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Analysis of Health Expenditure and Life Insurance Density in OECD Countries

Ioana Lăzărescu★, Alexandra Eliza Mihailov★★, Alexandrina Brînză★★★

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ABSTRACT

The study analyzes the relationship between life insurance density and the share of health expenditure in GDP for a sample of 22 OECD member countries, for the period 2013–2022. The research starts from the idea that the development of the life insurance market is influenced not only by classical macroeconomic factors, but also by variables that reflect the level of social and institutional development. The empirical analysis uses panel data, with life insurance density as the dependent variable, and the share of government health expenditure in GDP, employment rate, inflation rate and human development index as explanatory variables. In order to identify the most appropriate econometric specification, the Pooled OLS, Fixed Effects Model and Random Effects Model models were compared, based on the Breusch–Pagan, Wald and Hausman tests. The results obtained highlight that the share of health expenditure in GDP has a positive and statistically significant influence on the density of life insurance, the estimated coefficient being 0.251843, at a probability of 0.0000. At the same time, the employment rate has a negative and also statistically significant effect, in the fact that the inflation rate is not significant at the 5% threshold, and the human development index has a positive, borderline significant influence. The results suggest that the development of the life insurance market is associated with both economic performance and the level of social investment.

1. Introduction

Currently, economic predictions are becoming increasingly important in addressing different management models at the company level. The insurance market is one of the most influential at the non-banking financial system level because in addition to the protection component it develops and offers, it also has an important investment component, supporting the pillars of a prosperous economy. At the individual level, life and health insurance offers protection against risks related to a person's physical well-being and death, allowing individuals to better financially manage the situation in the event of these unforeseen events, at the system level, insurance relieves the levers of social intervention in such events. Insurance companies play an important role in the financial sector, and the largest possible volume of insurance premiums compared to the number of inhabitants of a country is, without a doubt, an essential indicator of sustainable economic growth.

The life insurance industry is an integral part of the financial services sector, serving as an important way for countries to mobilize long-term savings, promote the development of capital markets, promote the efficiency of capital allocation, act as an intermediary for banking financial institutions, and also complement certain government security programs. Life insurance, as a concept, comprises two fundamental elements: capital accumulation and financial protection. Capital accumulation policies, represented by savings and investment plans, allow holders to reach a certain level of wealth over an extended period. Through the regular payment of insurance premiums, a fund is ensured on or from which, insurers in turn make investments to generate additional profits. At predetermined times within the contract, such as policy maturity, the occurrence of risk, policyholders gain access to the accumulated funds, often multiplied by the application of interest or investment returns. This form of life insurance allows individuals to proactively allocate resources to achieve future financial goals. Insurance plays a key role in ensuring personal financial security by providing protection through various policies. The extended time horizon of life insurance policies aligns them with the pursuit of sustainable financial goals.

A primary objective of insurance regulation is the solvency of insurance companies (Nguyen & Duong, 2020). Over the past decades, supervisors around the world have sought to strengthen their solvency

★, ★★, ★★★Dunarea de Jos University of Galati, Romania. E-mail addresses: ioanalupasc22@yahoo.com (Corresponding author – I. Lazarescu), elizaalexandramihailov@gmail.com (A. E. Mihailov), brinza.alexandrina00@gmail.com (A. Brinza).

regulatory regimes (Akpan et al., 2022). There has been a gradual shift from compliance-based to principles-based (risk-based) regulation in both developed and emerging markets. In addition to ongoing changes in global insurance regulatory frameworks, many countries have deregulated and liberalized their insurance markets to increase competition (Chandrapal et al., 2022). These reforms have been accompanied by a wave of mergers and acquisitions, mainly in Europe and the US, as well as an increase in cross-border insurance trade.

2. Literature review

Research studies focusing on the links between macroeconomics and the insurance sector are still quite few, as the subject has only recently begun to be addressed, and many of the studies come from various authorities in charge of regulating the insurance sector or ensuring financial stability.

Most OECD countries are facing a phenomenon of increasing healthcare and social security costs in direct proportion to the phenomenon of population aging due to improved quality of life. Based on the study conducted by (Vogel et al., 2017) the three oldest European nations from a demographic point of view were France, Germany and Italy. Population aging and the burden on the pension system are major problems currently faced by the economies of developed countries and these also affect, through contagion, public health spending, accelerating the need to find a long-term balanced solution.

