ARTIFICIAL INTELLIGENCE TO MODEL AND STUDY THE IMPACT OF DEVELOPMENTS IN THE INSURANCE SECTOR ON ECONOMIC DEVELOPMENT

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ABSTRACT

The research deals with the rates of the insurance sector as one of the financial sectors that act as a catalyst for economic development. The systematic analysis of the literary sources and methods of addressing the problem of the insurance sector developments, in addition to the existence of social, economic, political and institutional inhibitors to the effective reform of the insurance sector. Inputs were used as parameters that characterize the development of the insurance sector. Namely, the size of the insurance penetration, and the size of the insurance density in Romania. Indicators of the rate of economic development were predicted using CSR, CGSR, and Measuring Instrument methods. FOINNs.SVM A machine learning model from Python built an artificial neural network model. The statistical data of the Ministry of Finance and the World Bank served as an information base to study the relationship between the size of approved and implemented insurance sector developments. The relationship between approved and expressed insurance sector developments was studied using data from several statistical areas, the Ministry of Finance, and the World Bank. The results of the modeling demonstrated the negative impact of the developments in the insurance sector, the size of the insurance penetration rate and the insurance density in Romania in the long run. As these developments did not contribute to the growth of economic development indicators. Thus, the results of standard economic modeling represented the negative impact of the reforms that the insurance sector in Romania experienced after 2022. They did not contribute to increasing the insurance penetration rate, the insurance density rate, and therefore will have a negative impact on the insurance rate. economic development a year later. And during the next ten years in Romania.

Key words: Insurance Sector, Economic Development, Modeling, Artificial Intelligence, Prediction.

INTRODUCTION

A person is exposed throughout his life to many risks represented in the risks of property such as its loss or destruction, the risks of civil liability such as the responsibility of a person for damages to other people or their property, and job risks such as the risk of losing a job,(Adams et al., 2005) and it results from these risks if the individual is exposed to them to influence the plans that he draws it for his activities and the foundations that he sets for the practice of his public affairs, given that these dangers harm the life and activities of the individual and limit his capabilities and capabilities, even if he adopts several ways to avoid these risks and ways to prevent their occurrence by various means, (Acharya,2015) but these risks continue to haunt him, and among the ways to avoid risks There are some effective and most effective ways, which is insurance.(Acharya et al., 2012).

Citation Information: Hadouga, H. (2024). Artificial intelligence to model and study the impact of developments in the insurance sector on economic development. *Academy of Strategic Management Journal, 23S*(2), 1-10.

Despite the multiplicity of concepts about insurance, (Alves et al., 2015)some scholars took it as a legal basis, and some of them took it as a technical basis, but it remains a means of cooperation and solidarity organized and managed by insurance institutions, which is supported by a contract between the two parties (Baluch et al., 2011), (Ben-Hur & Weston, 2010).

The purpose of insurance is not limited to reducing the losses to which the individual is exposed, and the consequent provision of safety and stability for the members of society. (Berends et al., 2013)Rather, insurance also has a role in contributing to economic development. One of the most important of these contributions is the provision of financial resources and the development of savings awareness.(Adhikary,2011).

Most of the countries of the world understood the economic and social importance of insurance and worked to develop it by all means, including European countries, and specifically Romania.(Butaci ,2013).

Romania has made some significant changes, including the new solvency to switch from a factor-based solvency framework to a risk-based capital system,

(Dina,2011) consistent market assessment of assets and liabilities, incorporation of strong risk management and corporate governance within insurance companies, increased solvency and retention requirements, and expanded standards on disclosure General and supervisory reporting.(Naghi,2013).

The new risk-oriented solvency framework's primary goals are to enhance beneficiary and policyholder protection, harmonize solvency rules and regulations across the single market, manage risk effectively, and increase financial system stability.(Ciotină,2014).

As a member of the European Union, (Clipici , 2012) Romania has been implementing the new regime's requirements at the insurance company and Financial Supervisory Authority (ASF) levels since the start of 2016. Solvency Standards II's enhanced capital requirements led to a number of reforms and advancements in the insurance industry.

Research question: This study will be reviewed through the following research question: What are the expectations for the rate of economic development after targeted reforms within the insurance sector?

Hypothesis: *There is a positive effect of expectations for the rate of economic development after targeted reforms within the insurance sector during the next ten years after 2022. The paper consists of four sections: introduction, theoretical framework and empirical evidence, issues and methodological data, empirical analysis, and conclusion.*

LITERATURE REVIEW

In the academic literature, the issue of the potential financial impact of the insurance sector in Romania has been analyzed by several researchers.

