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Depth, Not Size: Rethinking the Insurance–Income Nexus in Mature OECD Markets

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Abstract

This study examines the relationship between insurance market development and economic performance measured by GDP per capita levels in mature OECD economies, focusing on whether insurance depth, market size, and life insurance structure have distinct long-run implications. Although the insurance–income nexus is documented in developed and emerging markets, the literature rarely separates the qualitative depth of insurance use from the mechanical size of the sector relative to GDP, and seldom examines life insurance structural features such as retention and foreign participation within a non-stationary panel framework; this study addresses that gap. Using a balanced panel of 33 OECD countries from 2011 to 2021, the analysis applies panel time-series methods that account for non-stationarity, cointegration, cross-sectional dependence, and heterogeneous country dynamics. The results show that total insurance density is positively associated with GDP per capita, and life insurance density remains positive and significant across the long-run estimators, suggesting that more intensive insurance use remains economically relevant even in advanced financial systems. By contrast, life insurance penetration is negatively associated with GDP per capita, even after accounting for its mechanical link to GDP. Life insurance retention also enters negatively, while foreign insurer participation shows no statistically significant association in the panel. The findings support a depth-not-size interpretation of the long-run association between insurance market structure and income levels in mature OECD markets, and suggest that policy attention should shift from expanding insurance-sector scale toward improving efficiency, risk allocation, and market sophistication. These results reflect long-run associations within the OECD panel and should not be interpreted as evidence of direct causal effects.

Keywords: insurance development; economic performance; GDP per capita; life insurance; insurance density; insurance penetration; OECD countries

JEL Classification: G22; O16; O40; C23; C33; E44

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1. Introduction

Insurance markets play a central role in modern economies by facilitating risk transfer, mobilising long-term savings, and enhancing financial stability. Through these channels, insurance activity can support investment and smooth consumption, thereby contributing to higher income levels (Islam et al., 2025). Accordingly, the relationship between insurance market development and economic performance has attracted sustained attention within the broader finance-growth literature (Saleh et al., 2023; Garcia & Atienza, 2026). However, empirical findings remain far from uniform, particularly when the focus shifts from emerging economies to advanced, institutionally mature countries. Early empirical studies typically report a positive association between insurance development and economic growth, interpreting insurance expansion as a complementary component of financial deepening alongside banking systems and capital markets (Loubergé & Dionne, 2025; Ward & Zurbruegg, 2000). More recent evidence, however, suggests that this relationship is context-dependent, varying with levels of economic development, institutional quality, and market maturity (Shojaei & Almansour, 2025; Shojaei, 2021; Blokhin, 2019). The channels through which insurance shapes long-run income operate at several levels. Greater insurance density mobilises household and corporate savings into long-term investable funds, improves the efficiency of capital allocation by pricing and transferring risk, and stabilises consumption and investment after adverse shocks (Asongu & Odhiambo, 2020). Life insurance, in particular, channels contractual savings into capital markets and infrastructure, while retention and reinsurance arrangements determine how efficiently long-term risks are diversified internationally (Emara et al., 2026). Penetration and market size, by contrast, may reflect demographic and regulatory pressures rather than productive intermediation (Magbondé et al., 2025). These distinctions motivate disaggregating insurance development into depth, size, and structure.

In advanced economies, where financial systems are already well-developed, further expansion of insurance markets may not translate into proportional gains in economic growth. The OECD setting provides a particularly relevant context to examine this issue, as OECD countries are characterised by high insurance penetration, sophisticated regulatory frameworks, extensive reinsurance networks, and substantial foreign insurer participation (Dawd & Benlagha, 2023). In such environments, insurance markets are less likely to function primarily as drivers of financial deepening and may instead operate as mechanisms for risk redistribution, capital allocation, and efficiency optimisation (Hu & Wang, 2024).

Several research gaps follow from this observation. First, insurance density and penetration are frequently used interchangeably as proxies for insurance development, despite capturing conceptually distinct dimensions of insurance activity (Hasan et al., 2025). Density reflects the intensity of insurance usage, whereas penetration measures the relative scale of the sector within the economy. Second, the literature remains heavily focused on total insurance markets, with comparatively limited attention to life insurance (Horvey & Odei-Mensah, 2025). Third, structural characteristics of insurance markets such as retention ratios and foreign insurer participation are often overlooked. Finally, much of the OECD-focused evidence has been produced within in-level fixed-effects frameworks that do not formally examine the stochastic properties of the underlying variables, raising the well-documented risk of spurious inference (Petrova, 2020; Rodriguez Gonzalez et al., 2022).

Against this backdrop, the present study examines the relationship between insurance market development and economic performance measured by GDP per capita levels using a balanced panel of 33 OECD countries over the period 2011–2021. Rather than treating insurance development as a single aggregate concept, the analysis distinguishes between insurance depth, market size, and structural characteristics, with particular emphasis on life insurance. Given the persistence of macroeconomic and insurance-market variables, the empirical strategy is based on panel time-series methods that test for unit roots, cross-sectional dependence, and cointegration before estimating the long-run relationship between insurance development and GDP per capita. This approach allows the study to examine whether insurance density, penetration, retention, and foreign insurer participation have distinct long-run associations with GDP per capita levels in mature OECD markets. The study is guided by three research questions. First, does insurance market development sustain a stable long-run relationship with GDP per capita levels in OECD countries? Second, do different dimensions of insurance development—particularly density versus penetration—display distinct long-run associations in advanced economies? Third, how do life insurance market structure and risk-sharing mechanisms, including retention and foreign participation, shape the long-run insurance–income relationship? The paper contributes to the literature by providing OECD-specific evidence based on a panel time-series framework, by disaggregating insurance development across depth, size and structure, and by framing the findings as long-run associations rather than causal effects.

2. Literature Review and Hypothesis Development

2.1. Theoretical Foundations

The relationship between insurance markets and economic growth is commonly framed within theories of financial intermediation and risk management. Insurance institutions contribute to economic performance by reducing uncertainty, facilitating risk pooling, and enabling households and firms to undertake higher-return but riskier activities (Gbadebo, 2024). By transferring idiosyncratic and systemic risks away from economic agents, insurance markets support capital accumulation and long-term planning, thereby complementing banking systems and capital markets. From the perspective of endogenous growth theory, financial institutions enhance economic growth by mobilising savings, improving capital allocation, and supporting productivity-enhancing investment (Michael & Izedomi, 2025). Within this framework, insurance plays a distinct role by managing non-financial risks that are not efficiently absorbed by traditional financial intermediaries. Life insurance, in particular, is associated with long-term savings mobilisation and the channelling of contractual funds into capital markets and infrastructure investment (Emara et al., 2026). At the same time, theoretical contributions emphasise that the benefits of financial deepening may not increase indefinitely. As financial systems mature, additional expansion can introduce complexity, agency problems, and potential misallocation of resources, thereby weakening the finance–growth relationship (Arcand et al., 2015).

2.2. Insurance Market Development in Advanced Economies: Empirical Evidence

Empirical research on the insurance–income nexus provides mixed evidence (Islam et al., 2025; Lee et al., 2016). Early cross-country studies generally report a positive relationship between insurance development and economic growth, interpreting insurance expansion as a driver of financial deepening (Han et al., 2010; Haiss & Sümegi, 2008). However, these studies typically pool developed and developing economies, implicitly assuming homogeneous effects across institutional contexts. More recent evidence challenges this assumption. Systematic reviews indicate that the positive association between insurance activity and economic growth is stronger in emerging and developing economies than in high-income countries (Horvey & Odei-Mensah, 2025; Singhal et al., 2022). In OECD economies, several studies document weaker or context-dependent relationships, suggesting that insurance markets may play a different role once a high level of financial maturity is reached (Dawd & Benlagha, 2023; Apergis & Poufinas, 2020; Ward & Zurbruegg, 2000).