Thus, (Beck & Webb, 2003) closely studied the potential for the development of insurance markets in Central, Eastern and South-Eastern Europe and estimated the growth of insurance premiums by applying a panel regression in which the growth of premiums was explained by the growth of GDP, without taking into account other macroeconomic variables that could have contributed to the development of the insurance market in the region. The coefficient he obtained is 1.51 (i.e. for every percentage point of GDP growth, the insurance market would grow by 1.51 percentage points between the two, there being a strong positive correlation). Also, (Hudson et al., 2016) examine the determinants of life and general insurance premiums for a group of 90 countries in the period 2000-2008. The results of his study show that the insurance density expressed in the growth of insurance premiums is determined by the following factors: per capita income, population size and density, demographic structures, income distribution, size of the public pension system, among the most important. (Eling & Kiesenbauer, 2012) investigates the determinants of gaps in the German life insurance industry for different lines of business. The study was conducted on 133 life insurance companies in the period 1997-2009, (Beck & Webb, 2003). The results of this research confirmed the existence of a strong link between macroeconomic indicators and the evolution of the loss rate, the models used can be applied to forecast the lapse rates of different products. (Bagge et al., 2013) and (Bernheim, 1991)apply a panel regression for 41 countries covering the years 1979-2007 and their study reveals a long-run equilibrium relationship between real GDP and net life insurance premiums, which may have favored the emergence of the heterogeneous country effect. Their results suggest that a 1% increase in net premiums will increase real GDP by 0.06%.

A 2014 study (Brokešová et al., 2014) and (Chui & Kwok, 2009), focusing on the demand for life insurance in the former communist countries and using a data sample ranging from 1995 to 2010, found some results opposite to those in developed Western economies. The risk of unemployment, indebtedness to banks, and increased work rates can lead to health problems. (Hazra et al., 2018) addressed the determinants that influence the cost of healthcare, noting that comorbidities, impairments, and proximity to death are the main variables that increase healthcare costs, especially among the elderly. Similarly, the costs of comorbidity among survivors are generally not related to age, and the additional costs in the last years of a person's life decrease with age.

The relationship between macroeconomics and the insurance sector has recently entered a new phase of analysis. Currently, OECD countries are facing an increase in health and social protection costs, a phenomenon directly fueled by demographic aging. In this context, (Batool et al., 2023) demonstrate a complementary link between public health spending and the demand for life insurance, suggesting that the pressure on public systems accelerates the need for private solutions in the long term.

While the theoretical foundations of insurance demand have been established in the past decades, current research coordinated by (Kozak & Fel, 2024) redefines the determinants of insurance density, highlighting the critical role of digitalization and financial education to the detriment of traditional factors. At the same time, recent studies by (Chen et al., 2025) confirm the persistence of higher risk aversion among women, but highlight a convergence of insurance behaviors in developed economies.

Cumulating all the directions presented and framing them in the current economic context, we can state, without a margin of error, that the development of additional financial funds, either in the form of savings or in the form of life insurance, is more than justified. Nowadays, individuals increasingly feel the need for protection against risks that may affect their life, bodily integrity or their own health or that of their family members.

AUTHORS OF THE STUDIES	YEARS	INDICATORS							
		SSEH	SSEP	P>65	pLI	PIB	Ri	DBO	HDI
Bianchi	2011				„+”	„+”			
Feyen		„+”		„+”	„+”	„+”			
Kiesenbauer	2012				„-”	„-”			
Kiosevski		„+”			„+”	„+”			
Lee	2013				„+”	„+”			
Sliwinski					„+”	„+”	„+”	„+”	
Brokesova	2014				„-”/„„+”			„-”	„+”
Evilia	2015				„+”				„+”
Ertl	2017				„+”				„+”
Vogel, Ludwig and Borsch-Supan		„+”		„+”	„+”				
Hazra, Rudisill and Gulliford	2018		„+”		„+”				
Mare, Dragos, Dragota	2019				„+”	„+”			„+”
Dankiewicz and Simionescu	2020				„-”	„-”			

Figure 1. Summary of most significants studies

Source: Data processed by the author based on the specialized literature

Based on the literature reviewed, it is observed that the relationship between macroeconomic variables and life insurance demand is complex and dependent on the specifics of the sample, which justifies separate testing of the relationship between SSEH and life insurance density for OECD countries.

