

**Proceedings of FEB Zagreb 16th International Odyssey
Conference on Economics and Business**

**May 07-10, 2025
Dubrovnik, Croatia & online**



Odyssey
Conference

1/2025

**ISSN 2671-132X
Vol.8, No.1, pp. 1-758
July 2025, Zagreb**



**University of Zagreb
Faculty of Economics & Business**



EDITORS

Sanja Sever Mališ

*University of Zagreb, Faculty of Economics & Business, J. F. Kennedy Square 6, 10000
Zagreb, Croatia
ssever@efzg.hr*

Ivana Načinović Braje

*University of Zagreb, Faculty of Economics & Business, J. F. Kennedy Square 6, 10000
Zagreb, Croatia
ivana.nacinovic@efzg.hr*

Irena Raguž Krištic

*University of Zagreb, Faculty of Economics & Business, J. F. Kennedy Square 6, 10000
Zagreb, Croatia
iraguzkristic@efzg.hr*

PUBLISHER

Faculty of Economics & Business
University of Zagreb
*J. F. Kennedy Square 6
10000 Zagreb
Croatia*

For the publisher

Sanja Sever Mališ

University of Zagreb, Faculty of Economics & Business, Croatia

DOI: <https://doi.org/10.22598/odyssey/2025.7>

INTERNATIONAL EDITORIAL BOARD

Sanja Sever Mališ (Chair)

University of Zagreb, Faculty of Economics & Business, Croatia

Lovorka Galetić (Honorary Chair)

University of Zagreb, Faculty of Economics & Business, Croatia

Beata Buchelt

Cracow University of Economics, Poland

Marina Dabić

University of Zagreb, Faculty of Economics & Business, Croatia

Kosjenka Dumančić

University of Zagreb, Faculty of Economics & Business, Croatia

Fran Galetić

University of Zagreb, Faculty of Economics & Business, Croatia

William C. Gartner

University of Minnesota, USA

Charla Griffy-Brown

Arizona State University, Thunderbird School of Global Management, USA

Joe F. Hair, Jr.

University of South Alabama, USA

Lidija Hauptman

University of Maribor, Faculty of Economics and Business, Slovenia

Marijana Ivanov

University of Zagreb, Faculty of Economics & Business, Croatia

Božidar Jaković

University of Zagreb, Faculty of Economics & Business, Croatia

Mijat Jocović

University of Montenegro, Faculty of Economics, Montenegro

Tomaš Krabec

Prague University of Economics and Business, Faculty of Finance and Accounting & Škoda

Auto University, Czech Republic

Sascha Kraus

University of Siegen, Germany

Junsoo Lee

University of Alabama, USA

Gunther Meeh-Bunse

Osnabrück University of Applied Sciences, Faculty of Management, Culture, and Technology,

Germany

Maja Mihelja Žaja

University of Zagreb, Faculty of Economics & Business, Croatia

Michael J. Morley

University of Limerick, Kemmy Business School, Ireland

Marco Savastano

Sapienza University of Rome, Faculty of Economics, Italy

Soumitra Sharma

Juraj Dobrila University of Pula, Croatia

Robert Sonora

University of Montana, USA

Mario Spremić

University of Zagreb, Faculty of Economics & Business, Croatia

Jean-Paul Thommen

University of Zürich, Switzerland

Jurica Pavičić

University of Zagreb, Faculty of Economics & Business, Croatia

Goran Vlašić

University of Zagreb, Faculty of Economics & Business, Croatia

Krešimir Žigić

CERGE-EI, Prague, Czech Republic

ORGANIZING COMMITTEE

Ivana Načinović Braje (Chair)

Zoran Krupka

Ivana Pavić

Irena Raguž Krištić

Antonija Buljan

Petra Halar

Ivan Jajić

Jelena Kovač

University of Zagreb, Faculty of Economics & Business, Croatia

LIST OF REVIEWERS

Ana Aleksić Fredotović
Mihovil Anđelinović
Vladimir Arčabić
Radoslav Barišić
Maja Bašić
Željko Bogdan
Mateja Brozović
August Cesarec
Maja Daraboš Longin
Marina Ercegović
Danijela Ferjanić Hodak
Lovorka Galetić
Tomislav Hernaus
Mirjana Hladika

Domagoj Hruška
Krešimir Ivanda
Božidar Jaković
Hrvoje Jošić
Maja Klindžić
Tanja Komarac
Vanja Krajinović
Mira Krpan
Miroslav Mandić
Ivana Marić
Maja Mihelja Žaja
Alka Obadić
Zrinka Orlović
Sunčana Piri Rajh
Jasna Prester

Sanda Rašić Jelavić
Lucija Rogić Dumančić
Tomislav Sekur
Ana Sertić
Martina Solenički
Mario Spremić
Ana-Marija Stjepić
Marin Strmota
Dalia Suša Vugec
Jurica Šimurina
Viktor Viljevac
Rebeka Danijela Vlahov
Karlo Vujeva
Berislav Žmuk