2.3. Insurance Density and GDP per Capita Levels

Insurance density, measured as premiums per capita, reflects the intensity of insurance usage within an economy. Unlike penetration, density is less sensitive to fluctuations in aggregate GDP and therefore provides a more direct indication of how extensively households and firms utilise insurance services (Emara et al., 2026). Higher insurance density is theoretically associated with improved risk management, broader financial inclusion, and enhanced economic stability (Yap et al., 2024). Empirical evidence generally supports a positive relationship between insurance density and economic growth, particularly in contexts where insurance markets are expanding or becoming more sophisticated (Arena, 2008; Fernando et al., 2023). Even in advanced economies, increases in insurance usage may reflect qualitative improvements in coverage, product design, and risk diversification rather than simple expansion in market size (Outreville, 2013). Accordingly, the first hypothesis focuses on the depth of insurance usage:

H1. *Higher total insurance density is positively associated with GDP per capita levels in the long run.*

Given the specific role of life insurance in mobilising long-term savings and supporting capital formation, the depth of life insurance usage may exert a distinct influence on economic outcomes (Hu & Wang, 2024; Munmun et al., 2026). Unlike non-life insurance, which is mainly associated with short-term risk protection, life insurance combines risk transfer with long-term saving and investment functions. Higher life insurance density may therefore reflect greater household participation in long-term financial planning, intertemporal consumption smoothing, and the accumulation of contractual savings that can be channelled into capital markets. Accordingly, the second hypothesis is proposed as follows:

H2. *Higher life insurance density is positively associated with GDP per capita levels in the long run.*

2.4. Insurance Penetration, Market Maturity, and Diminishing Returns

Insurance penetration, defined as premiums relative to GDP, measures the size of the insurance sector in relation to the overall economy. While widely used, its interpretation in advanced economies is less straightforward. In mature markets, high penetration ratios may reflect demographic structures, regulatory requirements, or relatively slow GDP growth rather than efficiency-enhancing expansion of insurance services (Haward, 2024). This concern is particularly relevant for life insurance, where demand is strongly influenced by ageing populations, pension systems, and long-term savings behaviour. From a theoretical perspective, once insurance markets reach a high level of development, further expansion may generate administrative complexity, regulatory burdens, or allocative inefficiencies, reducing its marginal contribution to economic growth (Magbondé et al., 2025; Shojaei, 2024). In life insurance markets, this effect may be reinforced by long-term liabilities and conservative investment strategies that limit productive capital allocation (Haiss & Sümegi, 2008; Munmun et al., 2026). Empirical evidence also suggests that the growth effects of life insurance weaken as markets mature (Arena, 2008). Accordingly, the following hypothesis is proposed:

H3. *Higher life insurance penetration is negatively associated with GDP per capita levels in the long run.*

2.5. Life Insurance Market Structure and Risk-Sharing Mechanisms

Beyond market size and usage intensity, the structural configuration of life insurance markets plays a critical role in shaping their association with GDP per capita levels. Life insurance contracts are inherently long-term, exposing insurers to longevity, interest-rate, and systemic risks that are typically managed through reinsurance and international risk-sharing arrangements (Meier & Outreville, 2010). Structural indicators such as the retention ratio and foreign insurer participation are therefore central to understanding how life insurance markets function in advanced economies. The life insurance retention ratio, defined as the share of premiums retained domestically rather than ceded to reinsurers, reflects the extent to which risk is diversified internationally. In advanced economies with well-developed reinsurance markets, lower retention may enhance capital efficiency and financial resilience by spreading long-term risks across global markets. Conversely, higher retention may increase exposure to concentrated risks, although this may also reflect factors such as domestic reinsurance capacity, regulatory frameworks, or market preferences (Balbás et al., 2013). Despite its theoretical relevance, retention has received limited empirical attention in the insurance–income literature. In mature life insurance systems, higher retention may be associated with structural constraints or institutional arrangements that influence risk allocation, rather than purely reflecting productive capacity (Wang et al., 2025). Given these considerations, the following hypothesis is proposed:

H4. *Higher life insurance retention is negatively associated with GDP per capita levels in the long run.*

Another important structural dimension is foreign insurer participation. Life insurance relies heavily on actuarial expertise, asset–liability management, long-term investment capability, and regulatory compliance. Foreign insurers may enhance market efficiency by introducing advanced underwriting practices, governance standards, product innovation, and competitive pressure (Huang et al., 2012; Srbinoski et al., 2024). These channels suggest that foreign participation can support more efficient insurance intermediation and potentially strengthen the contribution of life insurance markets to economic growth. However, in OECD markets, where domestic insurers already operate within advanced regulatory and supervisory frameworks, the marginal impact of foreign participation may be more limited than in less developed insurance systems (Rahma et al., 2025). Accordingly, while theoretical arguments suggest a positive effect, the empirical impact of foreign participation in mature markets remains uncertain. Hence, the following hypothesis is articulated as

H5. *Higher foreign insurers' market share in life insurance is positively associated with GDP per capita levels in the long run.*

Figure 1 summarises the conceptual framework, linking each insurance dimension to GDP per capita with the hypothesised direction of association.

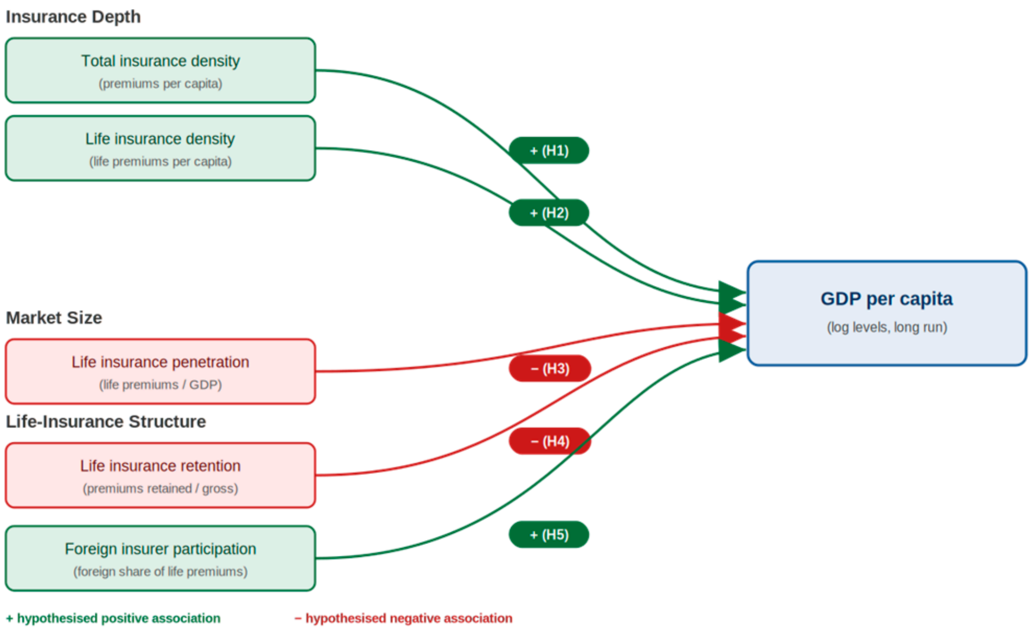

Figure 1. Conceptual framework of the insurance–income relationship.

3. Data and Methodology

3.1. Data

The empirical analysis is based on a balanced panel dataset covering 33 OECD countries over the period 2011–2021. All insurance market data and macroeconomic indicators are obtained from publicly available international databases, ensuring transparency and replicability (OECD, 2024; World Bank, 2024). Appendix A reports the list of countries included in the analysis. The sample period is primarily determined by data availability and consistency across insurance indicators, particularly for life insurance retention and foreign participation, which are not consistently available prior to 2011 for all OECD members. Restricting the sample to 2011–2021 ensures a balanced panel and avoids biases associated with missing observations. A small number of missing observations (under 2% of total cells, concentrated in the foreign-participation series) were addressed by linear interpolation within each country; countries with gaps exceeding two consecutive years for any core variable were excluded to preserve the balanced structure. The resulting time dimension of T = 11 is at the lower end of what second-generation panel estimators such as CCEMG and AMG typically require for reliable inference. Monte Carlo evidence in Pesaran (2006) and Eberhardt and Bond (2009) indicates that these estimators remain approximately unbiased at T = 10–15 when N is moderate, though standard errors widen and significance levels should be interpreted conservatively. This small-T constraint is acknowledged throughout and reinforces the framing of all results as long-run associations rather than precise causal estimates.

3.2. Variable Definitions and Measurement

Economic performance is proxied by GDP per capita, expressed in natural logarithms. This transformation reduces skewness (Matusiewicz, 2025). Where variables are transformed as ln(GDPpc), the estimated coefficients represent standard elasticities. Where variables are transformed as ln(1 + x), the coefficients represent pseudo-elasticities: the exact marginal effect of a one-unit increase in x on ln(GDPpc) is $\beta \times [1/(1 + \overline{x})]$, where $\overline{x}$ is the sample mean of x. Calculated marginal effects at the sample mean are reported alongside the coefficient estimates. Insurance market development is captured along multiple dimensions: insurance density reflects the intensity of insurance usage, while insurance penetration captures the size of the insurance sector relative to the overall economy. For life insurance markets, two structural variables are incorporated: the retention ratio and foreign insurers' market share. Within-market controls include the claims ratio, the expense ratio, and insurance market total assets. To reduce omitted variable bias, the vector X_{it} in Equation (1) is extended to include standard macroeconomic controls drawn from the World Bank World Development Indicators: gross capital formation (% of GDP), capturing physical investment; trade openness (exports plus imports as % of GDP); inflation (annual CPI growth rate); and following the literature (Eldomiaty et al., 2026) an institutional quality index (the average of the six World Governance Indicators: voice and accountability, political stability, government effectiveness, regulatory quality, rule of law, and control of corruption). For the life insurance specifications, two additional controls are included: the old-age dependency ratio (population aged 65+ as % of working-age population), which captures demographic pressure on life insurance demand and GDP growth simultaneously, and a financial development index (IMF Financial Development Index), which separates the contribution of insurance markets from that of the broader financial system. All monetary and ratio variables are obtained for the same 33-country, 2011–2021 balanced panel. These controls are included in all specifications. All scale variables are transformed using natural logarithms; where zero values may arise, the transformation ln(1 + x) is applied. Insurance density is expressed in current USD per capita sourced from OECD Insurance Statistics;

all monetary values are converted to USD using period-average exchange rates and are expressed in nominal terms, consistent with the use of nominal GDP per capita from the World Bank. No purchasing power parity (PPP) adjustment is applied to insurance density, as cross-country price-level comparisons are not the focus of the analysis; sensitivity to PPP-adjusted values is noted as a direction for future work. The econometric analyses are conducted using R (version 4.3.2). Table 1 summarises the operational definition and measurement unit for each variable.