3. Methodology

The research is conducted on a sample of 22 OECD member countries, which nevertheless makes it admissible for the application of regression, since the number of countries represents more than 50% of the total OECD statistical population of 38 countries.

The countries that constitute the final study sample are: Australia, Austria, Belgium, Czech Republic, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Israel, Italy, South Korea (Korea), Latvia, Lithuania, Netherlands, Poland, Portugal, Slovenia, Spain and Turkey. The values of the indicators analyzed for the 22 countries cover a period of 10 years, between 2013 and 2022.

The variables used in the econometric analysis are the following: the dependent variable was the life insurance density (ρLI), and the following indicators were chosen as determinants used to identify the influences of the social environment on the density of insurance premiums: the rate of government health expenditure as a share of GDP, the employment rate, the inflation rate and the human development index.

Table 3. Description of variables included in the econometric model

Variable	Symbol	Type	Description
Life insurance density	ρLI	Dependent	Average per capita expenditure on life insurance
Health expenditure as a share of GDP	SSEH	Independent	Share of government health expenditure in gross domestic product
Employment rate	ROFM	Independent	Indicator reflecting labour market dynamics
Inflation rate	RI	Independent	Indicator capturing the general increase in consumer prices
Human Development Index	HDI	Independent	Composite indicator reflecting the level of human development

Source: Author's own processing based on Eurostat, OECD, WHO, and national statistical sources

To complement the information presented in Table 1, Figure 2 provides a descriptive overview of the annual average evolution of the two main variables of interest, namely life insurance density and health expenditure as a share of GDP, over the period 2013–2022.

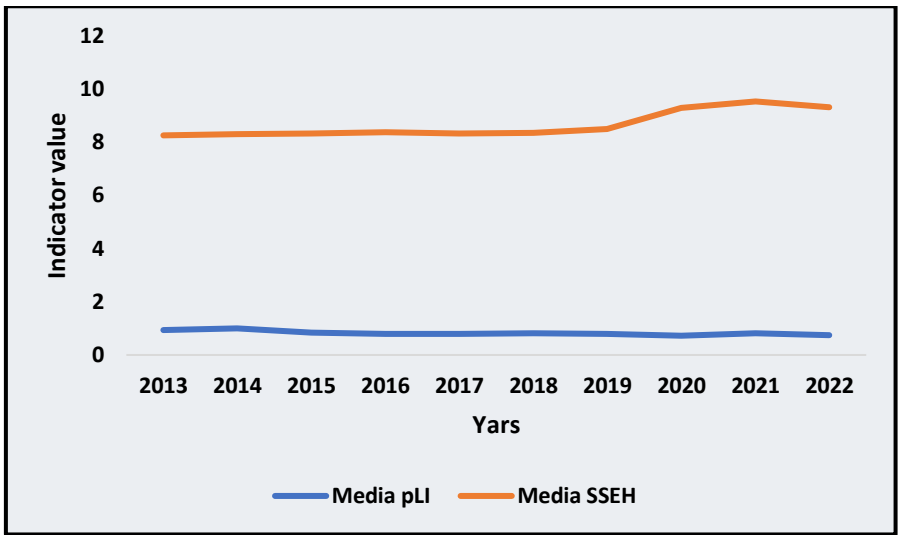

Figure 2. Annual average evolution of life insurance density (ρLI) and health expenditure as a share of GDP (SSEH)

Source: Author's own processing based on statistical data

Figure 2 shows the evolution of the annual averages for life insurance density (ρLI) and for the share of health expenditure in GDP (SSEH) over the sampling period.

3.1 Research hypotheses

Starting from the sample data, the association between the independent variable SSEH and the dependent variable ρLI was analyzed, in other words, whether there is an association between the share of health expenditure in GDP and life insurance density, whether the increase or decrease in the values of these variables can be associated with the increase or decrease in life insurance density.

We predict that SSEH has a positive influence on pLI and we want to find out if this will be confirmed following linear regression.

H1: Health expenditure as a share of GDP significantly influences life insurance density.

H2: The influence of SSEH on life insurance density is positive.

H3: The selected macroeconomic variables explain the variation in life insurance density in OECD countries in a relevant way.