François (2012) proposed reviewing 85 empirical publications that examined the connections between insurance and growth, or the relationship between insurance and economic development. Most previous studies of the economic significance of the insurance industry focused on the demand side (among other factors influencing demand for insurance, the degree of economic development is an explanatory variable). More recent papers have examined the causal links between insurance and economic development and the role of insurance as an important determinant in the process of economic growth because the role of the insurance sector and its contribution to development is on the agenda of international organizations and because the relationship between financial development and economic growth has been well recognized and emphasized in the field of economic development (François,2012). Ghosh (2013) come to

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agree that financial institutions and financial intermediaries have a role in fostering economic growth by enhancing the effectiveness of capital accumulation, boosting saves, and eventually enhancing economic output. According to recent studies, the creation of jobs, risk aversion, and financial intermediation are all ways that the insurance sector might boost economic growth. The purpose of this study is to determine the connection between India's economic progress and the life insurance business. According to the study, which examined the long-term link between India's life insurance market and economic growth, the country's total economic development benefits from the growth of the life insurance market. This would enable us to better comprehend the effects of the growth of the life insurance market in the post-reform era (Amlan,2013). (Noordhoek et al., 2022), (Outreville, 2013) Note that over the past few decades, the economies of many emerging markets have grown rapidly, lifting millions out of poverty and creating a rising middle class. Insurance is critical to economic development because it enables economic activity by protecting lives, livelihoods, and assets from insurable risks. Additionally serving as a shock absorber for unfavorable circumstances, insurance offers crucial risk reduction services and aids in luring private capital into economies. The incidence of COVID-19, climate change-related occurrences, and other calamities has increased people's awareness of their susceptibility. The fact that insurance penetration in emerging nations is still low is quite concerning for this reason. Financial ruin and poverty (Dennis,2020).

Data

The dataset consists of three inputs: IPD, which measures insurance penetration; ID, which measures insurance intensity; PCGDP, which measures the degree of economic development in Romania, below Figures shows the statistical hash analysis of the input parameters. Some input variables affect the results of the descriptive analysis. The total number of data points for each variable and the analytical parameters used to display the relevant values were included. And due to the nuances, problems of multilinearity will not exist in this case. The input parameter between them greatly influences the output results when there are problems with multilinear communication, resulting in incorrect results.

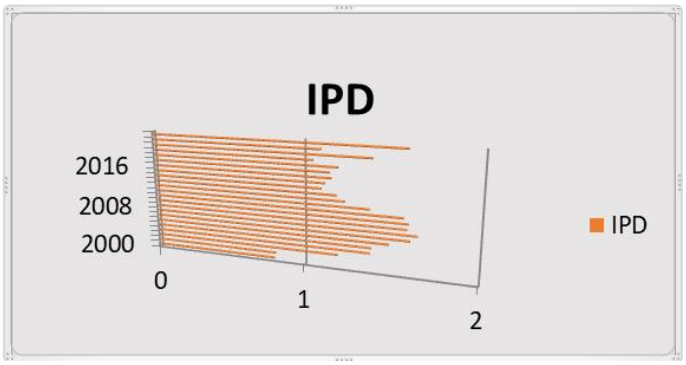

FIGURE1
INSURANCE PENETRATION RATE DISTRIBUTION

From Figure 1, we notice a fluctuation in the insurance penetration rate, as it reached 0.8 in the year 2000. Then it began to gradually increase until the year 2009, when it reached the highest rate of 1.662, and then it began to decline every year, reaching in 2016 a rate of 1.1,

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then it began to rise until the year 2018, reaching 1.2. Then it continued to fluctuate in stability until 2022, reaching 1.6.

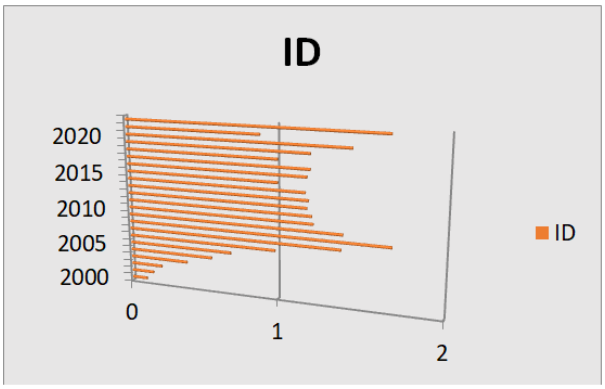

FIGURE2
DISTRIBUTION OF INSURANCE DENSITY RATE

From Figure 2, we notice a fluctuation in the insurance density ratio, as it reached 0.1 in 2000, then began to gradually rise until 2008, when it reached the highest rate of 1.69. Then it started declining every year. year, where in 2016 it reached a rate of 1.18, then it began to rise until 2018 to reach 1. Then the volatility continued to stabilize until 2022, reaching 1.67.