Table 1. Variable definitions and measurement.

Variable	**Definition**	**Unit**
Dependent Variable		
GDP per capita	Gross domestic product divided by population, natural log	USD, ln
Independent Variables		
Total insurance density	Total premiums per capita	USD per capita, ln(1 + x)
Life insurance penetration	Life premiums/GDP	%, ln(1 + x)
Life insurance retention	Premiums retained/gross premiums	%
Foreign insurers' share	Foreign-owned insurer premiums/total life premiums	%
Control Variables		
Claims ratio	Claims paid/premiums earned	%
Expense ratio	Operating expenses/premiums	%
Insurance market total assets	Total assets of insurance sector	USD, ln
Gross capital formation	Gross fixed capital formation/GDP	%
Trade openness	(Exports + imports)/GDP	%
Inflation	Annual change in consumer price index	%
Institutional quality	Average of six World Governance Indicators	Index
Old-age dependency	Population 65+/working-age population	%
Financial development	IMF Financial Development Index	Index

3.3. Econometric Strategy

The empirical strategy is designed to account for the time-series properties of macro-panel data. GDP per capita and insurance-market indicators are likely to be persistent over time. However, estimating relationships among persistent variables in levels without testing for unit roots and cointegration may lead to misleading inference, particularly in panel settings where conventional regression statistics can be affected by spurious relationships among non-stationary variables (Kao, 1999). The analysis therefore first examines whether the variables are non-stationary, whether the panel exhibits cross-sectional dependence, and whether a stable long-run relationship exists between insurance development and GDP per capita. Conditional on these diagnostics, the long-run relationship is estimated using panel cointegration estimators and complementary robustness checks. The empirical strategy proceeds in five steps. The long-run relationship between insurance market development and GDP per capita is specified as

$$\ln(\mathrm{GDPpc})_{it} = \alpha_i + \delta_t + \beta_1\,\mathrm{INS}_{it} + \beta_2\,\mathrm{Retention}_{it} + \beta_3\,\mathrm{Foreign}_{it} + \gamma'\,X_{it} + \varepsilon_{it} \quad (1)$$

where $i = 1, \ldots, N$ indexes countries ($N = 33$) and $t = 1, \ldots, T$ indexes years ($T = 11$); INS_{it} denotes the relevant insurance-development indicator (total insurance density for

H1, or life insurance density and life insurance penetration for H2 and H3); $Retention_{it}$ and $Foreign_{it}$ are the structural variables for H4 and H5; X_{it} is the vector of controls comprising insurance-market variables (claims ratio, expense ratio, insurance market total assets) and macroeconomic variables (gross capital formation, trade openness, inflation, institutional quality, old-age dependency ratio, and financial development index); α_i are country-specific intercepts; δ_t are common time effects; and ε_{it} is the error term. Conditional on cointegration, coefficients on ln-transformed variables are interpreted as standard elasticities. Coefficients on ln(1 + x)-transformed variables are pseudo-elasticities; exact marginal effects at the sample mean are calculated using the formula $\beta \times [1/(1 + \bar{x})]$.

3.3.1. Step 1: Panel Unit-Root Tests

All variables are tested for unit roots using two first-generation tests—the Levin–Lin–Chu (LLC) test (Levin et al., 2002) and the Im–Pesaran–Shin (IPS) test (Im et al., 2003)—and one second-generation test, the cross-sectionally augmented CIPS test of Pesaran (2007), which is robust to cross-sectional dependence. A variable is treated as integrated of order one, I(1), when it is non-stationary in levels but becomes stationary after first differencing. The lag length is selected by the Schwarz Bayesian Information Criterion.

3.3.2. Step 2: Cross-Sectional Dependence

The Pesaran (2004) CD test and the weak-CSD bias-adjusted variant of Pesaran (2015) are applied to the residuals of the baseline equation. The presence of cross-sectional dependence determines (i) which unit-root test is treated as authoritative (CIPS rather than LLC/IPS), (ii) the choice between first- and second-generation cointegration tests, and (iii) the choice of long-run estimator (CCEMG/AMG instead of plain FMOLS/DOLS) and the form of standard error (Driscoll–Kraay rather than country-clustered).

3.3.3. Step 3: Panel Cointegration Tests

If the variables are individually I(1), the relevant question is whether a stable long-run linear combination exists. Three complementary tests are used. The Pedroni (1999, 2004) residual-based tests, both within-dimension (panel) and between-dimension (group), allow for heterogeneous slopes. The Kao (1999) ADF residual test imposes homogeneous cointegrating slopes and serves as a robustness check. The error-correction-based test of Westerlund (2007) examines whether the speed-of-adjustment coefficient differs from zero in the panel and is generally less sensitive to the common-factor restrictions of residual-based tests.

3.3.4. Step 4: Long-Run Estimation

Conditional on cointegration, the long-run relationship between insurance development and GDP per capita is estimated by four estimators chosen for their complementary properties. The Fully Modified OLS (FMOLS) and Dynamic OLS (DOLS) estimators of Pedroni (2001) correct for endogeneity and serial correlation in the cointegrating regression. The Common Correlated Effects Mean Group (CCEMG) estimator of Pesaran (2006) augments the regression with cross-sectional means of the dependent and independent variables, thereby filtering out unobserved common factors and producing consistent estimates under cross-sectional dependence and slope heterogeneity. The Augmented Mean Group (AMG) estimator of Eberhardt and Bond (2009) explicitly extracts a common dynamic process and is reported for comparison. The Pesaran (2006) CCEMG estimator augments Equation (1) with cross-sectional averages of the dependent and regressor variables to filter unobserved common factors:

$$\ln(\mathrm{GDPpc})_{it} = \alpha_i + \beta_i Z_{it} + \theta_{1i} \ln(\mathrm{GDPpc})^{-}{}_{t} + \theta_{2i} \overline{Z}_t + \varepsilon_{it} \tag{2}$$

where Z_{it} collects the insurance regressors and the controls, and a bar denotes the cross-sectional mean at time t. The mean-group long-run coefficient is $\hat{\beta}$_CCEMG = N^{-1} Σ_i $\hat{\beta}_i$. The AMG estimator of Eberhardt and Bond (2009) replaces the cross-sectional means with an estimated common dynamic process extracted from the year dummies of a pooled first-difference regression.

3.3.5. Step 5: Robustness and Identification

Several further checks are reported. First, a Pesaran–Shin–Smith (Pesaran et al., 1999) pooled mean group (PMG) ARDL is estimated in error-correction form:

$$\Delta \ln(\text{GDPpc})_{it} = \varphi_i\,[\ln(\text{GDPpc})_{i,t-1} - \beta'\,Z_{i,t-1}] + \Sigma_j\,\psi_{ij}\,\Delta \ln(\text{GDPpc})_{i,t-j} + \Sigma_j\,\eta_{ij}'\,\Delta Z_{i,t-j} + \alpha_i + \nu_{it} \tag{3}$$

where β is the common long-run vector imposed by the estimator and φ_i is the country-specific speed-of-adjustment coefficient; a negative and significant pooled φ provides independent evidence of cointegration. Second, a Blundell and Bond (1998) two-step system-GMM estimator with Windmeijer (2005)-corrected standard errors is applied to a growth-rate specification:

$$\Delta \ln(\text{GDPpc})_{it} = \varrho\,\Delta \ln(\text{GDPpc})_{i,t-1} + \pi'\,\Delta Z_{it} + \delta_t + u_{it} \tag{4}$$