4. Results and discussions

Following the parameterization of the model with the least squares method, the equation representing the shape of the study model at the level of all independent variables considered was obtained.

$$\rho LI(i,j) = \beta 0 + \beta 1\ SSEH(i,j) + \beta 2\ R_{ofm}(i,j) + \beta 3\ R_i(i,j) + \beta 4\ HDI(i,j) + \varepsilon \qquad (1)$$

βn = Coefficient or Predictor; n ∈ [1 , 10] ∈ ℕ.

β0 = Intercept or Constant; This constant must be added to the relationship for two reasons:

If all variables were to take the value 0, if β0 were not introduced, then it would be assumed that the predicted value of the mean of ρLI is 0, which cannot be true.

Considering that the model makes a prediction, the lack of β0 would generate a statistical interference (bias), a situation that must be avoided.

ε = Errors. Error is a term that defines a residual variable produced by a model, which can be statistical or mathematical. This variable is formed when the model does not fully represent the real relationship between the independent variables and the dependent variables, resulting in an incomplete relationship. As a result, the error term (or residual) is the value by which the equation can differ during the empirical analysis.

i = Country; i ∈ [1 , 22] ∈ ℕ

j = Year; j ∈ [1 , 10] ∈ ℕ

The proposed model has the following form:

Table 4. Results of the proposed econometric model

Dependent variable	ρLI			
Time period = j	2013-2022			
Included cross-sections= i	22			
Total observations	220			
Independent variables	**Coefficient**	**Std. Error**	**t-Statistic**	**p-value**
C	0,006744	0,566272	0,011910	0,9905
SSEH	0,251843	0,022412	11,23712	0,0000
ROFM	-0,036806	0,005002	-7,358813	0,0000
RI	-0,011195	0,006492	-1,724433	0,0861
HDI	1,303709	0,653647	1,994515	0,0474
R^2	0,460222			
Adj R^2	0,450179			
P(F-statistic)	0,000000			
Akaike info criterion (AIC)	1,711557			
Schwartz criterion	1,788685			
Durbin-Watson stat (DW)	0,186831			

Source: Author's own processing based on EViews 12 Student Lite results

From the data obtained, we can see that the Durbin-Watson statistic value is close to the threshold of 0.18, which indicates a positive correlation because it tends to zero and shows that it could be an autocorrelation due to problems related to a temporal factor.

At the same time, the Durbin-Watson statistical analyses the correlation in the model only with a lag (t-1) behind, without going further into the past to detect the phenomenon.

The method of detecting how many lags should be analyzed for autocorrelation is the correlogram, which shows us a higher correlation at a lag, meaning that the effects of the previous year are felt in the current year and as a result we should introduce a lag(-1) variable for ρLI, in order to isolate this effect.

Thus, the model will become:

$\ln\rho LI_{-1}$ = The lag variable of the life insurance density; this variable is necessary to isolate the lagged effect of the explanatory variable SSEH on the dependent variable ρLI.

$$\ln\rho LI_{(i,j)} = \beta_0 + \beta_1 SSEH_{(i,j)} + \beta_2 Rofm_{(i,j)} + \beta_3 Ri_{(i,j)} + \beta_4 HDI_{(i,j)} + \beta_{11} \ln\rho LI_{-1(i,j)} + \varepsilon \quad (2)$$

To analyze the panel data obtained from the statistical sample processing, it is necessary to determine the optimal method among the three proposed, namely:

- Pooled OLS (POLS)
- Fixed Effects Model (FEM)
- Random Effects Model (REM)

Table 3. Model selection for panel data estimation

Specification	Reported statistic	Value	Interpretation	Final status
Pooled OLS	Adjusted R^2	0.450179	Baseline model with moderate explanatory power	Benchmark model
Pooled OLS	AIC	1.711557	Inferior fit compared with alternative panel specifications	Not retained
Pooled OLS	Durbin–Watson	0.186831	Suggests autocorrelation issues	Limitation noted
FEM (cross-section)	AIC	-0.534593	Better fit than pooled OLS	Competitive alternative
FEM (period effects)	AIC	1.736406	Weaker specification	Rejected
FEM (combined effects)	AIC	-0.626998	Good fit according to AIC	Not retained in final analysis
REM	Durbin–Watson	0.042366	Estimated and compared with FEM	Candidate final model

Specification	Reported statistic	Value	Interpretation	Final status
Breusch–Pagan test	p-value	> 0.05	Used to assess random effects	Intermediate diagnostic
Wald test	p-value	> 0.05 (as reported)	Used to assess fixed effects relevance	Intermediate diagnostic
Hausman test	p-value	0.0000	Used to choose between FEM and REM	**REM selected**

Source: Author's own processing based on EViews 12 Student Lite results.