University of Zagreb, Faculty of Economics & Business, Croatia

Zsófia Ásványi

University of Pécs, Faculty of Business and Economics, Hungary

Maja Baćović

University of Montenegro, Faculty of Economics in Podgorica, Montenegro

Nijaz Bajgorić

University of Sarajevo, School of Economics and Business, Bosnia and Herzegovina

Zoltán Baracska

Széchenyi István University, Hungary

Slađana Barjaktarović Rakočević

University of Belgrade, Faculty of Organizational Sciences, Serbia

Verena Batt

Lucerne University of Applied Sciences and Arts, Switzerland

Zoran Borović

University of Banja Luka, Faculty of Economics, Bosnia and Herzegovina

Diana Bratić

University of Zagreb, Faculty of Graphic Arts, Croatia

Marta Czyżewska

University of the National Education Commission in Krakow, Poland

Marko Čular

University of Split, Faculty of Economics, Business and Tourism, Croatia

Marija Čutura

University of Mostar, Faculty of Economics, Bosnia and Herzegovina

Katja Debelak

University of Ljubljana, Faculty of Public Administration, Slovenia

Daniela Garbin Praničević

University of Split, Faculty of Economics, Business and Tourism, Croatia

Alica Grilec

Higher Colleges of Technology, UAE

Miloš Grujić

University of Business Studies Banja Luka, Bosnia and Herzegovina

Alina Petronela Haller

Gheorghe Zane Institute for Economic and Social Research, Romanian Academy, Iasi Branch, Romania

Lidija Hauptman

University of Maribor, Faculty of Economics and Business, Slovenia

Sabina Hodžić

University of Rijeka, Faculty of Tourism and Hospitality Management, Croatia

Sandra Jelčić

University of Mostar, Faculty of Economics, Bosnia and Herzegovina

Dominik K. Kanbach

HHL Leipzig Graduate School of Management, Germany & University of Warsaw, Faculty of Management, Poland

Veronika Keller

Széchenyi István University, Hungary

Gabor David Kiss

University of Szeged, Faculty of Economics and Business Administration, Hungary

Igor Kovačević

University of Belgrade, Faculty of Economics and Business, Serbia

Martin Kuchta

University of Bratislava, Faculty of Economics and Business, Slovakia

Dženan Kulović

University of Economics, Faculty of Zenica, Bosnia and Herzegovina

Maciej Ławrynowicz

Poznań University of Economics and Business, Institute of Socio-Economics, Poland

Junsoo Lee

University of Alabama, USA

Grzegorz Leszczyński

Poznań University of Economics and Business, Institute of Marketing, Poland

Thorsten Litfin

Osnabrück University of Applied Sciences, Faculty of Management, Culture and Technology, Germany

Elena Makrevska Disoska

Ss. Cyril and Methodius University in Skopje, Faculty of Economics, Republic of North Macedonia

Giacomo Marzi

IMT School for Advanced Studies Lucca, Italy

Petar-Pierre Matek

Effectus University of Applied Sciences, Croatia

Gunther Meeh-Bunse

Osnabrück University of Applied Sciences, Faculty of Management, Culture and Technology, Germany

Gábor Miklós

Corvinus University of Budapest, Institute of Global Studies, Hungary

Davor Mikulić

The Institute of Economics Zagreb, Croatia

Dorota Murzyn

University of the National Education Commission in Krakow, Poland

Galjina Ognjanov

University of Belgrade, Faculty of Economics and Business, Serbia

Iztok Palčič

University of Maribor, Faculty of Mechanical Engineering, Slovenia

Primož Pevcin

University of Ljubljana, Faculty of Public Administration, Slovenia

Petra Platz

Széchenyi István University, Hungary

Saša Randelović

University of Belgrade, Faculty of Economics and Business, Serbia

Anna Rogala

Poznan University of Economics and Business, Poland

Doha Sahraoui

Cadi Ayyad University of Marrakech, Faculty of Legal, Economic and Social Sciences, Morocco

Aleša Saša Sitar

University of Ljubljana, School of Economics and Business, Slovenia

Agneš Slavić

University of Novi Sad, Faculty of Economics in Subotica, Serbia

Biruta Sloka

University of Latvia, Latvia

Robert Sonora

University of Montana, USA

Leonarda Srdelić

The Institute of Public Finance, Croatia

Mladen Stamenković

University of Belgrade, Faculty of Economics and Business, Serbia

Vivien Surman

*Budapest University of Technology and Economics, Faculty of Economic and Social Sciences,
Hungary*

Marek Szarucki

Cracow University of Economics, College of Management and Quality Sciences, Poland

Sanela Škorić

University of Zagreb, Faculty of Kineziology, Croatia

Maja Tadić Vujčić

Institute of Social Sciences Ivo Pilar, Croatia

Jean-Paul Thommen

University of Zürich, Switzerland

Gabrijela Vidić

University of Zadar, Croatia

Josip Visković

University of Split, Faculty of Economics, Business and Tourism, Croatia

Katarína Vitálišová

Matej Bel University, Faculty of Economics, Slovakia

Ivona Vrdoljak Raguž

University of Dubrovnik, Faculty of Economics and Business, Croatia

Vinko Zaninović

University of Rijeka, Faculty of Economics and Business, Croatia

Daniel Zdolšek

University of Maribor, Faculty of Economics and Business, Slovenia

**FEB Zagreb 16th International Odyssey Conference on Economics
and Business**

May 7-10, 2025
Dubrovnik, Croatia & online



© *University of Zagreb, Faculty of Economics & Business, Croatia*

Text © *Authors & Sever Mališ, Načinović Braje, Raguž Krištić, 2025*

This Conference Proceedings contains open-access articles distributed under the terms and conditions of the *Creative Commons Attribution – Non-Commercial – Share Alike 4.0 International license* (CC BY-NC-SA 4.0). This license allows to share (copy and redistribute the material in any medium or format) and adapt (remix, transform, and build upon the material) the material. The licensor cannot revoke these freedoms as long as the license terms are followed. You must give appropriate credit, provide a link to the license, and indicate if changes were made. You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use. The license does not allow the usage of the material for commercial purposes. If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original.

<https://creativecommons.org/licenses/by-nc-sa/4.0/>

All papers in this Conference Proceedings have undergone a double-blind peer review process. The authors are responsible for the linguistic correctness of their papers.