which reduces the risk of spurious inference from non-stationary level variables. Lagged levels and lagged differences in ln(GDPpc) and Z serve as instruments. To avoid instrument proliferation, the instrument matrix is collapsed and the lag depth restricted so that the total instrument count is held at 28, which is below the number of cross-sectional units (N = 33), in line with the rule of thumb of Roodman (2009). The number of instruments relative to cross-sections (28 vs. 33) is reported. The AR(2) test for second-order serial correlation and the Hansen J test of overidentifying restrictions are both reported; a failure to reject either provides evidence that the instrument set is valid and not weakened by proliferation. External historical instruments, including legal-origin indicators, were considered as an additional identification strategy. However, because legal origin is time-invariant and therefore collinear with country fixed effects in the present panel, and because its exclusion from the GDP-per-capita equation is contestable in mature OECD economies, it is not used as a primary instrument. Instead, the study relies on a triangulated robustness strategy based on collapsed system-GMM instruments, lag-based IV checks, Driscoll–Kraay standard errors, pre-pandemic estimation, residualised penetration, and outlier exclusion. These checks are interpreted as robustness exercises rather than as definitive causal identification. Third, an instrumental-variable estimator uses two- and three-period lags of the insurance variables as instruments, with a first-stage F-statistic and the Hansen J test reported. Fourth, all standard errors in the levels specification are reported in two forms: country-clustered and Driscoll and Kraay (1998), the latter being robust to both cross-sectional and serial correlation. Fifth, the sample is restricted to the pre-pandemic period, 2011–2019, to assess whether the results are driven by the COVID-19 shock. Sixth, to address the mechanical denominator concern associated with life insurance penetration, ln(1 + life insurance penetration) is replaced by the residual $\hat{\varepsilon}_{it}$ from the auxiliary regression:

$$\ln(1 + \text{LIP})_{it} = \kappa_0 + \kappa_1\,\ln(\text{GDPpc})_{it} + \alpha_i + \delta_t + \varepsilon_{it} \tag{5}$$

The resulting measure $\widetilde{\text{LIP}}_{it} \equiv \hat{\varepsilon}_{it}$ is by construction orthogonal to ln(GDPpc), country fixed effects and year fixed effects, reducing the likelihood that any remaining association is driven mechanically by the shared GDP denominator. Finally, the in-sample fit of the long-run model is evaluated using a leave-one-country-out validation in which each country is iteratively held out and its 2020–2021 GDP per capita is predicted from the cointegrating coefficients estimated on the remaining 32 countries. The estimated coefficients are interpreted as long-run associations within a cointegrating relationship rather than as treatment effects. The dynamic-panel and instrumental-variable specifications are used as robustness checks to assess whether the main patterns are sensitive to alternative identification assumptions. Finally, given that the leave-one-country-out validation identifies Luxembourg and Ireland as structural outliers, a robustness regression excluding these two countries from the full estimation sample is calculated.

4. Empirical Results

4.1. Descriptive Statistics and Correlation Matrix

Table 2 presents descriptive statistics for the variables used in the analysis. GDP per capita is expressed in logarithmic form, while insurance density and penetration variables are transformed using ln(1 + x). Life insurance retention and foreign insurers' market share are expressed in percentage terms. The mean of ln(GDPpc) is 10.62 (s.d. 0.42), indicating moderate income dispersion across OECD countries. Insurance density measures exhibit substantial variation, with total insurance density (mean 7.98; s.d. 0.81) and life insurance density (mean 7.21; s.d. 0.97) showing considerable heterogeneity. Life insurance penetration displays lower dispersion (mean 1.34; s.d. 0.46). The average life insurance retention ratio is 82.7%, ranging from 55.3% to 96.8%, while foreign insurers' market share averages 31.4%. The dispersion in foreign participation is notably wide (s.d. 18.9, range 2.1–78.6%), indicating substantial cross-country heterogeneity in market openness, while the relatively high mean retention ratio (82.7%) shows that most OECD life markets retain the bulk of premiums domestically, with reinsurance ceding concentrated in a minority of countries. Among the macroeconomic controls, gross capital formation averages 22.4% of GDP, while trade openness shows wide dispersion (mean 98.7%, s.d. 52.3), reflecting the presence of several small, highly open OECD economies. Average inflation is low at 1.8%, and the institutional quality (WGI index, mean 1.21) and financial development index (mean 0.68) values are consistent with a panel of high-income, institutionally mature economies. Including these controls reduces the risk that the estimated insurance coefficients capture omitted macroeconomic or institutional differences across OECD countries. Taken together, the descriptive statistics confirm that the panel combines broadly comparable income levels (ln GDPpc s.d. of only 0.42) with pronounced heterogeneity in insurance structure and macroeconomic conditions, which is the variation the long-run estimators exploit.

Table 3 reports the correlation matrix. Pairwise correlations range from −0.31 to 0.76 and remain below the conventional threshold of 0.80, suggesting that severe multicollinearity is unlikely (Ayadi et al., 2025; Shojaei, 2023). The highest correlation is between total insurance density and life insurance density (r = 0.76); however, these variables are not entered jointly in the same long-run specification. Variance inflation factors are below 5 across the reported specifications, further indicating that multicollinearity is unlikely to drive the results. The sign pattern in Table 3 previews the multivariate findings: density measures correlate positively with GDP per capita (r = 0.42 and 0.39), whereas life insurance penetration and retention correlate negatively (r = −0.31 and −0.28). The positive raw correlations among the insurance variables themselves confirm that depth and size move together across countries, underscoring the need to separate their distinct partial associations within the long-run model. Foreign insurers' market share is virtually uncorrelated with all other variables ($|r| \leq 0.10$), suggesting its influence is driven by regulatory rather than economic factors and will only emerge as a partial association in the long-run estimates.

Table 2. Descriptive statistics.

Variable	Mean	Std. Dev.	Min	Max
Dependent variable				
ln(GDPpc)	10.62	0.42	9.54	11.43
Insurance variables				
ln(1 + Total insurance density)	7.98	0.81	6.12	9.42
ln(1 + Life insurance density)	7.21	0.97	5.04	9.01
ln(1 + Life insurance penetration)	1.34	0.46	0.21	2.58
Life insurance retention (%)	82.7	9.6	55.3	96.8
Foreign insurers' share (life, %)	31.4	18.9	2.1	78.6
Macroeconomic controls				
Claims ratio (%)	68.4	11.7	42.6	93.1
Expense ratio (%)	26.9	6.8	13.4	45.2
Insurance market total assets (USD, ln)	25.74	1.86	21.83	29.91
Gross capital formation (% GDP)	22.4	3.6	15.8	31.2
Trade openness (% GDP)	98.7	52.3	24.9	382.4
Inflation (annual CPI, %)	1.8	1.9	−1.7	14.3
Institutional quality (WGI index)	1.21	0.49	−0.18	1.97
Old-age dependency ratio (%)	27.6	5.4	13.9	49.8
Financial development index	0.68	0.14	0.34	0.94

Notes: Balanced panel of 33 OECD countries, 2011–2021 ($N \times T = 363$). Insurance variables and GDP per capita are sourced from OECD Insurance Statistics and the World Bank; macroeconomic controls are from the World Bank WDI, the World Governance Indicators (institutional quality, the average of the six WGI dimensions), and the IMF Financial Development Index. Monetary values are in nominal current USD.

Table 3. Correlation matrix.

Variable	(1)	(2)	(3)	(4)	(5)	(6)
(1) ln(GDP_{pc})	1.00					
(2) ln(1 + Total insurance density)	0.42	1.00				
(3) ln(1 + Life insurance density)	0.39	0.76	1.00			
(4) ln(1 + Life insurance penetration)	−0.31	0.55	0.61	1.00		
(5) Life insurance retention	−0.28	−0.12	−0.18	0.22	1.00	
(6) Foreign insurers' market share (life)	0.04	0.10	0.07	−0.05	−0.09	1.00

4.2. Panel Unit-Root Tests

Table 4 reports panel unit-root tests in levels and first differences. The LLC, IPS and CIPS tests fail to reject the null of a unit root in the levels of every variable at conventional significance levels, while all three tests strongly reject the null in first differences. The conclusion that the variables behave as I(1) processes is therefore robust to whether cross-sectional dependence is allowed for. This finding provides the empirical foundation for the cointegration analysis that follows, since estimating relationships among I(1) variables in levels without testing for a stable long-run relationship may lead to spurious inference (Kao, 1999).

Table 4. Panel unit-root tests (LLC, IPS, CIPS).

Variable	LLC (Level)	IPS (Level)	CIPS (Level)	LLC (Δ)	IPS (Δ)	CIPS (Δ)
ln(GDPpc)	−0.84	−1.12	−1.78	−7.42 ***	−8.11 ***	−3.47 ***
ln(1 + TID)	−0.55	−0.87	−1.66	−8.09 ***	−8.86 ***	−3.62 ***
ln(1 + LID)	−0.41	−0.69	−1.59	−7.91 ***	−8.54 ***	−3.55 ***
ln(1 + LIP)	−1.02	−1.34 *	−1.84	−8.33 ***	−9.02 ***	−3.71 ***
Retention	−1.18	−1.41 *	−1.91	−7.65 ***	−8.27 ***	−3.49 ***
Foreign share	−0.96	−1.05	−1.72	−7.18 ***	−7.94 ***	−3.41 ***

Notes: Test statistics reported. Tests include an individual constant; LLC/IPS lag length selected by SBC; CIPS uses one cross-section augmentation lag. *** $p < 0.01$, * $p < 0.10$.

