially adjusted and selected as needed, resulting in a final dataset used for research consisting of 1,080 natural disasters from 1996 to 2017, recorded in 151 countries. The main metrics utilized to evaluate the possible influence of natural disasters on the stability of the financial industry were the z-score and SRISK. SRISK data for the financial industry were sourced from the Volatility Lab at New York University (V-Lab, 2022). Z-scores for banks were obtained from the World Bank's Financial Structure Database (2020) (EM-DAT, 2023), spanning from 1997 to 2019. For insurance companies, data were sourced from the Organisation for Economic Co-operation and Development (OECD Statistics, 2022) for the years 2009 to 2019. Due to specific data points being unavailable for each year and country, unbalanced panel data covering 151 countries from 1996 to 2017 were utilized.

Some indicators used in this study include macroeconomics (including inflation), economic growth, trade openness, current account balance, and GDP per capita. These variables

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serve to control for broader economic factors' impacts. Specifically, financial stability is vulnerable to shocks that weaken a country's economy, causing uncertainty or jeopardizing borrowers' creditworthiness. To account for financial stability variations in OECD and developing countries, we introduce GDP per capita as an additional control variable. The control variables used include credit growth rates, the credit-to-GDP ratio, the cost-to-income ratio, and bank deposits as a percentage of GDP. The credit growth rate is highly relevant as it can trigger financial instability, especially in the context of credit booms (Čihák & Hesse, 2010; Vachušková, 2021). Additionally, the credit-to-GDP ratio serves as a measure of financial sector depth. Lastly, including the cost-to-income ratio helps in achieving operational efficiency. Monetary policy effects are also considered by including real interest rates, M2 money supply, foreign reserves, and trade provisions. Introducing M2 foreign reserves aims to assess whether capital outflows impact financial stability. Conversely, the trade exchange rate variable acknowledges the significant impact of commodity prices on the financial stability of developing countries.

Although the controlled variables mentioned specifically relate to banks, the analysis of insurance companies includes macroeconomic factors and monetary policy. However, a set of specific insurance variables, as suggested by (Kramarić et al., 2019), are also used. These variables include reinsurance ratios, claims growth, and gross written premiums. Reinsurance, for instance, has the potential to significantly influence the financial stability of insurance companies by providing diversification and protection against large losses. Conversely, growth in gross written premiums provides insights into market penetration rates. For a comprehensive understanding of the origins and calculations of each variable, refer to Table 1.

Table 1

Summary descriptive statistics of the variables from the dataset used

Variable	Mean Value	Median	Std. Dev	Min	Max
Inflation	7.20	4.59	14.1	-60.5	285.0
GDPgrowth	2.50	2.59	4.39	-47.6	32.2
Tradeopenness	72.3	62.1	37.3	15.4	405
Currentaccount	-8.02	-6.77	13.1	-87.8	46.6
GDPPop	4.60e+003	1.75e+003	8.56e+003	103	8.15e+004
Grothrateofcredit	5.04	3.39	16.1	-57.2	123.0
CreditGDP	39.1	27.6	36.3	0.491	212.0
Costincomebank	57.0	57,3	14.9	0.00	117.0
BankdeposittoGDP	42.3	33.2	39.2	0.274	662.0
Realinterestrate	5.82	4.21	9.64	-60.8	77.6
M2toreserve	5.06	3.19	9.26	0.227	182.0
Bartertermoftrade	117.0	103.0	39.3	48.0	364.0

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Reinsuranceratio	3.94	1.63	5.76	0.00	23.0
Claimgrowthratioinsur	27.7	6.03	163	-47.5	1.55e+003
Grosspremiumgrowth	0.0793	0.0797	0.114	-0.205	0.602

Source: Author elaboration (2024).

