

**RESILIENCE ANALYSIS OF THE EUROPEAN INSURANCE
INDUSTRY*****Alexandra VINTILĂ^{a*}, Mihai Daniel ROMAN^b**^{a)b)} Bucharest University of Economic Studies, Romania**Abstract**

The insurance market does not generate only a risk dispersion tool, but constitutes a complex system that contributes to the efficient and effective functioning of the economy. In order to guarantee the fundamental role of this market in sustainable economic growth, insurers must prove resilience in the face of risk and uncertainty generated by the complexity of the system of interdependencies in which they operate. The purpose of the article is to analyze the resilience of the European insurance market, its adaptability to changes and the recovery of delays caused by recent health (especially the COVID-19 pandemic). The data used include variables that define the European insurance system (such as gross written premiums, gross claims incurred, total technical expenses, total assets, total liabilities and number of entities) from EIOPA's annual statistics from 2017 to 2023. Analysis tools include cluster analysis to evaluate the dissimilarity and similarity of European Union countries. The resilience of the insurance industry to shocks was also analyzed from the perspective of financial performance by using a clusterization analysis in order to group countries based on Euclidean distance. The results indicate a grouping of countries in two clusters whose composition remained relatively stable to shocks.

Keywords: resilience, European insurance market, unsupervised learning, clustering, uncertainty

JEL Classification: G22, C38, F23

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1. Introduction

The insurance industry plays a key role in the efficient functioning of the economy, contributing to financial stability and risk mitigation. It can be considered a protective factor and an economic stabilizer in the face of uncertainty as it allows the insurance of random events. The risk matrix that characterizes random events also includes economic factors. Thus, the insurance industry faces a combined system of risks, from technical to financial, to which it must demonstrate resilience. This is the key to sustainability, profitability and efficiency in the face of adversity in a dynamic and complex environment, in which only uncertainty is constant. Since risk estimation takes into account the fact that the distribution of profit or loss can be seriously distorted, it can be said that the risks assumed have distorted distributions (Lane, 2000). For this reason, the insurance industry can be considered a source of vulnerability for financial instability. By managing risks, promoting innovation and supporting the economy, this industry is indispensable in economic growth, sustainable development and risk dispersion. One of the main contributions of the insurance industry to the economy refers to the compensation of damages following adverse events (Apergis and Poufinas, 2020).

By definition, resilience is the ability to cope with, adapt to, and recover from random events and shocks. It is characterized by both the process itself and the results of the measures applied to overcome critical moments and prevent long-term failures. Since resilience is strongly correlated with risk management and the reduction of uncertainty through proactive planning, it can be stated that there is a causality between resilience, insurance, risk, and uncertainty. Thus, insurance strengthens resilience by dispersing risks and facilitating recovery after the occurrence of a random event, effective risk management allows for the reduction of uncertainty. Ultimately, resilience is impacted by the ability to manage risks, resulting in the ability to adapt to dynamic and constant changes, but also to withstand shocks. This causality is vital in an uncertain environment, characterized by information asymmetry, in which insurance builds an important pillar in maintaining stability and sustainability.

Despite economic, social and geopolitical challenges, the insurance industry has managed to establish a robust foundation that gives it resilience in both the short and long term. The resilience of the European insurance sector reflects its ability to adapt and withstand external shocks and emerging risks, while maintaining its financial stability and competitive advantage. This plays a key role in reducing the existing protection gaps in economic systems. To be characterized by resilience, the insurance industry must promote a culture of agility to respond quickly to shocks and changes, of innovation, of building operational robustness and of capitalizing on complex challenges in order to improve strategies, detect fraud, emerging risks and develop efficiently and effectively. The resilience of the insurance industry also refers to its ability to fulfill its obligations even in difficult circumstances, to adapt business models, customer portfolio and products to new risks and regulatory requirements. Financial resilience

to damages caused by random events is characterized by two dimensions, namely the value of damages and the speed of settlement and recovery. The insurance industry contributes to improving both dimensions of this type of resilience. Thus, the insurance industry must also be appreciated as an instrument of resilience, not only of risk dispersion. Solvency and liquidity, risk diversification and reinsurance, adequate capital, digitalization and adaptation to emerging risks are essential factors for the resilience of this industry. It is important to emphasize that systemic risks, climate change that increases the frequency and severity of claims, strict and complex regulations, and permanent changes in consumer behavior constitute important challenges for the resilience of the insurance industry.

Our research paper is organized as follows. The first part outlines the literature review regarding the connection between risk, uncertainty, resilience and insurance. The next section presents the research methodology. In section 4, we present an overview of the European insurance market, highlighting its evolution over the period 2017-2023 and identifying the main characteristics. Section 5 provides an analysis of the types of resilience in the insurance industry. The analysis is designed to identify the main types of resilience, focusing on the most important ones, namely operational and financial resilience. Financial resilience is characterized by an iterative clustering algorithm, taking into account gross written premiums, gross claims incurred, total technical expenses, total assets, total liabilities and number of entities. Lastly, the final section summarizes our findings.

2. Literature review

The literature has substantiated the importance of analyzing the relationship between risk, uncertainty, the insurance industry and economic growth, even if resilience is a relatively new topic of interest. Since resilience involves overcoming adversity, economic agents must adopt an effective risk management, learning and permanent review policy in order to strengthen resilience. Thus, it captures the multilateral interaction between the nature of risk and the related adversity. The three dimensions of resilience listed by Fraser et al. (1999) refer to overcoming odds, namely being successful despite exposure to high risks, sustaining competence under pressure, i.e. adapting to high risks, recovering from shocks, and adjusting to negative random events.

Through their analysis, Kwon and Wolfrom (2016) provided a benchmark on the purpose of analytical tools in macroprudential supervision of the insurance industry. The responses of the 24 OECD and non-OECD countries to the questionnaire that formed the basis of the analysis were used to extract information on the performance, stability and competitiveness of the insurance industry. The added value of the survey was “sharing experience and best practices among correspondents on the use of analytical tools to monitor the performance and stability of the insurance industry”. The set of indicators used to consolidate this survey referred

to the importance of the insurance sector, competition, underwriting performance and risk, liquidity, investments, monitoring of potential systemic risks, but also to the importance of brokers and agents in the distribution of insurance products. One of the key conclusions referred to the assessment of expenses and claims as alternative tools in the analysis of the size and degree of development of the insurance industry, instead of the classic indicators of concentration, density or penetration, mainly focused on gross written premiums. This was explained by the belonging of claims and expenses to the financial performance and underwriting metrics specific to this industry. The two variables were considered critical for macroprudential supervision. Another important conclusion was the identification of information regarding the lack of data that may make it difficult to monitor some variables specific to the analyzed industry. In order to highlight the role of the development of the insurance industry in economic growth, Apergis and Poufinas (2020) presented the advantages and disadvantages of using claims and expenses in assessing the size of this industry. Compared to gross written premiums, these two variables better quantify the real size of the insurance activity, since “premiums are determined through actuarial models by the benefits paid to the stakeholders, such as the insured, the staff and other providers”. Also, claims and expenses “are free of other loadings that can possibly distort, such as the level of commissions or profit margins or even policy fees”, these being factual. Regarding the disadvantages presented by Apergis and Poufinas (2020), they referred to the disclosure of the level of the three indicators: claims and expenses are not always fully disclosed publicly compared to premiums. Despite the comparative advantages highlighted for claims and expenses, there may be hypothetical one-off events (such as natural disasters) that impact claims and expenses but are mitigated by the level of premiums. With these arguments, Apergis and Poufinas (2020) motivated the replacement of the classic depth and penetration indicators with claims and expenses and their importance to the size of the insurance industry. Thus, claims and expenses influence the level of premiums and the size of assets, affecting the level of underwriting and financing performance.