Table 3 summarizes the results of the econometric model selection process used for the panel data analysis. The estimation started from the Pooled OLS specification, considered as the base model, after which the fixed-effects and random-effects models were tested. The comparison of model specifications indicates that the pooled model is limited in its ability to account for cross-country heterogeneity within the sample, whereas panel data models provide a more appropriate representation of the relationship under investigation.

Based on model selection criteria and statistical testing, the fixed-effects model (FEM) emerged as a viable alternative, supported in part by favorable Akaike Information Criterion (AIC) values for certain specifications. However, the results of the Hausman test, which is commonly used to distinguish between fixed-effects and random-effects models, ultimately supported the selection of the random-effects model (REM) as the preferred specification. Consequently, the interpretation of the empirical results is based on the REM model.

In addition, the results associated with the Hausman test suggest that the SSEH variable retains a high level of statistical significance in relation to life insurance density, which supports its inclusion as the main determinant in the final analysis.

Table 4. Results of the proposed econometric model

Variable	Coefficient	Std. Error	t-Statistic	p-value
C	0.006744	0.566272	0.011910	0.9905
SSEH	0.251843	0.022412	11.23712	0.0000
ROFM	-0.036806	0.005002	-7.358813	0.0000
RI	-0.011195	0.006492	-1.724433	0.0861
HDI	1.303709	0.653647	1.994515	0.0474

Model diagnostics	
Indicator	**Value**
R^2	0.460222
Adjusted R^2	0.450179
Prob(F-statistic)	0.000000
Akaike info criterion (AIC)	1.711557
Durbin–Watson statistic	0.186831

Source: Author's own processing based on EViews 12 Student Lite results.

Table 4 reports the estimation results of the proposed econometric model and provides empirical evidence on the relationship between life insurance density and the selected macroeconomic variables for the OECD sample. The results indicate that health expenditure as a share of GDP (SSEH) has a positive and highly statistically significant effect on life insurance density, as reflected by the estimated coefficient of 0.251843 and the associated p-value of 0.0000. This finding suggests that countries allocating a higher share of national output to health expenditure also tend to display a higher level of life insurance density. From an economic perspective, this result may reflect the fact that greater social investment is associated with more developed institutional environments, higher awareness of long-term risk protection, and a stronger demand for private financial protection instruments.

At the same time, the employment rate (ROFM) records a negative and statistically significant coefficient of -0.036806, with a p-value of 0.0000. Although this result may seem counterintuitive at first glance, it suggests that the link between labor market conditions and life insurance demand is not necessarily linear and may be shaped by broader structural factors, such as income distribution, public welfare mechanisms, or substitution effects between public and private protection systems. In contrast, the inflation rate (RI) has a

negative coefficient of -0.011195, but its p-value of 0.0861 indicates that it is not statistically significant at the conventional 5% threshold. The empirical findings indicate that inflation does not constitute a reliable determinant of life insurance density within the examined sample. By contrast, the Human Development Index (HDI) is associated with a positive effect (β = 1.3037) and reaches marginal statistical significance, as reflected by a p-value of .047. This result supports the idea that higher levels of human development are associated with a stronger life insurance market, likely because more developed societies exhibit better education, higher life expectancy, and a greater propensity to use long-term financial planning instruments. The positive sign of HDI is therefore consistent with the broader theoretical expectation that social and economic development stimulate the demand for life insurance.

In addition to the individual coefficients, the diagnostic indicators confirm the overall relevance of the estimated model. The value of R^2 = 0.460222 and Adjusted R^2 = 0.450179 shows that the explanatory variables included in the model account for approximately 46% of the variation in life insurance density across the selected countries and time. Moreover, the Prob(F-statistic) = 0.000000 confirms that the model is globally significant, meaning that the explanatory variables jointly contribute to explaining the dependent variable. However, the relatively low Durbin–Watson statistic (0.186831) may indicate the presence of autocorrelation, suggesting that the results should be interpreted with caution and that future research could benefit from dynamic panel specifications. Overall, the evidence supports the central argument of the paper, namely that life insurance density is influenced not only by standard macroeconomic indicators, but also by variables reflecting social expenditure and human development.