4.3. Cross-Sectional Dependence

Pesaran's (2004) CD test on the residuals of the long-run equation yields a test statistic of 18.62 ($p < 0.01$), strongly rejecting the null of cross-sectional independence. The average pairwise residual correlation is 0.49, while the bias-adjusted Pesaran (2015) weak-CSD test confirms that the dependence is not negligible. This finding is consistent with the presence of common cross-country shocks during the sample window, including the lingering macro-financial effects of the global financial crisis, international monetary-policy spillovers, and the COVID-19 shock (Claessens et al., 2012; Miranda-Agrippino & Rey, 2020; Brodeur et al., 2021). It also supports the use of CIPS as the preferred unit-root test, Westerlund's panel-cointegration test alongside Pedroni and Kao, CCEMG and AMG long-run estimators, and Driscoll–Kraay standard errors.

4.4. Panel Cointegration Tests

Table 5 reports the panel cointegration tests. Six of the seven Pedroni statistics reject the null of no cointegration at the 5% level or better; the Panel v statistic is the exception, with a *p*-value of 0.079, but Pedroni (2004) himself notes that the Panel v statistic has lower power than the other six in panels with moderate T, and the remaining six tests, together with the Kao residual ADF test, corroborate the rejection. The Westerlund Gt and Ga group statistics reject the null at the 5% level, while the panel statistics Pt and Pa reject at the 1% level, indicating that the rejection is not driven by a small number of countries. Therefore, the evidence supports the existence of a stable long-run cointegrating relationship between insurance development and GDP per capita in the OECD panel. This justifies estimating long-run coefficients in levels rather than relying solely on a differenced specification.

4.5. Long-Run Estimation: FMOLS, DOLS, CCEMG and AMG

Table 6 reports the long-run coefficients. The H1 specification (top block) shows that total insurance density is positively and significantly associated with ln GDP per capita across all four estimators, with coefficients in the range 0.048–0.055 (significant at the 5% level or better), corresponding to a marginal effect of approximately 0.0058 at the sample mean, supporting H1. Total and life insurance density are not entered jointly because of high collinearity (r = 0.76); for this reason H2–H5 are tested in the life insurance specification (lower block). Across these four estimators, life insurance density enters with a positive and statistically significant coefficient in the range 0.061–0.070, corresponding to a marginal effect of approximately 0.0079 at the sample mean, supporting H2 even after second-generation factor structures and slope heterogeneity are taken into account. Life insurance penetration enters negatively under all four estimators, with point estimates between −0.118 and −0.163, corresponding to a marginal effect of approximately −0.0645 at the sample mean; significance is at the 5% level under FMOLS, DOLS and AMG, and at the 10% level under

CCEMG. The attenuation under CCEMG is consistent with the higher T-demands of this estimator (T = 11 in our panel) and is precisely the kind of small-sample sensitivity that Pesaran (2006) discusses; we therefore treat H3 as supported but with weaker evidence than for H2 and H4. Life insurance retention is negative and significant in every column (between −0.0010 and −0.0013), supporting H4. Foreign insurer participation remains statistically indistinguishable from zero under every estimator, leading to the rejection of H5. This indicates no statistically detectable association in the present panel rather than evidence that foreign participation has no economic role.

Table 5. Panel cointegration tests.

Test	Statistic	*p*-Value	Decision
Pedroni—Panel v	1.41	0.079	Do not reject H0 (10% level)
Pedroni—Panel ϱ	−3.41	<0.01	Reject H0
Pedroni—Panel PP	−4.27	<0.01	Reject H0
Pedroni—Panel ADF	−3.96	<0.01	Reject H0
Pedroni—Group ϱ	−2.84	<0.01	Reject H0
Pedroni—Group PP	−4.11	<0.01	Reject H0
Pedroni—Group ADF	−3.72	<0.01	Reject H0
Kao—ADF	−3.18	<0.01	Reject H0
Westerlund—Gt	−2.64	<0.05	Reject H0
Westerlund—Ga	−9.41	<0.05	Reject H0
Westerlund—Pt	−12.07	<0.01	Reject H0
Westerlund—Pa	−8.83	<0.01	Reject H0

Figure 2 visualises the long-run coefficient estimates from Table 6, showing the consistency of signs across FMOLS, DOLS, CCEMG and AMG estimators.

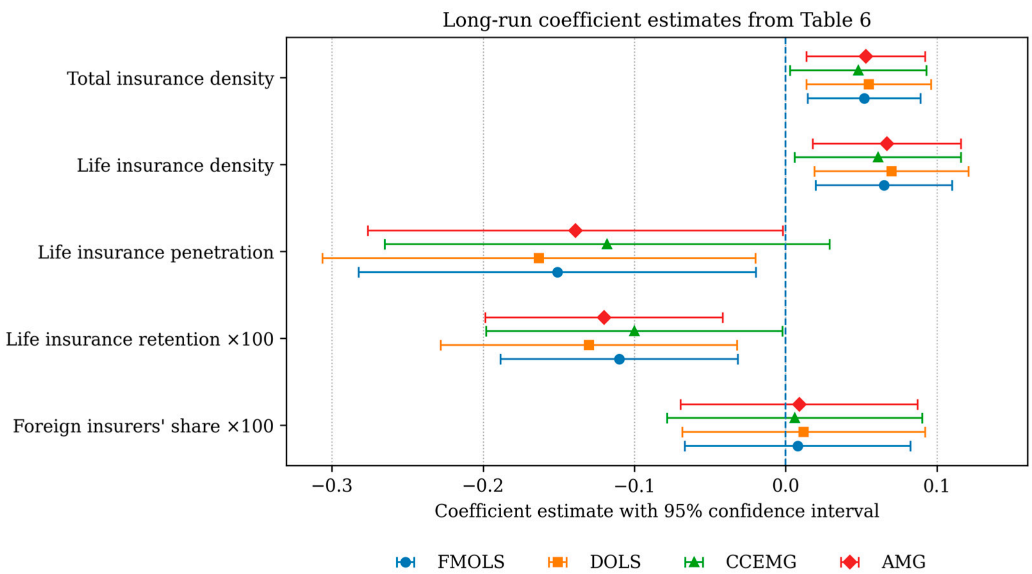

Figure 2. Visualised long-run coefficient estimates. Note. Points show coefficient estimates and horizontal bars show 95% confidence intervals. To improve visual readability, coefficients and confidence intervals for life insurance retention and foreign insurers' share are multiplied by 100. The zero line indicates no association.

Table 6. Long-run estimates (dependent variable: ln GDP per capita).

Variable	FMOLS	DOLS	CCEMG	AMG
H1 specification				
ln(1 + Total insurance density)	0.052 *** (0.019)	0.055 *** (0.021)	0.048 ** (0.023)	0.053 *** (0.020)
H2–H5 specification				
ln(1 + Life insurance density)	0.065 *** (0.023)	0.070 *** (0.026)	0.061 ** (0.028)	0.067 *** (0.025)
ln(1 + Life insurance penetration)	−0.151 ** (0.067)	−0.163 ** (0.073)	−0.118 * (0.075)	−0.139 ** (0.070)
Life insurance retention (%)	−0.0011 *** (0.0004)	−0.0013 *** (0.0005)	−0.0010 ** (0.0005)	−0.0012 *** (0.0004)
Foreign insurers' share (%)	0.00008 (0.00038)	0.00012 (0.00041)	0.00006 (0.00043)	0.00009 (0.00040)
Insurance-market controls	Yes	Yes	Yes	Yes
Macroeconomic controls	Yes	Yes	Yes	Yes
Country-specific intercept	Yes	Yes	Yes	Yes
Common-factor structure	No	No	Yes (CCE)	Yes (AMG)
Observations	363	330	363	363
Countries	33	33	33	33

Notes: Standard errors in parentheses. All specifications include country fixed effects. The H1 specification uses total insurance density; the H2–H5 specification uses life insurance variables. Total and life insurance density are not entered jointly (r = 0.76). Controls: claims ratio, expense ratio, insurance market total assets, gross capital formation, trade openness, inflation, institutional quality, old-age dependency ratio, and financial development index. For ln(1 + x)-transformed variables, marginal effects at the sample mean are: total insurance density 0.0058 (FMOLS); life insurance density 0.0079 (FMOLS); life insurance penetration −0.0645 (FMOLS). Calculated as $\beta \times [1/(1 + \bar{x})]$ where $\bar{x}$ is the sample mean from Table 2. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

4.6. Robustness and Identification Checks

4.6.1. Pooled Mean Group ARDL

The PMG ARDL estimator of Pesaran et al. (1999) imposes a common long-run relationship while allowing all short-run dynamics to vary by country. The long-run coefficients are 0.060 (s.e. 0.020) for life insurance density, −0.142 (s.e. 0.063) for penetration, −0.0011 (s.e. 0.0004) for retention, and 0.00009 (s.e. 0.00041) for foreign participation. The pooled error-correction coefficient is −0.244 (s.e. 0.058) and is highly significant, providing additional, model-based evidence of cointegration: deviations from the long-run relationship are corrected at a rate of approximately 24% per year. The Hausman test does not reject pooling of the long-run coefficients at the 5% level ($p = 0.08$), although the borderline p-value indicates some heterogeneity in the long-run relationship that the PMG estimator absorbs.