A theoretical and empirical analysis of the relationship between the insurance industry and economic growth at European level was carried out by Haiss and Sumegi (2008). Despite its considerable role in supporting economic activity, the insurance market has not received as much attention as the banking and capital markets. Investigating the impact of insurance investments and the importance of gross written premiums on GDP growth through an analysis based on panel data from 1992-2005 for 29 European countries, Haiss and Sumegi (2008) highlighted the need to pay more attention to the insurance industry in macroeconomic policy, but also in financial sector analysis. Their findings referred to the existence of a positive impact on GDP growth of life insurance in Norway, Switzerland, Iceland and the EU-15, but also to the impact on the insurance-growth nexus of the level of economic growth and the real interest rate. The main channels through which the insurance industry contributes to economic growth

identified by Haiss and Sumegi (2008) referred to risk and investment transfer. Combining cross-sectional data with time series, Lyian et al. (2010) analyzed the relationship between economic growth and insurance development in 77 countries, with the reference period 1994-2005. The set of variables provided information on economic growth, total insurance density, and insurance density by segments (life and non-life). The conclusions were substantiated by applying GMM models to dynamic panel data. The contribution of insurance industry development to economic growth was more significant in the case of non-life insurance compared to life insurance. An increase of 2.495% in economic growth was identified when the life insurance density for developing economies increased by 1%. Dividing the 77 countries into two categories, the results confirmed that insurance plays a more important role in developing economies compared to already developed ones. Thus, a 1% increase in general insurance density for developing economies generated an approximately 8.76% increase in economic growth, while a 1% increase in general insurance density for developed economies generated a 1.309% increase in economic growth.

Taking as a reference the definition of insurance from the risk and finance literature given by McCall (1987), Baumgärtner and Strunz (2014) formulated the economic (marginal) insurance value of resilience as the value of a particular function of it, namely the reduction of the income risk of the ecosystem user under conditions of uncertainty. The interpretation of resilience as insurance was possible due to the capacity to maintain fundamental functions and controls in the presence of disturbances. Thus, resilience insures risk-averse individuals against potential losses of well-being. Baumgärtner and Strunz (2014) analyzed the dependence of the insurance value of ecosystem resilience on its properties, risk preferences and the economic context. Using a classical economic model, the economic, respectively marginal, insurance value was derived to study this dependence. This analysis showed that the insurance value of resilience was positive (negative) for high (low) levels of resilience, increasing with the level of resilience, in contrast to normal economic goods whose marginal value decreases as their quantity decreases. Also, the insurance value of resilience was shown to be an additive component of its economic value, i.e. the insurance value was shown to be inferior to the economic value of resilience. The results confirmed that resilience functions as insurance only in the presence of high levels of resilience.

Garmestani et al. (2006) suggested that functional diversity along with functional richness are some of the critical attributes of resilience, not necessarily being correlated with the degree of industry concentration. Thus, industries with different firm sizes may be characterized by a higher degree of resilience as they combine these two capabilities. Also, large organizational structures have the possibility of diminishing the reactive flexibility to a given shock, compared to other smaller players, which are more reactive and flexible when conditions change. These results were also confirmed by Hendrickson (2015).

Rhodes and Stelter (2009) presented the advantage of holding a strong position during a recession. This advantage gives management of microeconomic entities that exhibit resilience to capitalize on mispriced assets or competitor weakness. Financial, strategic and operational resilience are the three most important types of resilience that characterize a performing industry. Tapper (2013) highlighted that increasing these types of resilience by the same proportion gives players the ability to both align their resilience approach with strategic objectives and anticipate their operational and financial risks. The continuous increase in the complexity of the infrastructure for providing services specific to the financial sector implies difficulties in the process of responding to unforeseen and diverse risks such as cyber attacks, geopolitical risks, pandemics, system failures. These factors, mainly driven by digitalization and the evolution of economic systems, have intensified the need for the financial sector to strengthen its capacity to respond to incidents, to recover major operations or operational resilience. In the “Principles for Operational Resilience”, the Basel Committee on Banking Supervision (“BCBS”) explained operational resilience as the capacity of the financial sector to respond to, or to recover quickly and flexibly from, disruptive random events (e.g. terrorism, cyber attacks, natural disasters). Developing a new risk management framework and replacing the existing one does not ensure the strengthening of operational resilience. This is possible by capitalizing on the existing framework, respectively by complementing it with a global vision at the level of the microeconomic entity KMPG (2023).

Wilson (2013) highlighted that crisis management involves resilience of players to severe individual risks, but also to the consolidation of a wide range of potential unforeseen risk accumulations. Stress scenarios are used to enhance resilience by developing plausible contingency and recovery plans and by restricting accumulations to possible scenarios. Richter and Wilson (2020) analyzed the degree of pandemic risk insurance, highlighting how stress scenario analysis and underwriting policies contributed both to the consolidation of resilience in advance and to the planning of emergency actions related to crisis scenarios. Following the COVID-19 pandemic, the need to strengthen resilience in advance in terms of solvency and liquidity, the need to be aware of the fact that the suspension of activities caused by the health crisis is not always an insurable risk due to the threat of external moral hazard and a significant potential for accumulation and threat.

Reducing risk exposure, allocating investments more cost-effectively, improving the ability to respond to shocks, and effectively preparing for unexpected risks are the four ways highlighted by Moore et al. (2019) through which insurance has the ability to promote resilience. These four ways also indicated the effectiveness of insurance in preventing negative random events, reducing risks, efficiently allocating capital, stimulating preparation for unexpected shocks, and strengthening their ability to respond to shocks. Salignac et. al. (2019) defined financial resilience as measured by the capacity of decision-makers to moderate, cope with, and recover from shocks without negatively impacting future well-being. In 2021,

Salignac et. al. proposed a framework to adequately understand and assess financial resilience, also demonstrating its multidimensional nature. Building on the work of Salignac et. al. (2019, 2021) and Martín et. al. (2020), Thompsen (2022) investigated how financial resilience is affected by access to life insurance. A significantly positive contribution of access to life insurance to financial resilience was identified. While substantial commitment from both the private and public sectors is needed to increase access to life insurance, cooperation between them can strengthen resilience, which can result in sustainable and inclusive growth.