5. Conclusions

This study set out to examine the relationship between life insurance density and health expenditure as a share of GDP in a sample of 22 OECD countries over the period 2013–2022. This topic holds particular importance from an economic standpoint, as life insurance density reflects not only the level of development of the non-banking financial sector but also households´ capacity and willingness to participate in long-term financial protection and savings activities. At the same time, health expenditure as a share of GDP reflects the social and institutional commitment of an economy to human capital, welfare provision, and risk management. Against this background, the paper aimed to assess whether the expansion of life insurance markets is associated with broader patterns of social investment and human development.

The empirical findings provide clear support for the central argument of the paper. Health expenditure as a share of GDP (SSEH) emerges as a positive and highly statistically significant of life insurance density, with an estimated coefficient of 0.251843 and a p-value of 0.0000. This result suggests that, within the OECD sample, higher public commitment to health spending is associated with stronger development of life insurance markets. Economically, this may indicate that countries characterized by greater social investment also tend to exhibit more mature institutional environments, higher awareness of long-term financial risks, and a stronger demand for private protection instruments. In this sense, the findings point to a complementary rather than substitutive relationship between public social expenditure and private financial protection.

The results also reveal that the employment rate (ROFM) has a negative and statistically significant coefficient (-0.036806; p-value = 0.0000), suggesting that the relationship between labor market conditions and life insurance demand is more nuanced than a simple positive linear association. This may reflect structural differences across countries in terms of labor market composition, income distribution, social protection mechanisms, or the relative importance of private versus public welfare arrangements. By contrast, the inflation rate (RI) records a negative coefficient (-0.011195), but does not reach statistical significance at the conventional 5% level (p-value = 0.0861), indicating that inflation is not a robust explanatory factor in the present specification. The Human Development Index (HDI), on the other hand, displays a positive and marginally significant effect (coefficient = 1.303709; p-value = 0.0474), confirming that broader human dev elopment conditions remain relevant for the expansion of life insurance markets.

From the perspective of overall model performance, the estimated specification shows moderate but meaningful explanatory power. The value of R^2 = 0.460222 and Adjusted R^2 = 0.450179 indicates that approximately 46% of the variation in life insurance density is explained by the selected explanatory variables, while the Prob(F-statistic) of 0.000000 confirms the joint statistical significance of the model. These results suggest that life insurance density is shaped by a combination of macroeconomic and social factors, rather than by purely financial variables alone. At the same time, the low Durbin–Watson statistic (0.186831) points to possible autocorrelation, which should be considered when interpreting the findings and motivates further extensions of the analysis.

An additional contribution of the study lies in its model selection strategy. By comparing Pooled OLS, Fixed Effects, and Random Effects specifications and relying on the Breusch–Pagan, Wald, and Hausman tests, the analysis sought to identify the most appropriate econometric framework for the panel structure of the data. Although some fixed-effects specifications performed favorably according to selected information criteria, the final analysis retained the Random Effects Model as the preferred specification, in line with the interpretation reported in the study. This strengthens the empirical framework of the paper and supports the robustness of the main conclusion concerning the role of health expenditure in explaining life insurance density.

Overall, the findings support the view that the development of life insurance markets should be understood within a broader socio-economic context. A higher share of health expenditure in GDP appears to be associated not only with stronger public investment in welfare, but also with economic environments in which households are more likely to adopt long-term financial protection strategies. The paper therefore contributes to the literature by showing that life insurance demand is linked not only to conventional macroeconomic indicators, but also to variables reflecting social investment and human development.

At the same time, several limitations should be acknowledged. The analysis is restricted to 22 OECD countries and to the period 2013–2022, which may limit the generalizability of the results beyond the selected sample. In addition, the exclusion of certain countries due to missing data or extreme values may have influenced the structure of the estimated relationships. Future research could address these limitations by extending the sample, incorporating additional institutional or demographic variables, and testing dynamic panel models capable of capturing persistence effects in life insurance density over time.

In conclusion, the results obtained indicate that health expenditure, as a percentage of GDP, is a relevant and statistically significant determinant of life insurance density in OECD countries. This finding reinforces the idea that the development of life insurance markets is integrated into broader processes of social, institutional and human development. We argue that the paper provides both an empirical contribution to literature and a broader economic argument in favor of integrated approaches that link social investment, public health spending and private financial protection.

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