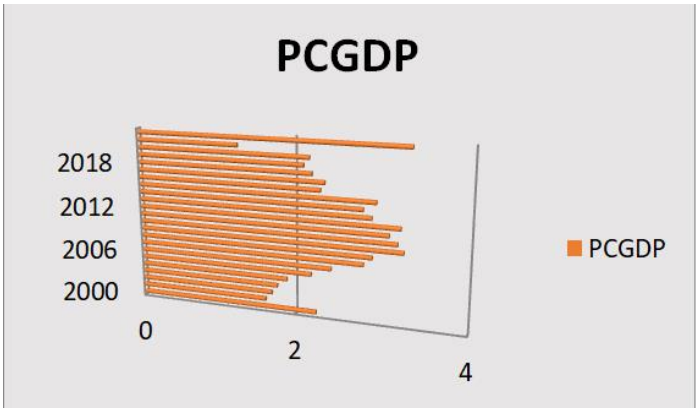

FIGURE3
DISTRIBUTION OF THE GDP RATE

From Figure 3, we notice a fluctuation in the percentage of the GDP rate, as in the year 2000 it was 2.25, then it began to gradually decrease and gradually rise until in 2009 it reached the highest peak of 3.27. Then it began to decline every year, as in 2015it reached a rate of 2.95. Then the volatility continued to stabilize until 2022, reaching 3.34.

Model

First used in neural networks in 1986, an inertial phrase was developed by Babcock and Westervelt. A second-order term is added to the update formula of classic neural networks to create second-order inertial neural networks. Such inclusion of inertial components might result in more complex dynamical behaviors, such as bifurcation and chaos, in the actual use of neural

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networks. Second-order inertial neural networks have been used for a variety of applications during the last ten years, including image recognition, natural language processing, and recommendation systems. In comparison to conventional neural networks.

(Yang & Yang 1996) they have demonstrated that these networks can achieve faster convergence and improved generalization.

As we all know, fractional-order derivatives offer a magnificent method to characterize memory and heredity aspects of diverse processes when compared to integer-order derivatives. Therefore, adopting fractional-order derivatives rather than integer-order ones is more practical and accurate for neural networks. Growing interest has been shown in the past several decades in the analysis of dynamical behavior as well as the existence, one-of-a-kindness, and stability of the equilibrium point of fractional order neural networks. Recent discussions on the many fractional-order neural network stability issues, such as Mittag-Leffler stability, asymptotic stability, and uniform stability.

A particular kind of neural network that combines the ideas of fuzzy logic and fractional calculus is called a fuzzy-order fuzzy cellular neural network (FOFCNN). They have been used in a variety of applications, such as pattern recognition, control systems, and image processing. In order to test global, asymptotic, and finite-time stability for fractional-order fuzzy cellular neural networks, specialist techniques like the fractional Lyapunov method and the Lyapunov function based on fuzzy sets must be used. For instance, employing quaternion-valued fuzzy NNs, the fractional Barbalats lemma, the Riemann-Liouville operator, and the Lyapunov stability theorem.(Kavikumar et al., 2019)

We take into account FOFNINNDs, (Yao et al., 2021) or fractional-order fuzzy neural-type inertial neural networks with delay.

$$ {}^{C}{}_{D^{B}}\left(CD\,BX_{I}\right)(\mathrm{t}) = -ai\,{}^{C}D^{B}{}_{xi}(t) - cixi(t) + \sum_{j=1}^{n} aijf_{j}(\mathrm{x}_{j}(t)) + \sum_{j=1}^{n} bij\mu j + \sum_{j=1}^{n} cijg_{j}(\mathrm{x}_{j}(t-\Gamma) + \overset{n}{\underset{j=1}{\Lambda}}\alpha_{ij} f_{j}\left(xj(t-\Gamma)\right) + \overset{n}{\underset{j=1}{Y}}\beta_{ij} g_{j}\left(xj(t-\Gamma)\right) + I_{i} \quad \text{.....(1)} $$

Let $0 < \alpha < 1$. If $G(t) \in C1[t0, +\infty)$, then

$$ {}^{c}D^{\alpha}\left|G[t]\right| \le \operatorname{sgn}(\mathrm{G(t)})^{c}\, D^{\alpha}\, G(\mathrm{t}) \quad t \ge t_{0} \quad \text{.....(2)} $$