The International Association of Insurance Supervisors (IAIS, 2020) focused on analyzing the financial and operational resilience of this industry to the COVID-19 health crisis. In the report published by this association on the global insurance market, they justified the existence of these types of resilience in the insurance industry. They also explained the ways in which insurers can mitigate the impact of the COVID-19 health crisis on their financial position, namely reducing dividend distributions to shareholders, adjusting premium rates, eliminating pandemic risks from new insurance policies and suspending share buybacks. Despite the significant shock to the financial market, the insurance industry has proven financial and operational resilience at a global level, being supported by operational supervisory measures, fiscal and monetary support measures. The results confirmed the existence of an adequate level of available capital resources even though the solvency and profitability of the insurance industry was affected by the financial market volatility generated by the COVID-19 pandemic.

One of the objectives of the work carried out by Fung et. al (2024) was to analyze the resilience of the insurance industry to the COVID-19 pandemic and how risk taking influences its resilience. The results highlighted the multidimensional nature of risk taking, with different dimensions of risk generating distinct effects on resilience and performance. On average, the property insurance business line was resilient to the COVID-19 pandemic, with insurers being most affected depending on their risk aversion. The high vulnerability of insurers with high asset and product risks to the adverse effects of the pandemic was noted, underlining the importance of effective risk management strategies in cushioning shocks. Thus, understanding the multidimensional nature of risk taking and developing sustainable targeted risk management strategies result in strengthening resilience and mitigating the negative impacts of future shocks. Risk taking has heterogeneous effects on the performance and resilience of insurers to the COVID-19 pandemic.

Chen et al. (2024) developed three models to strengthen the resilience of the insurance industry against the increasing threats posed by natural disasters. As global climate change increases the frequency and severity of natural disasters, the industry faces significant challenges in risk management and policy accessibility. The disaster impact model quantified the immediate impacts of various weather extremes, allowing for precise risk estimates. The insurance failure factor model forecasted the financial sustainability of insurers, taking into account the frequency and severity of random events. The underwriting risk prediction model

used area-specific data to accurately predict underwriting risks, allowing for the customization of insurance strategies. Using these models together, it was possible to improve risk management, optimize underwriting practices, and ensure the financial stability of the insurance industry in a changing climate. Thus, the long-term sustainability of the industry was promoted.

3. Methodology

Cluster analysis is an exploratory, multidimensional analysis that involves searching for and identifying groups or clusters within sets of objects or shapes, so that elements that are part of the same group are as similar as possible, and elements that are part of distinct groups are as different as possible from each other. In other words, cluster analysis is a way of evaluating the similarities and dissimilarities between objects that belong to a certain set, in order to group these objects into groups that are homogeneous inside, but distinct from each other. The grouping of objects into clusters is done in such a way as to guarantee maximum variability between classes, respectively minimum variability within classes (Ruxanda, 2009). This type of analysis falls into the category of unsupervised learning systems.

Clusters are obtained by applying hierarchical or non-hierarchical classification techniques that are based on the construction of the proximity matrix, which is an aggregate representation of dissimilarity or similarity indicators. As the distance between two objects becomes smaller, the degree of dissimilarity decreases, and the probability of their being grouped increases. Optimization or partitioning algorithms are the most used in cluster analysis, they are part of the category of non-hierarchical algorithms. One of the most applied algorithms in specialized studies is the k-means algorithm, in order to establish the number of clusters, k , into which the data set is to be divided for the application of this clustering method. The results of these partitioning classification algorithms are characterized by unique solutions, respectively by unilevel solutions. This algorithm involves selecting a number of objects equal to the number of classes known a priori. These can be chosen either randomly or based on a selection rule. The next step consists of determining the distances between the primary groups made up of the k elements and the rest of the shapes, finally forming the clusters. Each step involves recalculating the centroid of the classes, the objects being reallocated to the cluster to whose centroid they are closest. In this way, it is possible to reallocate the k shapes initially selected to other groups. The algorithm is repeated until either the cluster structure no longer shows changes from one iteration to another, or the convergence criterion has been met (Muraru, 2021).

In cluster analyses, distance is used as an indicator of segregation of observations. There are several types of distance as follows (Muraru, 2021):

- Euclidean distance (straight line distance): it is determined as the square root of the sum of the squares of the differences in the coordinates of the objects, being especially recommended when the variables have identical units of measurement.

$$d(x, y) = \sqrt{(x - y)(x - y)} = \|x - y\| = \sqrt{\sum_{i=1}^n (x_i - y_i)^2} \quad (3.1)$$

- Mahalanobis distance: it is useful in the case of correlated data sets, and when the variance-covariance matrix is equal to the identity matrix, it becomes equal to the Euclidean distance.

$$d(x, y) = (x - y)^T S^{-1} (x - y) \quad (3.2)$$

- Manhattan distance (city-block type): is determined as a sum of the absolute values of the differences between the coordinates of the objects.

$$d(x, y) = \sum_{i=1}^n |x_i - y_i| \quad (3.3)$$

- Chebyshev distance: being equal to the maximum absolute value of the coordinate differences, the Chebyshev distance makes two shapes appear distinct even when they differ from the perspective of a single characteristic.

$$d(x, y) = \max_n |x_i - y_i| \quad (3.4)$$

There are also several alternatives for measuring the distance between classes (Ruxanda, 2009, Muraru, 2021):

- Nearest neighbor method: measures the distance between two clusters as the distance between the closest objects belonging to the two classes.

$$d(\theta_I, \theta_J) = \min\{d(o_i, o_j), o_i \in \theta_I, o_j \in \theta_J\} \quad (3.5)$$

- Farthest Neighbor Method: measures the distance between two clusters as the distance between the furthest objects belonging to the two classes

$$d(\theta_I, \theta_J) = \max\{d(o_i, o_j), o_i \in \theta_I, o_j \in \theta_J\} \quad (3.6)$$

- Centroid method: the distance between two clusters is evaluated as the distance between the centroids of the two clusters.

$$d(\theta_I, \theta_J) = d(\bar{o}_I, \bar{o}_J) \quad (3.7)$$

- The method of average distances between pairs – after calculating the distance between all pairs of objects belonging to the two clusters, their average is calculated.

$$d(\theta_I, \theta_J) = \frac{\sum_{i=1}^{n_I} \sum_{j=1}^{n_J} d(o_i, o_j)}{n_I n_J} \quad (3.8)$$

- Ward's method – this method aims to maximize the degree of homogeneity of clusters, respectively minimize intracluster variability. There is a strong and negative correlation between the degree of homogeneity and the total sum of the squares of intracluster deviations. Compared to previous methods, Ward's method is the only one that formulates distances from the point of view of minimizing intracluster variability.