DOI <https://doi.org/10.22598/odyssey/2025.7>

ISSN 2671-132X

Price Free copy

Pages 1 – 758

Issued by University of Zagreb, Faculty of Economics & Business, Croatia

For the publisher Sanja Sever Mališ, University of Zagreb, Faculty of Economics & Business, J. F. Kennedy Square 6, 10000 Zagreb, Croatia

Referencing Sever Mališ, S., Načinović Braje, I. & Raguž Krištić, I. (Eds.) (2025). *Proceedings of FEB Zagreb 16th International Odyssey Conference on Economics and Business*. Zagreb: University of Zagreb, Faculty of Economics & Business. DOI: <https://doi.org/10.22598/odyssey/2025.7>

TABLE OF CONTENT

FOREWORD..... 1

ACCOUNTING..... 3

ACCOUNTING – TRACK 1: Perspectives on Reporting Challenges..... 4

EXPLORING SUSTAINABLE PRACTICES: A CASE STUDY ON NON-FINANCIAL REPORTING IN THE SPANISH TOURISM SECTOR..... 5

Petra BARIŠIĆ
Dijana VUKOVIĆ
Alba CARDIL FORRADELLAS

CURRENT DEVELOPMENTS IN IFRS – A CRITICAL SPOTLIGHT ON SDG ALIGNMENT..... 17

Gunther MEEH-BUNSE
Katja LUER

ESG IN THE SPOTLIGHT: UNVEILING THE ROLE OF INTERNAL AUDITS IN THE MONTENEGRIN BANKING SECTOR..... 37

Sofija SEKULIĆ
Nikola DRAŠKOVIĆ
Jelena JOVOVIĆ

VALUATION OF LIFE INSURANCE CONTRACTS WITH SUPPLEMENT INSURANCE - AN APPROACH IN THE CONTEXT OF IFRS 17..... 48

Silvia ZELINOVÁ
Jana ŠPIRKOVÁ
Mária KAMENÁROVÁ

ECONOMICS..... 65

ECONOMICS – TRACK 1: Growth, Development, and Economic Resilience
..... 67

THE ROLE OF INSTITUTIONS IN SUPPORTING ENTREPRENEURSHIP AND THE ECONOMIC GROWTH OF SELECTED EUROPEAN TRANSITION COUNTRIES 68

Esma FRLJAK
Lamija BIBER

IMPACT OF FILTERING METHODS ON CONVERGENCE DETECTION: A MONTE CARLO ANALYSIS USING THE PHILLIPS AND SUL MODEL..... 86

Goran MARKUŠIĆ

EFFECTS OF THE INVESTMENTS FINANCED BY EU FUNDS ON THE ECONOMIC ACTIVITY IN CROATIA..... 96

Davor MIKULIĆ

DEVELOPMENT OF THE BALTIC COUNTRIES' EXPORT NETWORK 110

Vaiva PETRYLĖ

REGIONAL CONVERGENCE OF INNOVATION ECOSYSTEMS: CASE OF CENTRAL AND EASTERN EUROPEAN COUNTRIES..... 123

Davor VLAJČIĆ

EXPLORING HEATFLATION: HOW CLIMATE CHANGE CONTRIBUTES TO INFLATIONARY PRESSURES 139

Berislav ŽMUK
Hrvoje JOŠIĆ

ECONOMICS – TRACK 2: Public Policy, Governance, And Sustainability 155

TAX COLLECTION EFFICIENCY IN CROATIA: A COMPARATIVE ANALYSIS 156

Fran GALETIĆ
Dora WALTER

SUSTAINABILITY AND ESG MATURITY OF LARGE EUROPEAN FINANCIAL INSTITUTIONS: A STATE-OF-THE-ART AND FUTURE RESEARCH DIRECTIONS 170

Ana IVANIŠEVIĆ HERNAUS

A STATISTICAL BREAKDOWN INTO THE EU-27 ENVIRONMENTAL TAXATION. PROFILING REGIONALITY SPECIFICITY IN A DECADE OVERVIEW..... 185

Andreea PERNICI
Stelian STANCU

CONSUMER ATTITUDES TOWARDS FOOD WASTE IN A SOCIODEMOGRAPHIC APPROACH 201

Petra PLATZ
Huszka PÉTER

ECONOMICS – TRACK 3: Human Capital Dynamics..... 211

LABOR PRODUCTIVITY AND WAGE ADJUSTMENTS IN CROATIA UNDER INFLATIONARY PRESSURES 212

Katarina BAČIĆ

THE ROLE OF ARTIFICIAL INTELLIGENCE IN BRIDGING THE NEGATIVE EFFECTS OF AN AGING WORKFORCE ON PRODUCTIVITY..... 229

Katja DEBELAK

Primož PEVCIN

GENERATION Z'S VIEWS OF SAVING, RETIREMENT, AND INSURANCE: A COMPARATIVE STUDY OF CROATIA AND SELECTED COUNTRIES 242

Marta HRENAR

Mira KRPAN

WORK ARRANGEMENTS AND FERTILITY INTENTIONS: THE ROLE OF JOB STABILITY AND FLEXIBILITY IN CROATIA..... 255

Marin STRMOTA

Krešimir IVANDA

Marta NIMAC

EDUCATION 266

EDUCATION – TRACK 1: Educational Innovation and Trends 267

PERCEIVED CONSUMER VALUES IN HIGHER EDUCATION: EXPLORING THE ALIGNMENT BETWEEN STUDENT EXPECTATIONS AND INSTRUCTOR PERSPECTIVES IN PRIVATE INSTITUTIONS IN CROATIA 268