If a nonnegative continuous function $u : [-h, T] \to R$ satisfies the following inequality

$$ {}^{c}D^{\alpha}\mu(t) \le a(t)\mu(t) + b(t)\mu\left(t - p(t)\right) + c(t), \qquad t \ge 0 $$
$$ \mu(\theta) = \vartheta(\theta), \qquad -h \le \theta \le 0, \quad \text{.....(3)} $$

(H1) The functions f j, gj (j = 1, 2, ..., n) are Lipschitz continuous. (Kumar et al., 2021) That is, there exist positive constants F j, Gj such that

$$ \left|f(x) - f_{j}(y)\right| \le F\left|x - y\right|, \quad \left|g_{j}(x) - \mathrm{g}_{j}(y)\right| \le G_{j}\left|x - y\right| \qquad \forall x, y \in R $$

hold. If there exist constants mi (i = 1, 2, ..., n) such that the following inequality holds

$$ m_{i}c_{i} - \sum_{j=1}^{n}\left[m_{j} f_{i}\left(\left|a_{ji}\right| + \left|\alpha_{ji}\right|\right) + m_{j}G_{i}\left(\left|c_{ji}\right| + \left|\beta_{ji}\right|\right)\right] \ge 0, \qquad i = 1, 2....n, \quad \text{.....(4)} $$

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In this study, SVM (Ajeeb et al., 2013)classifiers that reduce classification error by choosing the optimal separating hyperplanes are paired with enhanced feature vectors.(Akbani et al., 2004) Given a labeled feature pair (pf, qf), where pf stands for the feature vector and qf (+1, 1) for the labeled feature.(Alham et al., 2010).

$$class\ of\ \ x = \arg\max_{j\ =_{1.....e}} \left(wt_{j(x)} + b_j \right)$$

The accuracy of the various multiclassification approaches is equivalen

The OAA formulation only assigns a data point to a class if and only if that class has accepted it, and all other classes have not. (Hur ,2010)As a result, when several classes accept it or when all classes reject it, there are unsure areas in the feature space. Vapnik (1998) proposed allocating data points, (Boser et al., 1992), (Casian, 2013) regardless of sign, to the class with the highest value. The class that displayed the greatest output value receives the final label output(Catanzaro et al., 2008), (Ciotina, 2014).

The accuracy of the various multiclassification approaches is equivalen

(Fine & Scheinberg 2001) for appropriate dataset sizes. The best technique must be chosen depending on the situation at hand, (Knerr et al., 1990)the desired precision, and the training and development time objectives.(Kong & Wang 2010).

RESULTS

Inertial neural networks with integer-order delays have been the subject of much research in terms of stability and synchronization up until this point . This study examines fractional-order inertial neural networks with time-varying delays and its finite-time stabilization. It should be noted that a fractional-order inertial neural network becomes an integer-order inertial neural network when = 1. Therefore, a specific example of fractional-order inertial neural networks known as an integer-order inertial neural network may be considered.

Explored a class of BAM fractal neural networks with temporal delays for time-finite Mittag-Leffler synchronization. That the setting period T is for 10 years should be noticed. beginning in the year 2022 We examine the inertial neural network's fixation on time and provide the value of setting time T in this research, which is based on Lemma 1 and the Lyapunov theorem. The findings in this study have a more useful application. On the other hand, our research offers an advancement that exclusively considers the asymptotic and exponential stability of neural networks.

Our conclusions on finite-time stabilization are reached utilizing the Lyapunov direct approach and feedback controller, which are clearer and simpler to ascertain than those drawn from prior work using Halany inequality, the matrix measure method, and linear matrix inequality techniques. The results reached are represented in below Figures.

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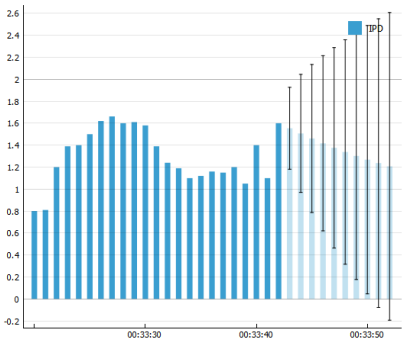

FIGURE4
INSURANCE PENETRATION RATE FORECAST FOR THE PERIOD 2023-2032

From Figure 4, we note that the insurance penetration rate is expected to decrease starting from the end of 2023, and it begins to gradually decrease at a rate of 0.41 for the year, to become negative, as it will reach during the year 2024 a rate of 0.9, and in the year 2025 a rate of 0.8 , 2026 at a rate of 0.61, 2027 at a rate of 0.42, 2028 at a rate of 0.3, in 2029 at a rate of 0.19, in 2030 at a rate of 0.01, in 2031 at a rate of -0.1, in 2032 at a rate of -0.2.