Thus, the main goal of cluster analysis is to determine classes with the following properties: observations grouped in the same class should be as similar as possible, but should be as different as possible from those belonging to other groups. Determining the optimal number of clusters, the ways in which dissimilarity is measured, and selecting the types of connections constitute challenges for this unsupervised learning technique. The choice of the method for evaluating distances between clusters generates the differences between the way clusters are constructed.

4. Evolution of the European insurance market

The insurance industry is an essential framework for supporting economic activities, thus contributing to sustainability and economic growth. A resilient industry will in turn generate consumer resilience. The European insurance industry occupies an important place at global level, and the existing regulations contribute to the efficiency and effectiveness of risk management and sustainability. There are a number of indicators that describe the evolution and performance of the European insurance industry. In order to provide a brief description of the evolution of this industry, six indicators have been selected from the database provided by EIOPA, which are also specific to financial resilience, for the period 2017-2023. Depending on their level, players in the European insurance industry have a strategic positioning even at a global level.

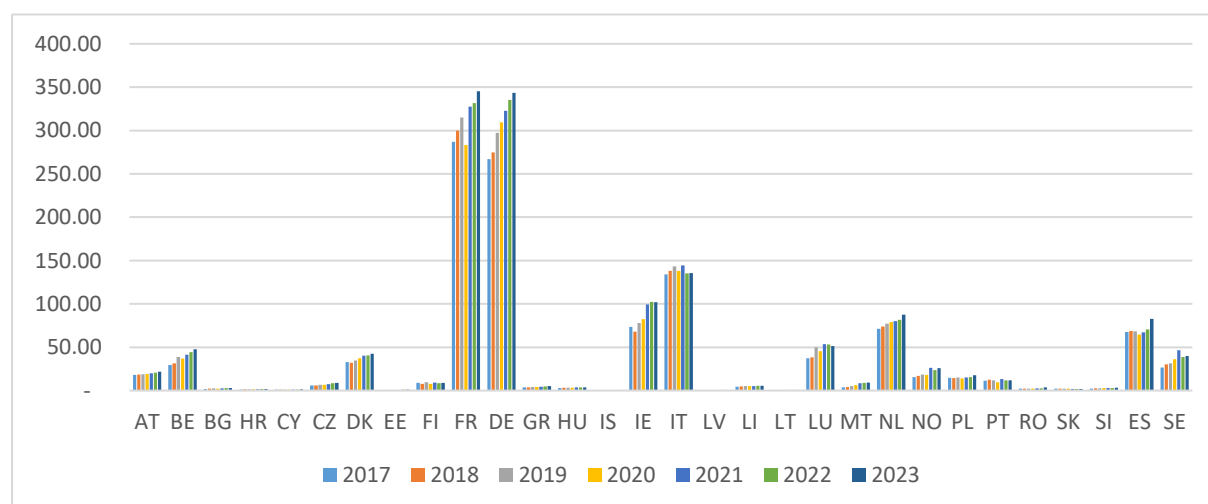


Figure no. 1: Evolution of gross written premiums during the period 2017-2023 (billion EUR)

Source: authors' processing

One of the most important indicators for the insurance industry is gross written premiums, as they constitute the main source of income and are fundamental for consolidating all types of resilience existing on this to give competitive advantage to players. Underwriting policy, economic conditions, diversity of product portfolio are factors that influence their level. During

the analyzed period, the volume of gross written premiums varied between EUR 1129.42 billion and EUR 1414.09 billion with an increasing trend, except for 2020 when decreases were recorded at the industry level. This year was affected by the COVID-19 pandemic. The most significant increase was recorded at the level of the analyzed countries in 2021, with the volume of gross written premiums increasing by EUR 130.2 billion. France, Germany, Italy, Ireland and the Netherlands are in the top five countries recording the highest volumes of gross written premiums, while Iceland, Latvia and Lithuania record the lowest volumes. Austria, Germany, Malta, the Netherlands, Romania and Slovenia are countries that recorded increases throughout the analyzed period in terms of the volume of gross written premiums.