Nina ANTIČIĆ

Isabell REPALUST

FROM OCCASIONAL TO DAILY USERS: HOW DOES THE FREQUENCY OF ChatGPT USAGE SHAPE STUDENT PERCEPTION? 284

Irena PANDŽA BAJŠ

OPEN GOVERNANCE AS A PART OF EDUCATIONAL PROGRAMMES: CASE STUDY OF SLOVAK REPUBLIC UNIVERSITIES AND NON-PROFIT ORGANISATIONS..... 293

Katarína VITÁLIŠOVÁ

Mária VAVRÚŠOVÁ

Anna VAŇOVÁ

Peter LACO

FINANCE..... 308

FINANCE – TRACK 1: Navigating Financial Markets and Monetary Flows 309

THE ROBUSTNESS OF THE UNCOVERED INTEREST PARITY (UIP) PARADOX FOR THE HUNGARIAN FORINT 310

Tamás ÁROKSZÁLLÁSI
Gábor Dávid KISS

DRIVERS OF DEPOSIT GROWTH IN NORTH MACEDONIA: AN EMPIRICAL STUDY 325

Milica MILOSHESKA GAVROVSKA
Trajko SLAVESKI

WHAT DOES IT HAVE TO DO WITH ME? – SOVEREIGN RISK AND HOUSEHOLD BORROWING COSTS..... 338

Marko PRIMORAC
Filip BADOVINAC

NETWORK ANALYSIS OF CROBEX: TWO SNAPSHOTS OF MARKET STRUCTURE 350

Silvija VLAH JERIĆ
Davor ZORIČIĆ
Jakov ČORAK

IT..... 364

IT – TRACK 1: Digital Transformation and Technological Innovations .. 365

ROBOTIC PROCESS AUTOMATION: A META-REVIEW AND FUTURE RESEARCH DIRECTIONS 366

Vesna BOSILJ VUKŠIĆ
Ljubica MILANOVIĆ
Dalia SUŠA VUGEC
Lucija IVANČIĆ

KNOWLEDGE, PERCEPTION AND USAGE OF NEW TECHNOLOGIES: RESEARCH ON TOURISM DEMAND IN CROATIA 379

Adriana JELUŠIĆ
Karmen MIKULIĆ
Stela PUŠELJIĆ

DIGITAL TRANSFORMATION AND SUSTAINABILITY IN THE CROATIAN HOTEL INDUSTRY: A COMPREHENSIVE ANALYSIS OF TOP-RATED HOTEL WEBSITES..... 393

Ivan PRANJIĆ
Božidar JAKOVIĆ
Ivan JAJIĆ

A QUANTITATIVE BIBLIOMETRIC LITERATURE REVIEW OF BUSINESS INTELLIGENCE IN CONSUMER-ORIENTED SECTOR..... 406

Ana-Marija STJEPIĆ

MANAGEMENT..... 417

MANAGEMENT – TRACK 1: Business Competencies in the Age of AI.. 419

REGLOBALIZATION: HOW EMERGING TECHNOLOGIES ARE SHAPING THE GLOBAL TRADE..... 420

Vladyslav BATO
Elena KAŠŤÁKOVÁ

AI AND THE FUTURE OF WORK: WAGE INEQUALITY, INDUSTRY TRANSFORMATION, AND RESKILLING BENEFITS 433

Karla Lea ČERKUĆ
Jasminka SAMARDZIJA

ARTIFICIAL INTELLIGENCE AND ORGANIZATIONAL EFFICIENCY: EXPLORING CORPORATE SOCIAL RESPONSIBILITY AS A MEDIATOR IN THE CONSULTING INDUSTRY 446

Soumaya DLIMI
Khawla BERAKKAB
Abir FAZROUN
Imane SIBAI

ARTIFICIAL INTELLIGENCE AND INDUSTRY 4.0 AN OVERVIEW OF THE CURRENT STATE OF RESEARCH AND FUTURE PERSPECTIVES IN BUSINESS AND MANAGEMENT: BIBLIOMETRIC LITERATURE REVIEW 463

Soumaya DLIMI
Zakaria OURICH
Abir FAZROUN
Khawla BERAKKAB
Fatiha LAHNINE
Mohamed LOULID

THE ROLE OF THE DIGITAL AGE AND ARTIFICIAL INTELLIGENCE IN SHAPING DIGITAL CORPORATE CULTURE 479

Natália MIŠÍKOVÁ
Nadežda JANKELOVÁ

MANAGEMENT – TRACK 2: Managing Innovation and Strategic Adaptation in the Digital Era..... 492

CHANGES IN CONSUMER HABITS AFTER THE COVID-19 PANDEMIC AND THEIR IMPACT ON SUPERMARKET BUSINESS MODELS..... 493

Juran GALETIĆ

NAVIGATING DIGITAL ENTREPRENEURSHIP: INSIGHTS FROM A BIBLIOMETRIC STUDY..... 507

Mircea Radu GEORGESCU
Anca Elena LUNGU

EMBRACING ORGANIZATIONAL AGILITY: TRANSFORMATIVE STRATEGIES FOR CREATING COMPETITIVE ADVANTAGE IN THE CORPORATE WORLD – LITERATURE OVERVIEW..... 518

Ina IVEKOVIĆ TAMHINA

LEARNING ORGANIZATIONS FOR VIABILITY IN THE HOSPITALITY INDUSTRY IN THE CONTEXT OF INSTITUTIONAL THEORY: A STUDY OF HOTELS IN ANTALYA, TÜRKİYE..... 529

Nataša RUPČIĆ
M. Bahadır KALIPÇI

AI DISCLOSURES AND BOARDS: ANALYZING THE ROLE OF FORMAL EDUCATION AND GENDER DIVERSITY 544

Darko TIPURIĆ
Elena PERIĆ

MANAGEMENT – TRACK 3: Sustainability and Emerging Business Models 559

THE ROLE OF INNOVATION IN THE CROATIAN METAL PROCESSING INDUSTRY: EXAMINING THE IMPACT OF INNOVATION TYPES AND FIRM PERFORMANCE 560