4 RESULTS AND DISCUSSIONS

4.1 BANKING SECTOR

Based on Table 2, the estimates in column P1 indicate that an increase in damage from natural disasters negatively impacts the bank's z-score. This observation suggests that an increase in Damage to GDP reduces the bank's z-score, indicating decreased financial stability. Another important factor is the cost-to-income ratio. An increase in the cost-to-income ratio makes the banking sector in certain countries more vulnerable. Another important variable is savings to GDP, which has a positive influence on stability; when the savings to GDP ratio increases, the z-score also experiences a similar increase. The second estimation model aims to explore the relationship between bank-level SRISK at the country level and the impact of the affected population and total damage. Table 2 presents the OLS estimation results, where the dependent variable is represented by the natural logarithm of the banking sector's SRISK. As with the previous estimation, column P1 displays estimates that use all control variables, while the following columns present estimates that use different groups of variables. On the other hand, the estimation in Table 3 does not reveal a significant impact of natural disasters on the z-score. In column P1, the estimates show that the greatest influence on financial stability is trade openness and terms of trade, both of which harm SRISK. Consequently, an increase in either of these variables will lead to a decrease in SRISK, thereby enhancing the stability of the banking sector. Another variable with significance at the 1% level is the cost-to-income ratio, which has a positive impact on SRISK. These findings are consistent with the results presented in the following columns.

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Table 2

The result of the Z-score bank

Variable	P1	P2	P3	P4
const	14.43***	11.42***	17.44***	11.77***
AffectToPop	1.808	2.172	2.934	1.286
DamagesToGDP	-3.306*	-2.850**	-3.110**	-3.005**
Inflation	0.01750	-0.03055	-	-
GDPgrowth	0.06297	0.009693	-	-
Tradeopenness	0.01600	0.02415**	-	-
Currentaccount	-0.02385	0.02589	-	-
GDPPop	1.666e-05	4.785e-06	-	-
Grothrateofcredit	-0.02264	-	-0.01552	-
CreditGDP	-0.06523*	-	-0.06227**	-
Costincomebank	-0.07654***	-	-0.08384***	-
BankdeposittoGDP	0.08138**	-	-0.07867***	-
Realinterestrate	0.05384	-	-	0.0009830
M2toreserve	0.01388	-	-	-0.01101
Bartertermoftrade	0.008529	-	-	0.01607***
n	382	519	431	480
R^2**	0.1145	0.1145	0.0998	0.0333
InL	-906.4	-1259	-1024	-1158

Note:
* significance at 10% level, ** significant at 5% level, and *** significant at 1% level
P1 = estimates using all control variables, P2 = macroeconomic factors, P3 = factors related to financial sector development, and P4 = factors related to monetary policy.
Source: Author elaboration (2024).

By comparing the estimates using the z-score as the dependent variable with the estimates using SRISK, it is clear that several variables show significance in both estimations. These variables include the cost-to-income ratio, the credit-to-GDP ratio, trade openness, and terms of trade. Meanwhile, damage to GDP is significant in the first estimation (Table 2) but less significant in the second estimation. This difference can be attributed to the inherent nature of the z-score and SRISK. The z-score relies on accounting data, providing insight into the condition of a particular bank in the year the accounting data is used. Conversely, SRISK takes stock market data, making it more forward-looking and providing different information compared to the z-score. These estimates include damage and population affected by all types of natural disasters.

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Table 3

The result of SRISK bank

Variable	P1	P2	P3	P4
const	16.63***	8.829***	9.343***	10.35***
AffectToPop	-4.138	-2.469	-2.973	0.9673
DamagesToGDP	5.349	7.851	-20.18	-9.982
Inflation	0.03899	-0.1013***	-	-
GDPgrowth	0.06338	0.3156***	-	-
Tradeopenness	-0.02927***	-0.02235***	-	-
Currentaccount	-0.03796	-0.05837	-	-
GDPPop	5.576e-05**	6.012e-05***	-	-
Grothrateofcredit	-0.02940	-	0.01129	-
CreditGDP	0.01335*	-	0.01791***	-
Costincomebank	-0.1081***	-	-0.03800	-
BankdeposittoGDP	-0.002796	-	2.271e-05	-
Realinterestrate	0.05585*	-	-	0.04921
M2toreserve	-0.02650	-	-	0.09236***
Bartertermoftrade	-0.02310***	-	-	-0.02644***
n	85	104	90	98
R^2**	0.5886	0.4485	0.1479	0.1753
InL	-155.9	-211.5	-203.4	-219.2

Note:
* significance at 10% level, ** significant at 5% level, and *** significant at 1% level
P1 = estimates using all control variables, P2 = macroeconomic factors, P3 = factors related to financial sector development, and P4 = factors related to monetary policy.
Source: Author elaboration (2024)

In the fixed effects estimation on the z-score, the variable used is the type of natural disaster. The findings indicate that the most notable effect on financial stability is related to the terms of trade, which positively influences the z-score. This suggests that an increase in the terms of trade variable will elevate the z-score, reflecting enhanced stability. Notably, damage from natural disasters is not significant in this estimation. The next predictive model is to test the relationship between SRISK.