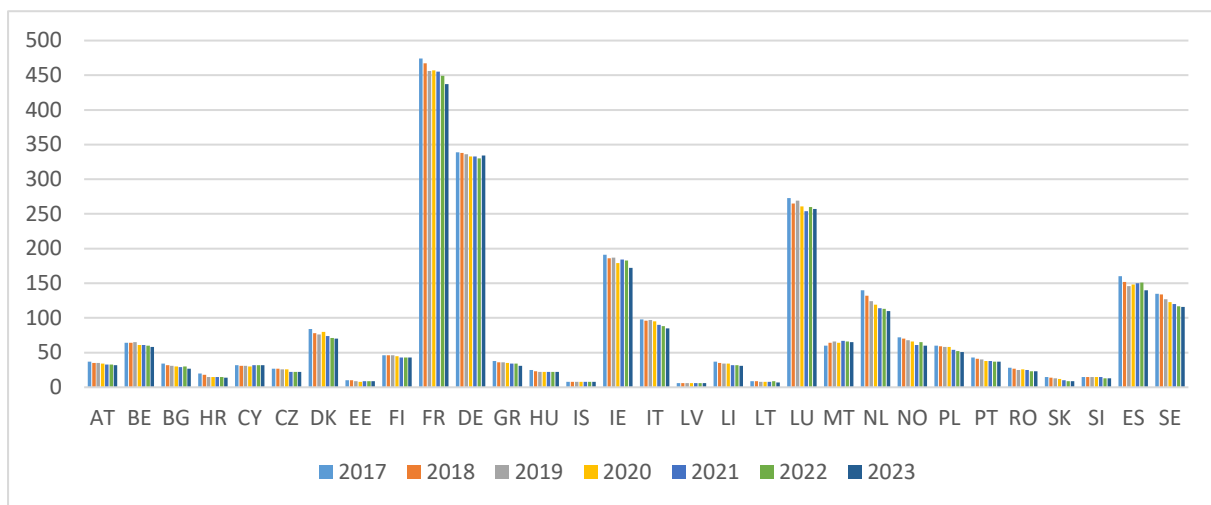


Figure no. 2: Number of submissions

Source: authors' processing

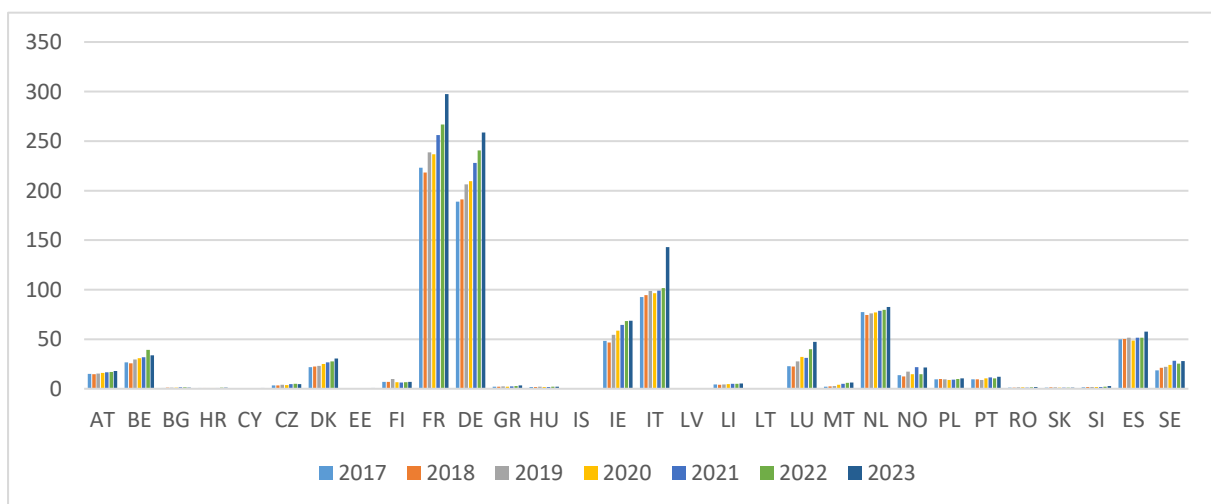


Figure no. 3: Evolution of gross claims incurred (billion EUR)

Source: authors' processing

At the level of the 30 European countries analyzed in the insurance industry, a decreasing trend was observed in the entities operating in this sector. This trend can be explained by the

increase in the number of mergers and acquisitions or bankruptcies. The total number of entities varied between 4344 and 4597. The most significant decreases were recorded in France, Ireland and Spain. The most entities operate in France, Germany, Ireland, Luxembourg, the Netherlands, Spain and Sweden (over 100 entities), and the least in Latvia (6 entities throughout the analyzed period). Of the set of indicators analyzed, this is the only one that registers a decreasing trend.

Claims incurred include both gross claims paid and gross reported but not settled claims for each claim file belonging to a specific accident year (refers to losses reported to an insurer that have not been settled by the end of the accounting period).¹ A strategic direction for the resilience of the European insurance industry, especially for the financial and operational ones, is to optimize their underwriting performance, digitalization, automation, reinsurance. The gross claims incurred have an impact on both profitability, operational efficiency, financial stability, and insurance premiums. Analyzing figure no.3, we note that the most significant variations were recorded in Belgium (maximum increase of EUR 7.37 billion in 2022 and minimum decrease of EUR 5.52 billion in 2023), Denmark (maximum increase in the level of gross claims incurred was EUR 2.83 billion in 2023), Finland (maximum increase of EUR 2.96 billion in 2019 and minimum decrease of EUR 3.33 billion in 2020), France, Germany, Ireland (maximum increase of EUR 8 billion in 2019 and minimum decrease of EUR 1.59 billion in 2018), Italy (maximum increase of EUR 41.48 billion in 2023 and minimum decrease of EUR 2.06 billion in 2020), the Netherlands and Norway.

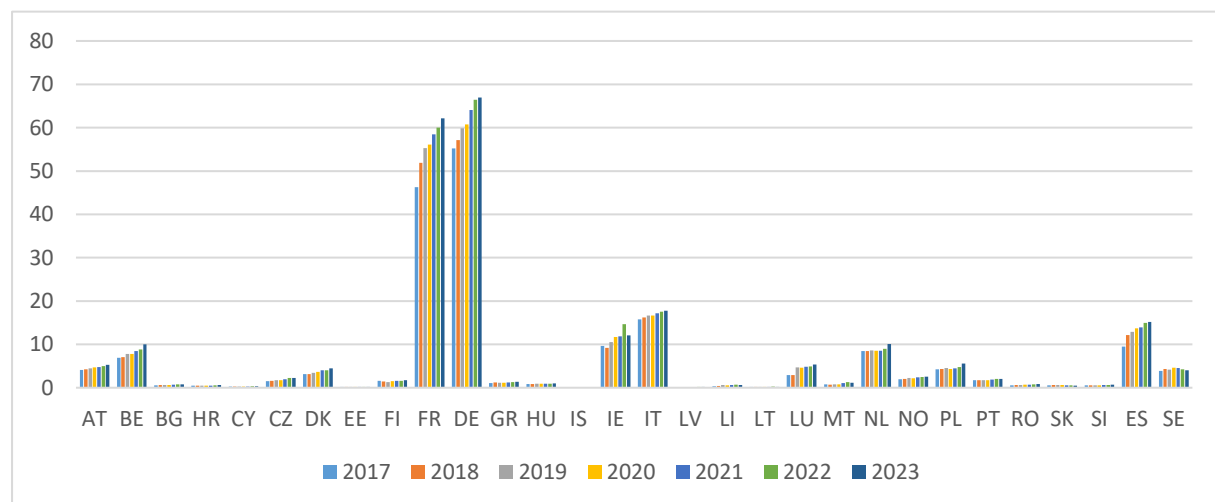


Figure no.4: Evolution of total technical expenses during 2017-2023 (billion EUR)

Source: authors' processing

An important factor for the financial resilience of the European insurance industry is technical expenses (which contain administrative expenses, investment management expenses,

¹ https://www.eiopa.europa.eu/qa-regulation/questions-and-answers-database/672_en accessed on 29 October 2024

claims management expenses, overhead expenses, acquisition expenses, other expenses). Their efficient management contributes to maintaining solvency, profitability, competitive advantages, operational stability, but also to controlling future risks by building up reserves. One of the most important indicators in the analysis of these expenses is the combined rate. The total volume of technical expenses in the 30 countries analyzed varied between EUR 183.37 billion and EUR 235.99 billion with an increasing trend throughout the analyzed period. In addition to the significant increases recorded in France and Germany, the following significant variations were also observed:

- Belgium: in 2024 (EUR +1.14 billion);
- Ireland: in 2019 (EUR +1.36 billion), 2020 (EUR +1.17 billion), 2022 (EUR +2.8 billion), 2023 (EUR -2.59 billion);
- Luxembourg: in 2019 (EUR +1.81 billion);
- Spain: in 2019 (EUR +2.66 billion).