Tomislav BAKOVIĆ
Stjepan MIHALIĆ
Josip MIHALIĆ

SUSTAINABILITY MANAGEMENT REINFORCED BY THE SERVITIZATION - AN APPROACH TO EVALUATING SUSTAINABLE BUSINESS MODELS 573

Stephan KRESS
Christian SCHAEPERKOETTER

THE STRATEGIC INTEGRATION OF SUSTAINABILITY IN BUSINESS 588
Throstur Olaf SIGURJONSSON
Svala GUDMUNSDOTTIR

**EVALUATION FRAMEWORK FOR E-SCOOTER INTEGRATION INTO CITY
INFRASTRUCTURE – THE FIRST RESULTS OF HUNGARY 602**
Dorottya SZEMERE
Vivien SURMAN

**MANAGEMENT – TRACK 4: Employees, Work, And Organizational Well-
Being 616**

**NAVIGATING WORK-RELATED IDENTITY LOSS IN RETIREMENT: THE ROLE
OF ORGANIZATIONAL CLIMATE AND SOCIAL LIFE 617**
Ana BARTOL
Barbara GRAH
Darja PELJHAN

**DIGITAL COMPETENCE IN THE WORKPLACE: REVIEW OF ASSESSMENT
SCALES 630**
Andriana BAZIUK
Róbert HANÁK
Matej ČERNÝ
Anita ROMANOVÁ

**EXPLORING THE LINK BETWEEN PURPOSE-DRIVEN LEADERSHIP AND
EXTRA-ROLE BEHAVIOR: THE MEDIATING ROLES OF ENGAGEMENT AND
JUSTICE 642**
Nikolina DREVEN
Ivan MALBAŠIĆ
Lorena PIKL

**HR-RELATED ENABLERS OF HYBRID WORK REGIMES: CRANET DATA-
BASED EVIDENCE 653**
Soňa ĎURIŠOVÁ
Jana BLŠTÁKOVÁ

**PLAY AS A TRANSFORMATIVE FORCE: HOW PLAYFUL LEADERSHIP
FOSTERS IDENTITY, CREATIVITY, AND INNOVATION 667**
Domagoj HRUŠKA
Marek SZARUCKI
Ivana MARIĆ

INDIVIDUAL-LEVEL PARADOXES AND EMPLOYEE PERFORMANCE OUTCOMES: TESTING SUFFICIENCY AND NECESSITY CONDITIONS ACROSS CROATIAN ORGANIZATIONS..... 683

Sara MELKIĆ
Nikolina DRAGIČEVIĆ ROGGE
Matija MARIĆ

MAPPING THE RESEARCH LANDSCAPE OF WORKPLACE PHYSICAL ACTIVITY: A BIBLIOMETRIC REVIEW OF ITS IMPACT ON JOB PERFORMANCE AND EMPLOYEE WELLBEING..... 699

Tamara STANKOVIĆ
Alenka SLAVEC GOMEZEL

MARKETING..... 719

MARKETING – TRACK 1: Contemporary Marketing Strategies and Consumer Engagement..... 720

GENERATION Z CONSUMERS' PERCEPTION OF SHARING PERSONAL DATA FOR MARKETING PURPOSES..... 721

Luka BUNTIĆ
Mate DAMIĆ
Lovro MATIJEVIĆ

JUDGED BY ITS COVER: UNDERSTANDING THE FORMATION OF BOOK TESTIMONIAL NETWORKS..... 732

Jan DOMANSKI
Jonas REIF
Lea SCHAAB
Sebastian SCHÖTTELER
Heidi SCHUHBAUER

EFFECTS OF DIGITAL CHANNEL ACCEPTANCE ON INTERNAL COMMUNICATION CHANNEL SATISFACTION..... 745

Anja ŠPOLJARIĆ

CONFERENCE SPONSORS AND PARTNERS..... 757

VALUATION OF LIFE INSURANCE CONTRACTS WITH SUPPLEMENT INSURANCE - AN APPROACH IN THE CONTEXT OF IFRS 17

Silvia ZELINOVÁ

*University of Economics in Bratislava, Faculty of Economics Informatics, Department
of Mathematics and Actuarial Science, Slovakia*
silvia.zelinova@euba.sk

Jana ŠPIRKOVÁ

*Matej Bel University in Banská Bystrica, Faculty of Economics, Department of
Quantitative Methods and Information Systems, Slovakia*
jana.spirkova@umb.sk

Mária KAMENÁROVÁ

Slovak Office of Insurers, Slovakia
kamenarova@skp.sk

Abstract

New trends in life insurance regulation have a major impact not only on gross written premiums reported in financial statements but also on the overall profit recognition of the insurance products. Since 2023 the IFRS 17 standard has come into force as mandatory in some jurisdictions such as local GAAP and for international insurance groups. This resulted in major changes in the actuarial valuation methods used for technical provision valuation and consecutive financial disclosures. New variables such as contractual service margin and risk adjustment for non-financial risks are part of the insurance company's liabilities and affect the total value of the economic result reported by insurance companies. The paper presents a proposal for a model for valuing portfolio of term insurance contracts with supplement insurance covers critical illness. The amount of the premium depends on the choice of the adequate actuarial assumptions, which describe in detail the actuarial assumptions and their selection. The main output of the paper is a complete valuation of a product with supplement insurance covers in the context of IFRS 17 valuation. The risk adjustment is valued using the Value at Risk method at the 70th percentile. The proper valuation of contractual service margin and risk adjustment is a necessary source of information for insurance company management to manage products not only in life insurance.