4.6.2. System-GMM on a Stationary Growth-Rate Specification

Because GDP per capita and the insurance variables are I(1), their first differences are stationary by construction. Estimating the model in growth rates therefore reduces the risk of spurious inference from non-stationary level variables. Table 7 reports the Blundell and Bond (1998) two-step system-GMM estimator with Windmeijer (2005) finite-sample corrections. The instrument count is held at 28, well below the 33 cross-sections, in line with Roodman's (2009) guidance. The lagged dependent variable is positive and significant; life insurance density growth and penetration growth retain the signs documented in the long-run analysis. The system-GMM coefficient on life insurance density is positive but not significant at conventional levels ($p = 0.16$), which is consistent with a growth-rate specification with T = 11: insurance density is a slow-moving variable, and once it is differenced and absorbed by the lagged dependent variable, much of its long-run signal is dampened. The diagnostic tests support the specification: the AR(2) test does not reject ($p = 0.42$) and the Hansen test of overidentifying restrictions does not reject ($p = 0.34$). An instrumental-variable specification using two- and three-period lags of the insurance variables as instruments produces results consistent with the main density and penetration findings. The first-stage diagnostic suggests that weak instruments are unlikely to drive the results, and the Hansen J test does not reject the overidentifying restrictions ($p = 0.27$).

Table 7. Robustness and identification checks (selected coefficients).

Variables	(1) FE-DK	(2) Growth-FE	(3) Sys-GMM	(4) IV	(5) Pre-2020	(6) Alt. Pen.	(7) Excl. LUX/IRL
ln(1 + LID)	0.076 *** (0.024)	0.055 *** (0.023)	0.037 (0.030)	0.064 *** (0.027)	0.074 *** (0.025)	0.072 *** (0.023)	0.069 *** (0.024)
ln(1 + LIP)	−0.231 *** (0.085)	−0.135 ** (0.062)	−0.130 ** (0.064)	−0.147 ** (0.072)	−0.201 *** (0.078)	—	−0.144 ** (0.071)
LIP residualised	—	—	—	—	—	−0.112 ** (0.052)	—
Retention	−0.0014 *** (0.00046)	−0.0010 ** (0.0004)	−0.0011 ** (0.0005)	—	−0.0013 *** (0.0005)	−0.0012 *** (0.0004)	−0.0012 ** (0.0005)
Foreign share	0.0001 (0.00045)	0.00008 (0.00041)	0.0001 (0.00043)	—	0.0001 (0.0005)	0.0001 (0.0004)	0.0001 (0.0004)
Lag dep. var.	—	—	0.176 *** (0.062)	—	—	—	—
Macro Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	363	330	297	330	297	363	341
Countries	33	33	33	33	33	33	31
Diagnostics	DK SEs	$R^2 = 0.30$	AR2 $p = 0.42$; J $p = 0.34$	First-stage F = 18.7; Hansen J $p = 0.27$	Excl. 2020–2021	LIP ⊥ ln GDP	Excl. LUX/IRL

Notes: Standard errors are in parentheses. (1) Two-way FE with Driscoll–Kraay standard errors, four lags. (2) Two-way FE in first differences. (3) Two-step system-GMM with Windmeijer-corrected standard errors; instrument matrix collapsed and restricted to 28 instruments against N = 33 cross-sections, satisfying the Roodman (2009) rule. AR(2) $p = 0.42$; Hansen J $p = 0.34$. (4) IV specification using two- and three-period lags as instruments. (5) Sample restricted to 2011–2019. (6) Life insurance penetration replaced by the residual from an auxiliary regression on ln(GDPpc), country fixed effects and year fixed effects. *** $p < 0.01$, ** $p < 0.05$.

4.6.3. Driscoll–Kraay Standard Errors

Column (1) of Table 7 reports the levels specification with Driscoll–Kraay standard errors, which are robust to cross-sectional and serial dependence. The coefficient signs are consistent with the main findings: life insurance density remains positive and significant, life insurance penetration and retention remain negative and significant, and foreign insurer participation remains statistically insignificant. The DK estimate of penetration (−0.231) is somewhat larger in absolute value than the cointegration estimates of Table 6, which is expected since column (1) of Table 7 is a levels FE specification rather than a proper long-run estimator; the consistency in sign and significance is the relevant point. This suggests that the main inference is not driven by the choice of variance estimator.

4.6.4. Pre-Pandemic Sub-Sample

Column (5) restricts the sample to 2011–2019. The qualitative pattern is preserved: life insurance density remains positive and significant at 1%, and penetration is negative at −0.201, suggesting that the documented relationships are not driven by the COVID-19 period.

4.6.5. Mechanical Denominator: Residualised Penetration

Column (6) addresses the mechanical relationship between life insurance penetration (premiums/GDP) and ln(GDP per capita). Penetration is replaced by the residual from an auxiliary regression of ln(1 + LIP) on ln(GDPpc), country and year fixed effects; the residualised variable is by construction orthogonal to ln(GDPpc). Its coefficient remains negative and significant at the 5% level (−0.112, s.e. 0.052), with an absolute magnitude noticeably smaller than the FMOLS/DOLS estimates in Table 6. This suggests that the negative association is not entirely mechanical, and that an economically meaningful component remains after the GDP denominator is removed. To address the analogous concern that insurance density may simply reflect income-driven demand, total insurance density was also residualised on ln(GDPpc), country and year fixed effects, and re-entered in the long-run model. Its coefficient remained positive and significant (0.039, s.e. 0.017), indicating that the density–income association is not driven mechanically by the tendency of richer countries to spend more on insurance.

4.6.6. Out-of-Sample Validation

As a final predictive validation check, a leave-one-country-out procedure is implemented. The cointegrating coefficients reported in Table 6 are re-estimated 33 times, each time excluding one country, and are then used to predict the excluded country's GDP per capita for 2020 and 2021. The median absolute prediction error of ln(GDPpc) is 0.058 and the mean is 0.074, corresponding to roughly 6–7% in levels. Two countries—Luxembourg and Ireland—generate noticeably larger errors (0.31 and 0.24 respectively), reflecting their well-known status as macroeconomic outliers whose GDP-per-capita series are heavily affected by multinational profit-shifting and headquarters relocations (Lane, 2017; Tørsløv et al., 2023). When these two countries are excluded from the validation set, the mean absolute error falls to 0.054, comparable to a fixed-effects benchmark estimated over the same hold-out years. The cointegrating specification therefore retains reasonable predictive performance for the bulk of the panel while flagging two well-understood structural outliers.

4.6.7. Exclusion of Structural Outliers

Last column of Table 7 re-estimates the model excluding Luxembourg and Ireland, the two countries identified as structural outliers in the leave-one-country-out validation. The coefficients on life insurance density and penetration retain their signs, magnitudes, and significance, confirming that the main results are not driven by these two economies whose GDP-per-capita series are distorted by multinational profit-shifting.

5. Discussion

The results indicate that insurance markets remain economically relevant in advanced economies; however, their long-run contribution depends critically on how insurance development is measured. The positive and statistically significant association between both total insurance density and life insurance density and GDP per capita levels across all four cointegration estimators is consistent with the view that density captures qualitative improvements in insurance usage, including more effective risk management, broader coverage, and more sophisticated product design, rather than simple market expansion (Islam et al., 2025). This pattern aligns with prior work documenting a positive insurance–income link in advanced and mixed panels (Apergis & Poufinas, 2020; Lee et al., 2016; Dawd & Benlagha, 2023), while extending it by showing that the association operates through depth rather than size. In OECD countries, higher insurance density likely reflects more intensive utilisation of insurance services by households and firms, contributing to income stability and investment resilience over the long run. These associations should not be interpreted as evidence that increasing insurance density directly causes higher GDP per capita; omitted institutional, demographic, and macroeconomic factors may jointly shape both variables. The negative coefficient on life insurance penetration requires more cautious interpretation. Part of this association may be mechanical, since penetration shares its denominator with GDP per capita. The residualisation exercise in Section 4.6.5 isolates the non-mechanical component and finds that it remains negative and statistically significant, although smaller in magnitude. This residual is consistent with the broader narrative that, in mature economies, large life insurance sectors often coexist with structural features—ageing populations, conservative investment mandates, and demographically driven savings flows—that are themselves associated with slower growth (Magbondé et al., 2025). The result should be read as evidence of a long-run association in mature markets, not as evidence that increasing penetration causes lower growth.