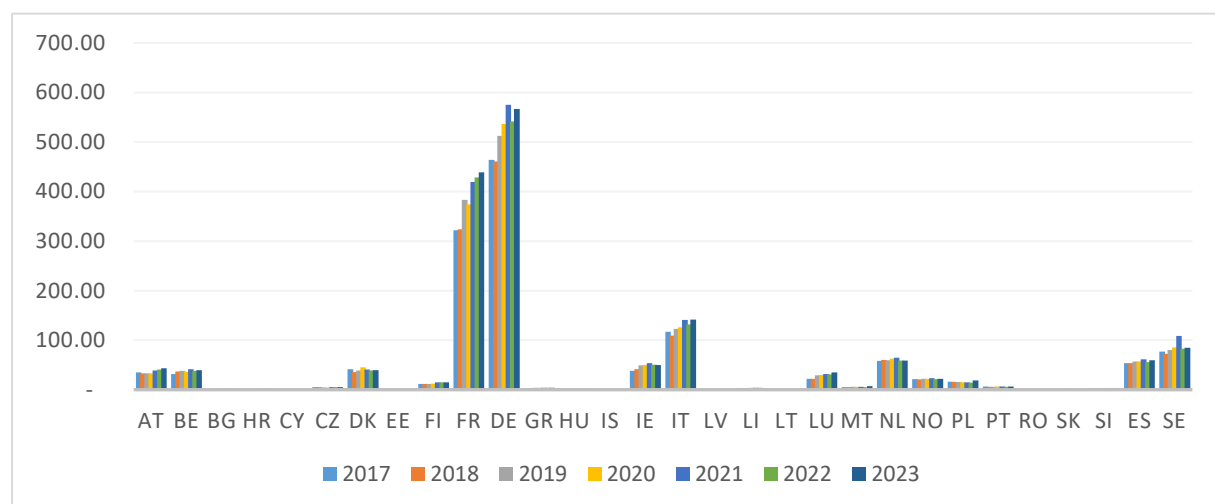


Figure no. 5: Excess of assets over liabilities (billion EUR)

Source: authors' processing

As an indicator reflecting financial resilience, the excess of assets over liabilities has a significant impact on covering the level of the solvency capital requirement, reflecting the level of solvency of insurers and contributing to increasing the sustainability of the business. Asset depreciation, increased capital requirements, low interest rates constitute challenges for maintaining excess of assets over liabilities. Analyzing figure no.5, we observe that the level of assets and liabilities recorded by insurers generated the recording of excess of assets over liabilities throughout the analyzed period. In general, the excess of assets over liabilities varied between a minimum of EUR 1333.28 billion (recorded in 2018) and a maximum of EUR 1669.1 billion (recorded in 2021). The largest variations were recorded in:

- France: in 2019, the excess of assets over liabilities increased by EUR 59.92 billion, and in 2021 by EUR 45.35 billion;

- Germany: 2019 (EUR +51.69 billion), 2020 (EUR +23.87 billion), 2021 (EUR +38.9 billion), 2022 (EUR -34.17 billion) and 2023 (EUR +25.36 billion);
- Sweden: 2021 (EUR +23.12 billion), 2022 (EUR -25.6 billion).

5. Resilience analysis in the European insurance market

The exponential and interconnected growth of risks underlines the crucial role of the insurance industry as an instrument of financial security, economic recovery and more efficient risk management. Thus, insurers are forced to adapt their business model to the accelerated pace of technological change, the amplification of economic uncertainty and crisis contexts.² The European insurance industry uses various strategies and mechanisms to maintain its stability and adaptability, which can be divided into several types of resilience.

5.1. Financial resilience

One of the most analyzed aspects of resilience is financial resilience, especially in the current difficult and volatile economic environment. This type of resilience is dynamic as it integrates the ability of players to recover from a negative financial shock. (Hamid et al., 2023) There is a bidirectional link between the insurance industry and financial resilience: „by supporting financial resilience, it acts as a shock absorber and promotes growth through its core activities”, both at the microeconomic and macroeconomic levels. Also, the quality of long-term investors gives insurers the fundamental role of reducing financing gaps.³ Thus, the level of financial resilience specific to the insurance industry is strongly correlated with the ability of players to adapt their financial models in order to maintain financial stability and sustainability, to maintain liquidity and solvency to meet contractual obligations despite adverse economic conditions and disruptive random events.

Portfolio diversification, risk transfer (reinsurance), financial stress scenarios, financial risk management, meeting capital, liquidity and solvency requirements are key elements in strengthening the financial resilience of the European insurance industry. The Solvency II Directive is a main framework that supports the pillars of financial resilience by establishing the solvency capital requirement, the continuous monitoring of financial, operational, credit and market risks, the obligation to maintain a sufficient level of reserves to support financial stability. EIOPA also supports the protection of the financial stability of the European

² <https://www.undp.org/publications/parametric-insurance-build-financial-resilience> accessed on 17 November 2024

³ <https://www.swissre.com/our-business/managing-our-assets/supporting-financial-stability.html> accessed on 11 November 2024

insurance industry by monitoring and assessing vulnerabilities and risks. EIOPA focuses on a forward-looking approach, seeking to adopt preventive measures. Thus, the central elements of this approach are regular crisis simulations, financial stability reports, stress tests and the risk dashboard. For example, simulations are conducted to test the resilience of the European insurance industry to adverse developments in economic and financial conditions. Such simulations lead to the identification of vulnerabilities in this industry and measures to improve resilience. The collapse of financial markets, simultaneous catastrophic random events, and an unexpected increase in claims are economic scenarios of interest for stress testing.⁴

The analysis of the resilience of the insurance industry at the European level was analyzed using the k-means clustering algorithm to see if there were any dissimilarities in the composition of the classes obtained for the analyzed period. In order not to distort the results, we eliminated extremely high values recorded by France and Germany. Since France and Germany recorded extremely high values, they were eliminated from the analysis in order not to distort the results., The data were normalized, and general configurations were generated, the best one being reported. Figure no.6 presents the results obtained after applying the partitioning classification method.



Figure no.6: Cluster analysis results

Source: authors' processing in R

⁴ https://www.eiopa.europa.eu/browse/financial-stability_en accessed on 15 November 2024

Analyzing the results, we observe that the grouping of the data led to two groups of size eight and 20, respectively, throughout the analyzed period, without identifying differences in their composition. Thus, the first class contains eight countries: Belgium, Spain, Denmark, Ireland, Sweden, Luxembourg, the Netherlands and Italy, and the second class is formed by the Czech Republic, Liechtenstein, Hungary, Norway, Austria, Slovenia, Iceland, Poland, Bulgaria, Lithuania, Estonia, Croatia, Portugal, Finland, Romania, Malta, Greece, Cyprus, Slovakia, Latvia. The lack of dissimilarity in class composition denotes the financial resilience of the European insurance industry.

An important step of this analysis is to measure the quality of the k-means partitions. Table no. 1 presents the results obtained. In the analyzed cases, the quality of the k-means partition was at least 63.94%, which allows a higher explained percentage and a higher quality.