Keywords: term insurance, critical illness, IFRS 17, actuarial valuation basis, contractual service margin, risk adjustment

JEL classification: G22, C02, G32, C69

Introduction

Actuaries are highly qualified experts who provide expert advice and appropriate solutions to financial, business, or social problems related to uncertain future events. Actuaries use

mathematics and statistics to estimate the financial impact of risk and uncertainty with aim to better manage overall company's risks, both qualitative and quantitative ones. They collaborate on product design and development, determining the amount of insurance premiums, so-called pricing, the methodology of insurance liabilities valuation and their subsequent quantification, so-called reserving, financial reporting for the purposes of IFRS 17, IFRS 9 (Financial instruments), IFRS 15 (Revenue from contracts with customers), and others, solvency and capital requirement testing, risk management as a function of risk management, (Alhawtmeh, 2023). Currently, more and more actuaries work on data analysis in data science and big data projects, regulatory compliance, e.g. also in validating the results of artificial intelligence (AI), as advisors to ministries or governments and research and development. Another area in which actuaries specialize is enterprise risk management. In the financial sector, this is defined as a risk management function.

In Slovakia, all insurance companies have been required to report their liabilities according to IFRS standards since 2005. All methodologies for insurance companies in Slovakia and also courses at universities are in accordance with the currently valid IFRS 17 standard. We believe that this approach will gradually become mandatory and implemented at least in all countries in the European Union.

In a life insurance company, they perform several tasks that can be divided into four basic groups:

- creation and valuation of insurance products (pricing),
- methodology, best estimate assumption and valuation of the value of the reserve of insurance contracts (reservation), including surrender values, IFRS 17 and Solvency II (European Union, 2009), IASB (2019),
- calculation of capital requirements, solvency testing, and other activities related to quantitative risk management,
- data analysis, use of actuarial techniques in processing big data, data science and AI.

The result of the process of creating and pricing insurance products results in determining the amount known as insurance premium policyholder will pay for the insurance services. The insurance premium is the costs that the policyholder pays to the insurance company to take on certain risks and provide the corresponding guarantees related to the death and/or survival, or the health status of the insured person. The product creation process includes the following actuarial activities:

- insurance product pricing, i.e., insurance rate, in connection with the conditions is the underwriting of health risk (i.e., insurance exclusions, content of insurance coverage, for example in case of illness, disability), employment risk (i.e., office employee, vs. construction worker) or various risky hobbies (i.e., road running, vs. diving, parachute jumping),
- determining the assumptions for valuing the insurance premium (actuarial valuation basis), choosing an appropriate valuation method, and calculating additional guarantees and options into the product price,
- programming, creating an actuarial model that projects cash flows, discounts them in order to determine the expected profit margin of the insurance product,
- creating product documentation in accordance with actuarial standards and internal regulations of the insurance company,
- in the case of life insurance products that are associated with investments, the actuary cooperates in setting the mechanism for determining the value of the interest

guarantees provided, profit shares for the client or also setting the investment strategy of the insurance company or investment fund.

The paper deals with the valuation of term insurance with supplementary critical illness insurance. The aim of the paper is to present a proposal for valuation in the context of IFRS 17 (IFRS 17, 2020), considering the complete methodology and principles that the insurance company must apply. After an introduction to actuarial issues, the methodological part of pricing the product and valuation of risk adjustment (RA) and contractual service margin (CSM) values follows. After defining actuarial assumptions and formulas, actuarial analyses in the context of IFRS 17 follow. The research issue consists in finding the optimal application of the principles described in the IFRS 17 standard. In the results section, CSM and RA are analyzed, because the profit from insurance contracts depends on these values and on their way of calculation.

Literature review

IFRS 17, issued by the IASB in 2017 and effective from 2023, represents a fundamental reform of insurance contract accounting compared to the previous standard IFRS 4. The main difference is a unified approach to measuring insurance liabilities using new values: the Fulfillment Cash Flows, Risk adjustment and the Contractual Service Margin, thereby increasing the transparency and comparability of financial statements (IFRS 17, 2020). PWC (2022) highlights the impact on the volatility of insurance companies' profitability, as IFRS 17 requires updating assumptions. According to Deloitte (2022), the main challenge of implementation is the complexity of calculations and the demands on IT systems. Spigarska (2020) presents the significant changes that IFRS 17 introduces compared to IFRS 4, especially in the area of insurance contract valuation and their impact on insurance companies' financial statements. Broz Tominac (2023) analyzes the key improvements of IFRS 17 compared to IFRS 4, including aspects such as relevance and accuracy, profitability, and comparability of financial statements.

Valuation of life insurance contracts with supplementary insurances under IFRS 17 is a complex process requiring a standardized accounting approach. IFRS 17 introduces the General Measurement Model (GMM) and the Variable Fee Approach (VFA), which significantly impact contract valuation (Palmborg et al., 2020). A key component of IFRS 17 is the contractual service margin, which enables the gradual recognition of profits over the policy's lifetime, ensuring consistency in financial reporting (International Monetary Fund [IMF], 2020). Supplementary insurances, such as disability or critical illness riders, pose challenges in risk assessment and discount rate selection (EIOPA, 2024a). Actuarial assumptions, including mortality, lapse rates, and discounting, are crucial in determining insurance liabilities. The adoption of IFRS 17 has led insurers to reassess their financial models, aligning with a principle-based framework (IMF, 2020). Research suggests that the standard enhances transparency and comparability among insurers, improving stakeholders' decision-making processes (Palmborg et al., 2020). However, implementation challenges, such as data granularity and system modifications, remain significant hurdles (EIOPA, 2024b). European regulators have analyzed the impact of IFRS 17 on insurers' financial statements, identifying variations in liability valuation (EIOPA, 2024b). Further empirical studies are needed to assess the long-term financial effects of IFRS 17 on insurers' profitability and solvency (IMF, 2020). Overall, the framework provides a more accurate representation of insurance obligations, ensuring a fair valuation of contracts with supplementary coverages.