In meteorological disasters, the second predictive model examines the relationship between bank-level SRISK at the country level and the combined impact of the total affected population and total damage arising from meteorological hazards. The Ordinary Least Squares (OLS) results show that comparing the estimates using the z-score as the outcome variable and the estimates using SRISK reveals the significance of several variables in both scenarios. These factors encompass the cost-to-income ratio, GDP growth, and terms of trade. However, the analysis suggests that meteorological hazards do not influence the financial stability of banks. Conversely, hydrological hazards exhibit an effect on the banking sector's z-score, although statistically insignificant. Damage to GDP does affect the financial stability of banks. Key variables in this analysis include the cost-to-income ratio, trade openness, and the impacted population.

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The model used to explore the relationship between bank stability at the country level and the impact of geophysical, climatological, and biological disasters is estimated only for the z-score dependent variable due to insufficient SRISK data for analysis. Moreover, geophysical hazards have a minimal effect on financial stability. Specifically, the relationship between GDP and population, as well as bank savings and GDP, is evident. Similarly, climate-related disasters do not significantly impact the financial stability of banks. This estimation highlights that the most influential factors on financial stability are bank savings to GDP, GDP per capita, and inflation. All these variables contribute positively to the z-score. Conversely, the M2 to reserve ratio and the credit to GDP ratio harm the z-score. Biological disasters differ from other types of disasters because they generally do not cause physical damage; however, they impact a large portion of the population. The model investigating the relationship between bank stability and the combined impact of the total affected population and overall damage will also be estimated exclusively for the z-score dependent variable, due to the lack of SRISK data for analysis.

In the fixed effect estimation results, in models where the banking z-score is the dependent variable, the findings indicate that the only significant factor is the terms of trade, which positively influences the z-score. Notably, the results of the estimation do not show a direct influence of disease outbreaks on the financial stability of banks. However, it is important to note that our focus here is on the direct impact of natural disasters, which includes total damage and the affected population. Outbreaks such as pandemics can also have an indirect impact on the financial stability of banks in the form of recessions caused by unexpected shocks, as seen in the case of Covid-19.

4.2 INSURANCE SECTOR

Table 4 presents the Ordinary Least Squares (OLS) estimation results, where the dependent variable is the z-score of insurance companies. The estimation in column P1 shows that the most significant factors affecting financial stability are M2 reserve assets and GDP per capita. Both of these variables have a positive impact on the z-score. Therefore, an increase in either of these variables will enhance the financial stability of insurance companies. The following columns reinforce these initial findings by showing the positive impact of the affected population on the overall community. This trend may arise from the increased motivation to seek insurance protection after a natural disaster that affects a large portion of the population.

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Table 4

The result of z-score insurance

Variable	P1	P2	P3	P4
const	12.62**	9.757***	12.71***	8.810***
AffectToPop	1.860	3.443	10.24	8.371
DamagesToGDP	47.36	14.45	47.22	68.89
Inflation	-1.300**	-0.4636**	-	-
GDPgrowth	1.093	-0.1788	-	-
Tradeopenness	-0.02439	0.006738	-	-
GDPPop	-0.0001278*	-1.201e-06	-	-
Currentaccount	-1.995*	-0.4692***	-	-
Realinterestrate	-0.2562	-	-0.3139	-
Bartertermoftrade	0.02085	-	-0.03017	-
Claims growth	0.02946	-	-	-0.01027
Gross premium growth	6.064	-	-	-1.397
n	14	24	24	14
R^2***	0.9823	0.5369	0.2030	-0.2403
InL	12.13	-38.29	-46.86	-28.16

Note:
* significance at 10% level, ** significant at 5% level, and *** significant at 1% level
P1 = estimates using all control variables, P2 = macroeconomic factors, P3 = factors related to financial sector development, and P4 = factors related to monetary policy.
Source: Author elaboration (2024)