Table no. 1 - Quality of k-mean partition

Indicator	2017	2019	2021	2023
Sum of squares of interclass variations	6.01	6.41	6.94	6.69
The sum of squares total	9.4	9.57	10.09	9.9
Score	63.94%	66.98%	68.78%	67.57%

Source: authors' calculation

Strengthening a solid foundation of practices and regulations supports the financial resilience of the European insurance industry. The benefits generated by a financially resilient industry refer to economic stability, including through risk redistribution, consumer protection, but also supporting economic recovery. Emerging risks, economic and health crises, geopolitical conflicts, low interest rates, but also climate change constitute complex challenges for the European insurance industry.

5.2. Operational resilience

In the insurance industry, operational resilience refers to the ability of players to combat and guarantee normal services following random disruptive events. This type of resilience is interdependent with resistance to major financial events, but also with the ability to manage operational, technological or security disruptions. Even if players in the insurance industry face random disruptive events, they must guarantee the integrity of technological and financial operations, business continuity, but also compliance with legal and regulatory obligations. Thus, in a highly volatile environment and exposed to an increasingly wide range of known and emerging risks, resilience capacity must be substantiated with the same speed in order to support business agility. Uncertainty has been amplified by the speed of technological and

digital changes, their acceleration in adoption, data risks, intensified cybersecurity and climate change. The severity of weather conditions has increased the pressure on insurers to respond to customer obligations in a timely and adequate manner given that the increase in claims volume implies increased claim processing times and increased costs. The complexity of such actions drives insurers to exploit new technologies to increase efficiency, effectiveness and improve customer experience.⁵ The implications of operational resilience are presented in figure no.7.

Digitalization and technology	Cybersecurity	Business continuity plans
•The implementation of artificial intelligence and automation is carried out in order to streamline operations, reduce costs, thus ensuring the adaptability of players to changes.	•The growing trend of investments in digital security, to ensure business continuity, is the result of exposure to cyber risks. The purpose was to ensure business continuity.	•Insurers are consolidating and implementing continuity plans for normal operation in the event of major risks (cyberattacks, health crises, natural disasters).

Figure no.7: The implications of operational resilience

Source: authors' processing

The exploitation of digitalization opportunities, the dependence on it, the accelerated pace of implementing digital solutions imposed by the COVID-19 pandemic have directly and strongly correlated a continuous level of cyber risk, with multiple consequences for both insurers and insureds. According to studies conducted on this topic by EIOPA (2021), insurers were included in the class of those who experienced the most events caused by cyber risks along with payment institutions and credit unions. Along with ESMA and EBA, EIOPA assessed the level of risks in the European financial system as follows: digitalization risk-73%, cyber risk-19%, and "InsurTech" competition - 8%. Large volumes of confidential data have turned insurers into targets of cyber attacks.⁶

Analyzing the scores of the digitalization index from 2010 to 2020, we observe that from the European insurance industry, markets in Finland and Sweden recorded the highest values. This was due to the preminent performance in the three specific dimensions of digitalization: innovation (optimization solutions), accessibility and use (the ability to apply solutions). A visible trend to note is the way in which France and Germany recorded average scores, despite their dominant positions and their labeling as outliers resulting from the analysis of the

⁵ <https://www.pwc.com.au/assurance/cps230-op-resilience-insurance-in-focus.pdf> accessed on 11 November

⁶ https://www.eiopa.europa.eu/cyber-risks-what-impact-insurance-industry-2021-10-15_en accessed on 21 October 2024

evolution of the European insurance industry presented in the previous section. Several groups of countries with close digitalization scores were identified, as follows: Denmark, Switzerland, the United Kingdom and Ireland, France, Norway and Germany, Austria and Belgium, Slovenia, Poland, the Czech Republic and Spain, Italy and Hungary, and the last class was formed by Germany and Portugal.

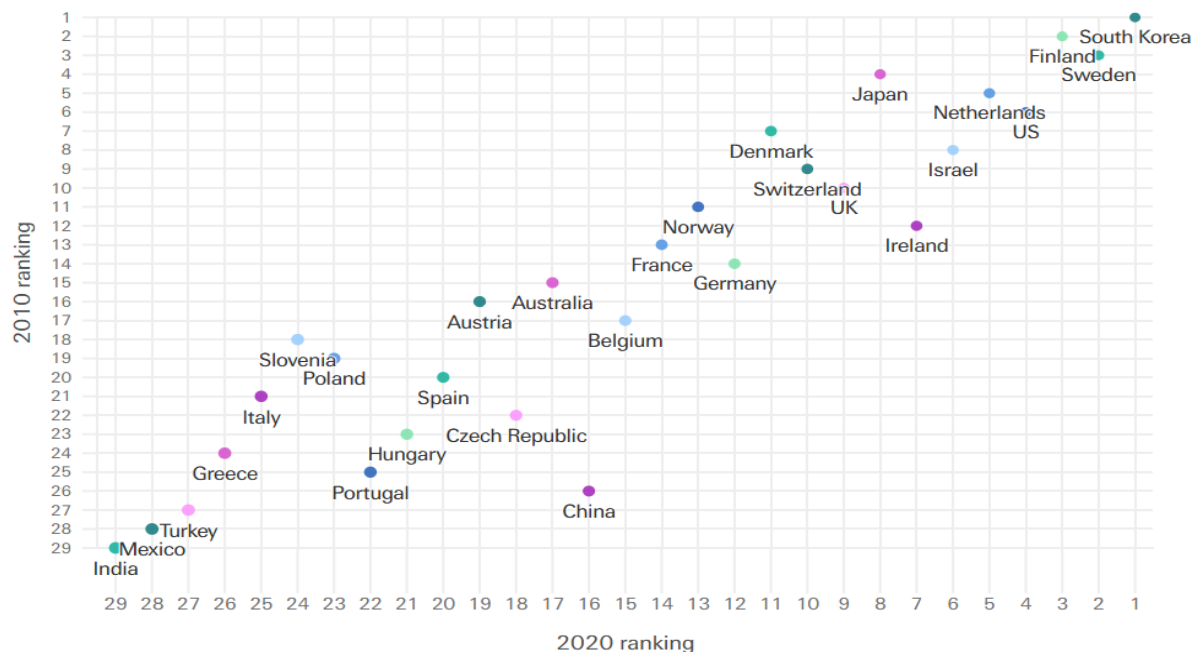


Figure no.8: Insurance Digitisation Index by country (2010, 2020)

Sursa: <https://www.swissre.com/risk-knowledge/advancing-societal-benefits/digitalisation/insurance-digitalisation-index.html>

The financial sector's increasing dependence on technology increases its vulnerability to cyber incidents or attacks. The importance of strengthening operational resilience is underlined by the existence of interdependencies between the financial sector and other economic sectors. The Digital Operational Resilience Act (DORA) is one of the European initiatives to increase operational resilience. It will apply from 17 January 2025, even though it entered into force on 16 January 2023. The aim of this initiative is to strengthen IT security for each financial entity and to ensure the competence of the European financial sector to show resilience in the face of major operational disruptions. The DORA initiative also harmonises the rules specific to operational resilience.⁷ Thus, protecting digital infrastructure against both cyber attacks and technological malfunctions, introducing uniform requirements for incident reporting and

⁷ https://www.eiopa.europa.eu/digital-operational-resilience-act-dora_en?prefLang=ro accessed on 29 October 2024

managing technological risks are the two important objectives of this project. Its impact will be represented by improving the ability to respond quickly to attacks or technological disruptions.