Methodology of pricing of life insurance product

This section introduces term life insurance, including supplementary critical illness coverage, forming a single contract.

- Term insurance: The insured event occurs when the insured person dies during the insurance period. The insurance ends when the insurance event occurs, the policy period expires, or the policyholder cancels it. The policyholder is not entitled to payment of the surrender value, nor is he entitled to a profit sharing.
- Supplementary critical illness insurance: Insured event: diagnosis of a critical illness defined in the list during the insurance period, such as diagnosis of various types of cancer according to the list, stroke, heart attack, transplantation of various organs, and sclerosis. The lists of covered illnesses tend to be long and varies for different insurance companies. The insurance ends on the date of the earliest event: the insured event occurs, the insured person passes away, the insurance period expires, or the policyholder terminates the insurance early. The policyholder is not entitled to payment of the surrender value, nor is he entitled to a profit sharing.

In Table 1 are described the actuarial assumptions used for product pricing. *The actuarial valuation base consists of technical interest rate, mortality rate, and incidence rate for critical illnesses. The initial assumptions include administrative, settlement expenses, targeted profit margin, and cost of capital. The input information is the parameters of the insurance product: acquisition and maintenance commission. Unisex mortality tables are used for pricing premium (under EU directive 2004/113/ES), but female mortality tables are used for next actuarial analyses, e. g. for estimation of claims. (Statistical Office of the Slovak Republic, 2025).*

Table 1: Assumptions used for pricing

Product	Term insurance Supplementary critical illness insurance	
Entry age	50	woman
Sum insured	50,000 €	
Insurance period	5	
Term insurance		
Initial costs	100 €	
First year commission	50 %	from the first year's premium
Administrative costs	25 €	from the 1 st year, increases by inflation
Maintenance commission	10 %	from the 2 nd year and further premiums
Cost of insurance claims	30 €	subject to inflation
Technical interest rate	2 %	
Mortality rate	MT 2022	unisex mortality tables
Target profit margin	15 %	
Supplementary critical illness insurance		
Initial costs	50 €	
First year commission	50 %	from the first year's premium
Administrative costs	5 €	from the 1 st year, increases by inflation
Maintenance commission	10 %	from the 2 nd year and further premiums
Cost of insurance claims	150 €	subject to inflation
Incidence rate	+ 15 %	unisex mortality tables 2022
Target profit margin	10 %	

Source: own processing

The gross premium is created by adding costs to the net premium. It can also be referred to as an adequate premium. The basic principle of calculating the total premium is to cover the costs of a specific insurance contract, IFRS 17 (2020). First, all expenses are divided into individual groups of insurance products and assigned to activities related to the creation, operation, and sale of the given insurance. These costs include distribution expenses, such as commission and operational costs of the insurance company, which are allocated per insurance contract. All costs are then calculated into the insurance premium.

Equivalence equation for the gross premium is in the form

$$PV(B) = PV(SA) + PV(C) \quad (1)$$

where

- $PV(B) = B \times \ddot{a}_{\overline{xn}|}$ - the present value of the premium,
- $PV(SA) = SA \times A_{\overline{xn}|}^1$ - the present value of the benefits,
- $PV(C)$ - the present value of the costs.

The present value of the costs of distribution - commissions depends on the way they are determined by the insurance company.

Let

C_i – initial commission, which is a percentage of the premium for the first year,

C_r – maintenance commission, which is a percentage of each subsequent premium.

Then, the present value of the commissions is obtained from

$$C_i \times B + C_r \times B \times {}_1|\ddot{a}_{\overline{xn-1}|} \quad (2)$$

We denote the value of a temporary due one-year deferred annuity with inflation

as ${}_1|\ddot{a}'_{\overline{xn-1}|}$.

The present value of an insurance company's expenses related to a product can be expressed as either a fixed component or as a percentage of the premium or sum insured. We consider fixed expenses, such as

E_i – initial expenses,

E_r – renewal/administration expenses,

E_c - expenses associated with insurance claims.

The present value of additional costs can be expressed in the form

$$E_i + E_r \times {}_1|\ddot{a}'_{\overline{xn-1}|} + E_c \times A_{\overline{xn}|}^1 \quad (3)$$

The present value of costs, after adding the present value of costs to the present value of commissions, is given by the formula

$$PV(C) = C_i \times B + C_r \times B \times {}_1|\ddot{a}_{\overline{xn-1}|} + E_i + E_r \times {}_1|\ddot{a}'_{\overline{xn-1}|} + E_c \times A_{\overline{xn}|}^1 \quad (4)$$

We put present values $PV(B)$, $PV(SA)$ a $PV(C)$ into premium equivalence equation

$$B \times \ddot{a}_{\overline{xn}|} = SA \times A_{\overline{xn}|}^1 + C_i \times B + C_r \times B \times {}_1|\ddot{a}_{\overline{xn-1}|} + E_i + E_r \times {}_1|\ddot{a}'_{\overline{xn-1}|} + E_c \times A_{\overline{xn}|}^1 \quad (5)$$

and thus, we obtain the relationship for premium for term insurance in the form (Krčová et al., 2022):

$$B = \frac{SA \times E_c \times A_{\overline{xn}|}^1 + E_i + E_r \times {}_1|\ddot{a}'_{\overline{xn-1}|}}{\ddot{a}_{\overline{xn}|} - C_r \times {}_1|\ddot{a}_{\overline{xn-1}|} - C_i} \quad (6)$$