The negative and statistically significant association between life insurance retention and GDP per capita highlights the role of risk allocation in mature insurance systems. In OECD countries with access to global reinsurance markets, lower retention may be associated with broader international risk-sharing and improved capital efficiency (Balbás et al., 2013), while higher retention may reflect domestic reinsurance capacity, regulatory preferences, or market structure (Wang et al., 2025). The absence of a statistically significant effect of foreign insurer participation suggests that, once cross-sectional dependence and slope heterogeneity are properly accounted for, foreign ownership does not exert a measurable independent influence on long-run GDP per capita in OECD life insurance markets. This is consistent with the view that the institutional and regulatory benefits often attributed to foreign insurers are already largely internalised in mature systems (Rahma et al., 2025). The result indicates no statistically detectable association in the present panel, rather than evidence that foreign insurers have no economic role.

Methodologically, the analysis contributes by showing that the distinction between insurance depth and market size remains relevant when the insurance–income relationship is examined within a panel time-series framework that accounts for non-stationarity, cross-sectional dependence, and slope heterogeneity. The results reduce concerns that the main findings are driven by non-stationarity, unmodelled common shocks, reliance on a single estimator, or the mechanical construction of life insurance penetration. Several caveats temper this conclusion. The time dimension of the panel (T = 11) is short relative to the asymptotic settings in which the CCEMG and AMG estimators are typically evaluated, and the attenuation of the life insurance penetration coefficient under CCEMG (significant only at the 10% level) and the loss of significance of insurance density under system-GMM are both consistent with this small-T sensitivity. The cointegration evidence is also imperfect: the Pedroni Panel v statistic does not reject at the 10% level, although it is the lowest-power member of the Pedroni family. Finally, the leave-one-country-out validation flags Luxembourg and Ireland as structural outliers whose GDP_{pc} series are heavily affected by multinational profit-shifting. Therefore, these caveats reinforce the cautious interpretation of the findings as long-run associations rather than causal treatment effects, and they identify natural directions for replication on longer panels.

6. Conclusions

This study examined the long-run association between insurance market structure and GDP per capita levels in 33 OECD countries over the period 2011–2021 by distinguishing between insurance depth, market size, and life insurance structure. Within a panel time-series framework that accounts for non-stationarity, cross-sectional dependence, and slope heterogeneity, the findings support a depth-not-size interpretation of insurance-market development in mature economies. Both total and life insurance density are positively associated with GDP per capita levels in the long run, whereas life insurance penetration and retention are negatively associated with GDP per capita levels; foreign insurer participation shows no statistically significant association in the present panel. These long-run associations suggest that, in advanced OECD markets, the economic relevance of insurance depends less on sectoral expansion and more on the intensity, efficiency, and structure of insurance activity; they should not be read as evidence of a direct causal effect of insurance on income levels. Policies aimed simply at increasing penetration ratios may therefore have limited economic value, and greater attention should instead be given to insurance-market efficiency, risk-transfer mechanisms, asset–liability management, and the quality of insurance intermediation. These recommendations are directed primarily at insurance regulators and supervisory authorities (for solvency, reinsurance, and market-conduct frameworks), at finance and economic ministries setting financial-sector development priorities, and at insurers' senior management responsible for capital allocation and product design. For mature OECD markets specifically, the implication is that supervisory and strategic effort is better spent on efficiency and risk-allocation quality than on headline expansion of penetration ratios. The study is limited by its aggregate country-level design and a relatively short time dimension (T = 11), which is at the lower end of what second-generation panel-cointegration estimators require; the attenuation of life insurance penetration under CCEMG and of insurance density under system-GMM are consistent with this constraint, and the findings should accordingly be interpreted as long-run associations rather than causal treatment effects. Future research could extend the analysis using longer panels, firm-level data, external instruments, and more explicit demographic and regulatory channels, particularly to examine how ageing populations, pension systems, solvency rules, and reinsurance arrangements shape the long-run association between insurance market structure and economic performance in mature economies.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Selected OECD Country List

Table A1. OECD countries included in the sample (2011–2021).

Australia	Belgium	Chile
Colombia	Costa Rica	Czech Republic
Denmark	Finland	France
Germany	Greece	Hungary
Iceland	Ireland	Italy
Japan	Korea	Latvia
Lithuania	Luxembourg	Mexico
Netherlands	Norway	Poland
Portugal	Slovak Republic	Slovenia
Spain	Sweden	Switzerland
Türkiye	United Kingdom	United States

References

Apergis, N., & Poufinas, T. (2020). The role of insurance growth in economic growth: Fresh evidence from a panel of OECD countries. *The North American Journal of Economics and Finance*, *53*, 101217. [CrossRef]

Arcand, J. L., Berkes, E., & Panizza, U. (2015). Too much finance? *Journal of Economic Growth*, *20*(2), 105–148. [CrossRef]

Arena, M. (2008). Does insurance market activity promote economic growth? A cross-country study for industrialized and developing countries. *Journal of Risk and Insurance*, *75*(4), 921–946. [CrossRef]

Asongu, S., & Odhiambo, N. (2020). Insurance policy thresholds for economic growth in Africa. *The European Journal of Development Research*, *32*(3), 672–689. [CrossRef]

Ayadi, I., Hussain, N., & Mwambuli, E. (2025). Economic policy uncertainty and ecological performance of European companies: Does the role of the board matter? *Corporate Social Responsibility and Environmental Management*, *32*(3), 3138–3149. [CrossRef]

Balbás, A., Balbás, B., & Balbás, R. (2013). Optimal reinsurance: A risk sharing approach. *Risks*, *1*(2), 45–56. [CrossRef]

Blokhin, A. A. (2019). Effects of institutional differences on economic growth. *Studies on Russian Economic Development*, *30*(5), 490–497. [CrossRef]

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, *87*(1), 115–143. [CrossRef]

Brodeur, A., Gray, D., Islam, A., & Bhuiyan, S. (2021). A literature review of the economics of COVID-19. *Journal of Economic Surveys*, *35*(4), 1007–1044. [CrossRef] [PubMed]

Claessens, S., Kose, M. A., & Terrones, M. E. (2012). How do business and financial cycles interact? *Journal of International Economics*, *87*(1), 178–190. [CrossRef]

Dawd, I., & Benlagha, N. (2023). Insurance and economic growth nexus: New evidence from OECD countries. *Cogent Economics & Finance*, *11*(1), 2183660. [CrossRef]

Driscoll, J. C., & Kraay, A. C. (1998). Consistent covariance matrix estimation with spatially dependent panel data. *Review of Economics and Statistics*, *80*(4), 549–560. [CrossRef]

Eberhardt, M., & Bond, S. (2009). *Cross-section dependence in nonstationary panel models: A novel estimator* (MPRA Paper No. 17692). University Library of Munich.

Eldomiaty, T., Fouad, J., El Kolaly, H., Hammam, R., & El Bedawy, R. (2026). Institutional quality and the prioritization of sustainable development: Perspectives from world economies. *Journal of Public Affairs*, *26*(1), e70113. [CrossRef]

Emara, N., Kasa, H., & Yılmaz, K. Ç. (2026). Shaping the savings curve: The diminishing returns of financial depth in Latin America. *Journal of Economic Studies*, *53*(3), 510–526. [CrossRef]

Fernando, K. D. U. D., Tharanga, T. M. N. T., Dewasiri, N. J., Sood, K., Grima, S., & Thalassinos, E. (2023). Insurance penetration and institutional spillover on economic growth: A dynamic spatial econometric approach in Asian and European regions. *Journal of Risk and Financial Management*, *16*(8), 365. [CrossRef]

Garcia, M. T. M., & Atienza, A. L. (2026). The insurance-economic growth nexus in Portugal. *Eurasian Economic Review*, *16*(1), 1–26. [CrossRef]

Gbadebo, A. D. (2024). Theories of financial intermediation: Evaluation and empirical relevance. *Journal of Law and Sustainable Development*, *12*(9), e3950. [CrossRef]

Haiss, P., & Sümegi, K. (2008). The relationship between insurance and economic growth in Europe: A theoretical and empirical analysis. *Empirica*, *35*(4), 405–431. [CrossRef]

Han, L., Li, D., Moshirian, F., & Tian, Y. (2010). Insurance development and economic growth. *The Geneva Papers on Risk and Insurance: Issues and Practice*, *35*(2), 183–199. [CrossRef]