Thus, operational resilience is one of the key elements of the stability of the European insurance industry. Players in this industry must adopt current risk management practices and remain agile to gain competitive advantage and support both policyholders and European economic systems. Numerous regulations and initiatives, strategic partnerships, stress scenarios come to their aid, thus being able to face current and future challenges. From an operational point of view, an insurer is resilient when it can mitigate, recover from and also learn from the impact of a wide range of random disruptive events whose impact is to disrupt the normal course of business by impacting critical operations or systems. Also, the insurance industry's focus on digital technologies intensifies the need to form a robust cyber resilience framework. The complexity of the insurance sector, its interdependencies and interconnections force players to adopt sustainable and prudent management practices to ensure business continuity in the event of an operational incident.⁸

5.3. Market resilience

Market resilience is the ability of insurers to adapt to market requirements and regulations, and to random changes in risk dynamics and consumer needs. To strengthen their market resilience, insurers must apply best practices to offer innovative products, adapt the complexity and specificities of their product portfolio to market requirements, distribute insurance products, and constantly monitor and review products in order to capitalize on market opportunities. It is also important for insurers to minimize risks related to customer protection and maintain their trust in order to demonstrate market resilience. Contractual flexibility is another important pillar in strengthening this type of resilience. International competitiveness, volatility of consumer requirements, identification of target customer segments without taking into account sustainability factors constitute real challenges for the market resilience of the European insurance industry.

5.4. Resilience to climate change and catastrophic risks

The increasing frequency and severity of climate change and catastrophe risks impact the sustainability and performance of the European insurance industry. Climate and catastrophe risks arise from a range of climatic elements that deteriorate over the long term and affect

⁸ <https://assets.kpmg.com/content/dam/kpmg/cn/pdf/en/2023/09/navigating-operational-resilience-in-the-insurance-industry.pdf> accessed on 23 October 2024

various lines of business of the insurance industry (property, casualty, life, health, etc.) to varying degrees. Robust and innovative market mechanisms, adaptation and transfer, review and improvement of policies for assessing and managing climate and catastrophe risks need to be analysed interdependently to assess the challenges posed by climate change in the insurance sector. (Gupta and Venkataraman, 2024) The vulnerability of certain lines of business to climate change is intensified due to significant differences between the historical distributions of exposure to these types of risk and the prevailing profile. (Wagner, 2022)

6. Conclusions

As insurance plays a fundamental role in supporting economic activity, the strong resilience of this industry contributes to the sustainability, efficient functioning and growth of the European economy in the face of an increasingly complex and unpredictable risk matrix. Efficient resource management, effective regulatory strengthening, investments in sustainability, digitalisation, risk diversification contribute to the resilience of the European insurance industry to overcome disruptive random events. The COVID-19 health crisis has demonstrated the ability of insurers to overcome the global crisis and to prove resilience.

To fulfil its roles and create added value, the European insurance industry must be able to respond quickly to market, climate or economic changes. To this end, processes can be streamlined through optimization and digitalization, improving accuracy, customer satisfaction and reducing operational costs. Thus, to achieve a long-term competitive advantage, the insurance industry must adopt an organizational culture of innovation and continuous improvement. Strengthening operational robustness is also essential for the resilience of the European insurance industry. Underpinning operational robustness includes strengthening resilient systems and processes that allow adaptation to evolving risks and their complexity. In the insurance industry, decision-making is data-driven, and the use of large databases and advanced analytics provides information on market trends, customer behaviour, financial education, but also risk factors. All these elements contribute to the development of a profitable product portfolio, the optimization of pricing strategies, but also to improving claims detection. To maintain their sustainability, European insurance industry players are investing in strengthening a solid data infrastructure, streamlining analytical capabilities. Artificial intelligence supports insurers for predictive modeling, fraud mitigation, risk assessment, and personalized customer experiences.⁹

⁹ <https://www.linkedin.com/pulse/building-resilience-insurance-industry-embracing-success-morris-b4ktf>
accessed on 22 November 2024

The description of the evolution of the European insurance industry was carried out based on six indicators: gross written premiums, number of submissions, gross claims incurred, total technical expenses, total assets, total liabilities from the database provided by EIOPA, which are also specific to financial resilience, for the period 2017-2023. During the analyzed period, an increasing trend in the volume of gross written premiums was identified, except for 2020 when decreases were recorded at the industry level. This year was affected by the COVID-19 pandemic. The most significant increase was recorded at the level of the analyzed countries in 2021, with the volume of gross written premiums increasing by EUR 130.2 billion. France, Germany, Italy, Ireland and the Netherlands are in the top five countries recording the highest volumes of gross written premiums, while Iceland, Latvia and Lithuania record the lowest volumes. The active entities in this industry showed a decreasing trend, which can be explained by the increase in the number of mergers and acquisitions or bankruptcies. Gross expenses have an impact on profitability, operational efficiency, financial stability and insurance premiums. This indicator showed significant variations in Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands and Norway. Also, the total volume of technical expenses in the 30 countries analyzed varied between EUR 1.85 billion and EUR 2.38 billion with an increasing trend throughout the analyzed period, and the level of assets and liabilities recorded by insurers generated the recording of excess assets over liabilities throughout the analyzed period.

The analysis of the resilience of the insurance industry at the European level was analyzed using the k-means clustering algorithm to identify the existence of dissimilarity in the composition of the obtained classes. After data normalization, 30 general configurations were generated, the best - in terms of Euclidian distance being reported. It was observed that the grouping of the data led to two clusters of size eight and 20, respectively, throughout the analyzed period, without identifying differences in their composition. The lack of dissimilarity in the composition of the classes denoted the financial resilience of the European insurance industry. The fruition of digitalization opportunities, the dependence on it, the accelerated pace of implementing digital solutions imposed by the COVID-19 pandemic directly and strongly correlated a level of continuous cyber risk. Thus, multiple consequences were generated for both insurers and insureds. The importance of strengthening operational resilience was underlined by the existence of interdependencies between the financial sector and other economic sectors. The Digital Operational Resilience Act (DORA) is one of the European initiatives to increase operational resilience. It will apply from January 17, 2025, with the main aim of strengthening IT security for each financial entity, respectively ensuring the competence of the European financial sector to show resilience in the face of major operational disruptions.

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