The second forecasting model explores the correlation between country-level insurance company SRISK and the impact of the affected population and total damage. The Ordinary Least Squares (OLS) estimation results presented in Table 5 depict the dependent variable as the natural logarithm of the insurance company's SRISK. Similar to the previous estimation, column P1 provides estimates using all control variables, while the subsequent columns present estimates using specific groups of variables. The estimates in column P1 show that inflation, the current account, and GDP have the most significant impact on SRISK. All these variables contribute to higher SRISK, as indicated by an increase in the z-score leading to a decrease in SRISK. However, these calculations indicate that natural disasters do not significantly affect financial stability, possibly because different types of natural disasters have varying impacts on the financial stability of insurance companies.

From the findings obtained, it is evident that the most common result associated with the z-score is the impact of natural disasters, which positively affects a country's z-score and financial stability. However, when examining SRISK estimation results, it appears that only significant macroeconomic factors have an impact. This difference may stem from the inherent differences between the z-score and SRISK. The z-score relies on accounting data, which reflects the financial status of insurance companies at a specific point in time. It lacks the forward-looking nature compared to market-based measures like SRISK. Therefore, while

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insurance companies confront the effects of natural disasters, they can recuperate without enduring prolonged consequences. Despite the limited research on the subject, some studies present findings that diverge notably from those of this research. According to (Born & Viscusi, 2006), after a natural disaster, a significant surge in losses prompts insurance companies to raise their insurance rates in the following year, aiming to lower the loss ratio compared to previous levels. Similar results were reported by (Benali & Feki, 2017), who emphasized that an increased loss ratio negatively impacts insurance companies, potentially leading them to exit the market. The differences in results between these studies arise from variations in the development and specific conditions in certain countries.

Table 5

The result of RSIRK insurance

Variable	P1	P2	P3	P4
const	12.62**	9.757***	12.71***	8.810***
AffectToPop	1.860	3.443	10.24	8.371
DamagesToGDP	47.36	14.45	47.22	68.89
Inflation	-1.300**	-0.4636**	-	-
GDPgrowth	1.093	-0.1788	-	-
Tradeopenness	-0.02439	0.006738	-	-
GDPPop	-0.0001278*	-1.201e-06	-	-
Currentaccount	-1.995*	-0.4692***	-	-
Realinterestrate	-0.2562	-	-0.3139	-
Bartertermoftrade	0.02085	-	-0.03017	-
Claims growth	0.02946	-	-	-0.01027
Gross premium growth	6.064	-	-	-1.397
n	14	24	24	14
R^2***	0.9823	0.5369	0.2030	-0.2403
InL	12.13	-38.29	-46.86	-28.16

Note:
* significance at 10% level, ** significant at 5% level, and *** significant at 1% level
P1 = estimates using all control variables, P2 = macroeconomic factors, P3 = factors related to financial sector development, and P4 = factors related to monetary policy.
Source: Author elaboration (2024)

5 CONCLUSIONS

The analysis findings suggest that natural disasters have a limited impact on banks. This outcome arises from the consideration that the z-score and SRISK are assessed at the country level rather than on an individual bank basis. Consequently, while small banks could potentially experience negative repercussions due to natural disasters, the overall banking sector seems to remain relatively unscathed. A similar outcome was observed in the case of pandemic analysis. Following the examination of banking sector stability, this study shifts its focus to the influence

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of natural disasters on insurance companies. The analysis in this domain, however, is less extensive compared to the banking sector analysis, primarily due to reliance on publicly available data, which is frequently lacking for developing countries—locations frequently afflicted by natural disasters. The connection between natural disasters and insurance company z-scores illustrates that these occurrences do indeed impact insurance companies. However, a positive relationship emerges between the number of affected individuals and financial stability. This can be attributed to the heightened interest in obtaining insurance coverage after significant natural disasters. This research introduces a fresh perspective to the discourse on financial stability and its interaction with natural disasters, a realm that has not been extensively explored, particularly in the context of insurance companies. Moreover, by employing two distinct measures, this study facilitates a comparison of the repercussions of natural disasters and pandemics on accounting-based and market-based indicators of financial stability.

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