Hasan, S. M., Munmun, S., & Saha, P. (2025). The dynamics of life insurance demand in Bangladesh: An empirical analysis of socio-economic influences. *Insurance Markets and Companies*, *16*(2), 11–23. [CrossRef]

Haward, V. (2024). Impact of Japan's aging population on healthcare costs and the long-term care insurance system. *Studies in Social Science & Humanities*, *3*(2), 39–44. [CrossRef]

Horvey, S. S., & Odei-Mensah, J. (2025). Towards economic growth in Sub-Saharan Africa: Is there a synergy between insurance market development and ICT diffusion? *Information Technology for Development*, *31*(1), 178–205. [CrossRef]

Hu, Q., & Wang, L. (2024). Economic growth effects of public health expenditure in OECD countries: An empirical study using the dynamic panel threshold model. *Heliyon*, *10*(4), e25684. [CrossRef] [PubMed]

Huang, L.-Y., Ma, Y.-L., & Pope, N. (2012). Foreign ownership and non-life insurer efficiency in the Japanese marketplace. *Risk Management and Insurance Review*, *15*(1), 57–88. [CrossRef]

Im, K. S., Pesaran, M. H., & Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics*, *115*(1), 53–74. [CrossRef]

Islam, M. M., Redwanuzzaman, M., & Rana, M. (2025). Exploring the role of insurance sector performance in driving economic growth in Bangladesh: A financial metrics perspective. *Journal of Ekonomi*, *7*(2), 95–106. [CrossRef]

Kao, C. (1999). Spurious regression and residual-based tests for cointegration in panel data. *Journal of Econometrics*, *90*(1), 1–44. [CrossRef]

Lane, P. R. (2017). *The treatment of global firms in national accounts* (Economic Letters 01/EL/17, pp. 1–8). Central Bank of Ireland.

Lee, C.-C., Chang, C.-H., Arouri, M., & Lee, C.-C. (2016). Economic growth and insurance development: The role of institutional environments. *Economic Modelling*, *59*, 361–369. [CrossRef]

Levin, A., Lin, C. F., & Chu, C. S. J. (2002). Unit root tests in panel data: Asymptotic and finite-sample properties. *Journal of Econometrics*, *108*(1), 1–24. [CrossRef]

Loubergé, H., & Dionne, G. (2025). Developments in risk and insurance economics: The past 50 years. In *Handbook of insurance: Volume I* (pp. 3–52). Springer. [CrossRef]

Magbondé, K. G., Thiam, D. R., & Konté, M. A. (2025). Foreign direct investment, institutions, and domestic investment in developing countries: Is there a crowding-out effect? *Comparative Economic Studies*, *67*, 221–261. [CrossRef]

Matusiewicz, M. (2025). Endless growth does not bring joy: Income inequality, human development, and happiness—A cross-country analysis with a focus on Europe. *The American Journal of Economics and Sociology*, *84*(5), 683–694. [CrossRef]

Meier, U. B., & Outreville, J. F. (2010). Business cycles in insurance and reinsurance: International diversification effects. *Applied Financial Economics*, *20*(8), 659–668. [CrossRef]

Michael, C. I., & Izedomi, I. M. (2025). Insurance sector development and economic growth: A case study of Nigeria from 2000–2023. *The Journal of Developing Areas*, *59*(2), 171–185. [CrossRef]

Miranda-Agrippino, S., & Rey, H. (2020). U.S. monetary policy and the global financial cycle. *The Review of Economic Studies*, *87*(6), 2754–2776. [CrossRef]

Munmun, S., Saha, P., & Hasan, S. M. (2026). Life insurance demand in OECD economies: New insights into economic, demographic, and social drivers. *Insurance Markets and Companies*, *17*(1), 51–64. [CrossRef]

OECD. (2024). *OECD insurance statistics*. Organisation for Economic Co-Operation and Development.

Outreville, J. F. (2013). The relationship between insurance and economic development: 85 empirical papers for a review of the literature. *Risk Management and Insurance Review*, *16*(1), 71–122. [CrossRef]

Pedroni, P. (1999). Critical values for cointegration tests in heterogeneous panels with multiple regressors. *Oxford Bulletin of Economics and Statistics*, *61*(S1), 653–670. [CrossRef]

Pedroni, P. (2001). Fully modified OLS for heterogeneous cointegrated panels. In B. H. Baltagi (Ed.), *Nonstationary panels, panel cointegration, and dynamic panels* (Vol. 15, pp. 93–130). Emerald Group Publishing Limited. [CrossRef]

Pedroni, P. (2004). Panel cointegration: Asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis. *Econometric Theory*, *20*(3), 597–625. [CrossRef]

Pesaran, M. H. (2004). *General diagnostic tests for cross section dependence in panels (Cambridge Working Papers in Economics No. 0435)*. Faculty of Economics, University of Cambridge.

Pesaran, M. H. (2006). Estimation and inference in large heterogeneous panels with a multifactor error structure. *Econometrica*, *74*(4), 967–1012. [CrossRef]

Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics*, *22*(2), 265–312. [CrossRef]

Pesaran, M. H. (2015). Testing weak cross-sectional dependence in large panels. *Econometric Reviews*, *34*(6–10), 1089–1117. [CrossRef]

Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled mean group estimation of dynamic heterogeneous panels. *Journal of the American Statistical Association*, *94*(446), 621–634. [CrossRef]

Petrova, Y. (2020). On cointegration between the insurance market and economic activity. *Empirical Economics*, *59*(3), 1127–1138. [CrossRef]

Rahma, M., Masyita, D., Sudarsono, R., & Anwar, M. (2025). Determinants of insolvency in life insurance companies: A systematic literature review and bibliometric analysis. *Cogent Business & Management*, *12*(1), 2573876. [CrossRef]

Rodriguez Gonzalez, M., Wegener, C., & Basse, T. (2022). Re-investigating the insurance-growth nexus using common factors. *Finance Research Letters*, *46(Part A)*, 102231. [CrossRef]

Roodman, D. (2009). A note on the theme of too many instruments. *Oxford Bulletin of Economics and Statistics*, *71*(1), 135–158. [CrossRef]

Saleh, M. H., Jawabreh, O., & Ali, B. J. (2023). The role of performance Jordanian insurance companies in economic growth: Evidence from the PMG Panel-ARDL approach. *Cuadernos de Economía*, *46*(131), 30–42.

Shojaei, S. A. (2021). *The impacts of diversification strategy on the financial performance of insurers* [Doctoral dissertation, Sheffield Hallam University].

Shojaei, S. A. (2023). Diversification strategy and financial performance of insurance firms: Evidence from Iran. *International Journal of Management, Accounting & Economics*, *10*(12), 997–1021. [CrossRef]

Shojaei, S. A. (2024). The association between technological diversification and firms' financial performance in Iran's insurance industry. *Industrial Engineering & Management Systems*, *23*(3), 439–453. [CrossRef]

Shojaei, S. A., & Almansour, B. Y. (2025). Balancing innovation and profitability: Technological diversification in Iran's insurance industry. *Asia-Pacific Journal of Risk and Insurance*, *19*(1), 1–25. [CrossRef]

Singhal, N., Goyal, S., & Singhal, T. (2022). The relationship between insurance and economic growth in Asian countries: A regional perspective. *Macroeconomics and Finance in Emerging Market Economies*, *15*(3), 301–322. [CrossRef]

Srbinoski, B., Poposki, K., Kwon, W. J., & Dencic-Mihajlov, K. (2024). Greenfield foreign direct investments and insurance market diversification: A cross-country analysis. *The Geneva Papers on Risk and Insurance: Issues and Practice*, *49*, 636–661. [CrossRef]

Tørsløv, T., Wier, L., & Zucman, G. (2023). The missing profits of nations. *The Review of Economic Studies*, *90*(3), 1499–1534. [CrossRef]

Wang, F., Liang, Z., & Zhang, Y. (2025). Stackelberg equilibrium strategies between insurance demand and government interventions. *Journal of Economic Dynamics and Control*, *179*, 105179. [CrossRef]

Ward, D., & Zurbruegg, R. (2000). Does insurance promote economic growth? Evidence from OECD countries. *Journal of Risk and Insurance*, *67*(4), 489–506. [CrossRef] [PubMed]

Westerlund, J. (2007). Testing for error correction in panel data. *Oxford Bulletin of Economics and Statistics*, *69*(6), 709–748. [CrossRef]

Windmeijer, F. (2005). A finite sample correction for the variance of linear efficient two-step GMM estimators. *Journal of Econometrics*, *126*(1), 25–51. [CrossRef]

World Bank. (2024). *World development indicators*. World Bank.

Yap, S., Lee, H. S., & Liew, P. X. (2024). The roles of insurance and banking services on financial inclusion. *SAGE Open*, *14*(2), 1–15. [CrossRef]

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