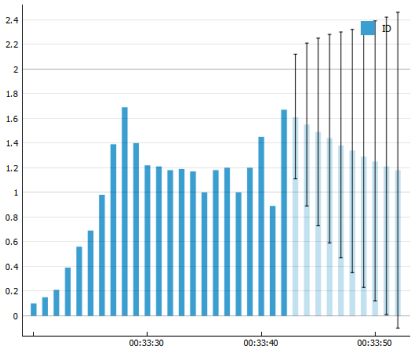

FIGURE 5
INSURANCE INTENSITY RATE FORECAST FOR THE PERIOD 2023-2032

From Figure 5, we notice that the insurance intensity rate is expected to decrease starting from the end of 2023, and it begins to gradually decrease at a rate of 0.42 for the year, to become negative, as it will reach during the year 2024 a rate of 0.9, and in the year 2025 a rate of 0.7 , 2026 at a rate of 0.6, 2027 at a rate of 0.45, 2028 at a rate of 0.38, in 2029 at a rate of 0.21, in 2030 at a rate of 0. 1, in 2031 at a rate of 0, in 2032 at a rate of -0.15.

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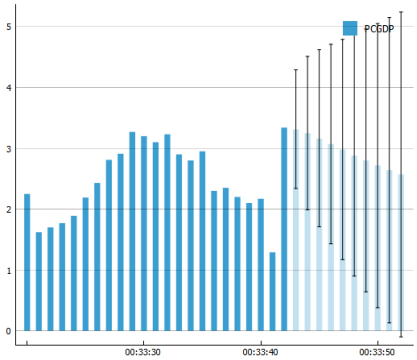

FIGURE 6
GDP RATE FORECAST FOR THE PERIOD 2023-2032

From Figure 6, we notice that the GDP rate is expected to decrease starting from the end of 2023, and it begins to gradually decrease at a rate of 1.06 for the year, to become negative, as it will reach during the year 2024 a rate of 2, and in the year 2025 a rate of 1.8 , 2026 at a rate of 1.5, 2027 at a rate of 1.2, 2028 at a rate of 0.9, in 2029 at a rate of 0.6, in 2030 at a rate of 0.4, in 2031 at a rate of 0.1, in 2032 at a rate of -0.1.

Based on the expectations presented in Figure No. I, the hypothesis identified is rejected, as there is a negative impact of expectations on the rate of economic development after the targeted reforms in the insurance sector during the next ten years after year 2022.

CONCLUSION

Insurance companies make a significant contribution to advancing the wheel of economic development forward through their contribution with the state in its development plans and filling gaps in this field, and in order to play this leading role in the economies of countries, they must continue to maximize their growth in a way that can rise, through continuous development and improvement. In insurance operations and insured risks.

The insurance industry in Romania went through a number of reforms and developments, the most important of which was the specialization of public companies, and then the opening of the sector to private companies, which resulted in the entry of new companies that expanded the scope of competition.

According to our study, predicting the rate of economic development is crucial in the context of adopted reform policies. With Romania rapidly implementing aggressive reform programmes, accurate forecasting of the rate of economic development in the insurance sector is crucial. This is so that the difficulties in the insurance sector can be dealt with properly while also planning for the steady expansion of the economy. It is noted that the evolution of the contribution of the insurance sector to the GDP alternated between growth and decline, and it was the lowest value of the contribution of the insurance sector during the years (2018, 2019, 2020) with a contribution rate of (2.3, 2.1, and 2.17), respectively. The years that recorded the highest levels of this contribution were (2009.2022), where the estimated contribution was (3.27 ,3.34). Despite this progress, especially in recent years, and based on the results of the study, it is expected that the insurance sector's contribution to economic development is still far from equal. It is expected, according to the approved study, that the insurance industry will have the potential to play a negative role in the economic development of Romania, especially in light of concerns about the problems that permeate the insurance sector from internal factors mainly related to

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insurance operations, and other external factors, the most important of which is the absence of an insurance culture.

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Received: 02-Dec-2023, Manuscript No. ASMJ-23-14273; **Editor assigned:** 04-Dec-2023, PreQC No. ASMJ-23-14273;(PQ); **Reviewed:** 18-Dec-2023, QC No. ASMJ-23-14273; **Revised:** 21-Dec-2023, Manuscript No. ASMJ-23-14273(R); **Published:** 28-Dec-2023

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