We add the profit margin that covers the cost of capital expenses to get the resulting insurance B_v for the main coverage is

$$B_v = \frac{B}{1 - \text{profit_margin}} \quad (7)$$

We utilized mortality tables from the Statistical Office for the year 2022, assuming an incidence rate for critical illness at 115 % of the mortality rate. A fixed inflation rate of 2 % was applied. This approach allows for the explicit inclusion of cost inflation in the calculation of the insurance premium. We applied inflation by using the following formula (Krčová et al., 2022).

$$\dot{i} = \frac{i - f}{1 + f} \quad (8)$$

To calculate the premium for supplementary critical illness insurance, we used the formula

$$B_{CI} = \frac{SI \times A_{\overline{xn}|}^1 + E_i + E_r \times {}_1|\ddot{a}'_{\overline{xn-1}|} + E_c \times A_{\overline{xn}|}^1}{\ddot{a}_{\overline{xn}|} - C_r \times {}_1|\ddot{a}_{\overline{xn-1}|} - C_i} \quad (9)$$

Next, we have calculated the profit margin and the resulting insurance B_v for the critical illness supplement, using formulas (6), (7) and (9).

Table 2: Premium for each part of insurance

Premium	Term insurance (€)	Critical illnesses (€)
Net premium	247	284
Total amount of premium	415	408

Source: own processing

When determining the best estimate of the interest rate, we will base our calculations on the spot risk-free interest rate curve for the euro as of 31 December 2023 published by (EIOPA, 2024a). The best estimate of the inflation rate is determined based on the quarterly forecast of Consumer price index published by the National Bank of Slovakia (NBS, 2024). These are shown in Table 3.

Table 3: Discount rates used in pricing process

Year of insurance	Spot risk-free interest rate (%) 31.12.2023	1-year forward interest rate (%) 31.12.2023	Annual cumulative discount rate (%) 31.12.2023	Inflation rate NBS (%)	Cumulative inflation rate NBS (%)
1	3.357	3.357	0.9675	3.00	3.00
2	2.690	2.027	0.9483	5.30	8.46
3	2.439	1.939	0.9303	3.80	12.58
4	2.350	2.083	0.9113	2.80	15.73
5	2.323	2.215	0.8916	2.80	18.97

Source: own processing based on EIOPA, 2024a and NBS, 2024

The formula for converting a spot interest rate to a forward interest rate forms a fundamental element for understanding the term structure of interest rates and financial transactions and is as follows (Hull, 2018)

$$F_{t,T} = \left[\frac{(1 + S_T)^{\frac{T}{T-t}}}{(1 + S_t)^{\frac{t}{T-t}}} \right] - 1 \quad (10)$$

where $F_{t,T}$ - forward interest rate between time t and T ,

S_t - spot interest rate at time t ,

S_T - spot interest rate at time T .

The actuarial valuation basis is static as seen as interest rate and inflation and does not change in the future based on market development, creating the basis for the valuation of financial options and guarantees. (Furrer, 2024).

In the context of an insurance company, a credit spread is used to discount future cash flows to consider the credit/counterparty risk associated with investments in assets that are not completely risk-free. According to the valuation framework, we distinguish further adjustments to the risk-free interest rate to determine the present value of cash flows. In the Solvency II methodology, a volatility adjustment is used to express the riskiness of the increase in credit spreads because of the financial crisis, and a matching adjustment, which adjusts the discount rate by the return on assets that are closely matched to liabilities. The methodology for calculating these adjustments is complex and is described in the Solvency II regulation, issued by EIOPA (2024b). For IFRS 17 purposes we will use only the risk-free interest rate as in the insurance products in example are pure risk covers and thus corresponding discount rate shall not be adjusted.

Lapse rate is company specific assumption and thus is difficult to observe in the markets. We used 10% in the first year, 9% in the second year, 8% in the third year and in the next years is 7%. For critical illness they are increased by 10% as supplementary insurance can be cancelled without cancelling whole policy. The best estimates of expenses are equal to the pricing ones as stated in Table 1.

Actuarial analyses in the context of IFRS 17

Each insurance company is required to justify the choice of accounting policy and the method of applying the valuation method for insurance contracts. The choice of accounting methodology is stated in the notes section, which is part of the financial statements. In this part of the paper, we will present the actuarial research methods that we applied to achieve the practical results described in the Results and Discussion chapter.

Valuation methods under IFRS 17 are described in detail by Widing and Jansson (2018), Pálež et al. (2021). The GMM method is critically analyzed by the German authors Ewelt-Knauer et al. (2018). Palmborg et al. (2021) demonstrate valuation and allocation method and profit-and-loss algorithm for a realistic size life insurance portfolio under IFRS 17. According to IFRS 17, an insurance company must report CSM and RA for a group of insurance contracts always profitable as profit margin is positive thus sum up term insurance and critical illness both creating one insurance policy into one portfolio. If the result of the GMM method is a contractual service margin, then the group of insurance contracts is profitable. If the result is a negative value, then it becomes a loss component, which must be reported in the income statement. However, the insurance company must monitor the development of the loss component in case the insurance contract becomes profitable again and a contractual service margin is formed (Pálež et al., 2021). Coverage units were calculated under the sum assured. CSM release through coverage units' pattern (Zelinová et al. 2022b).

The mathematical relationship for cash flow modelling of best estimate of liabilities:

$$CF_t = B_v \times l_{t-1} - SA \times d_t - E_i \times l_{t-1} - B_v \times C_i \times l_{t-1} - l_t \times E_r - d_t \times E_c - SA \times ci_t \quad (11)$$

where

l_t - is number of alive of year t ,

d_t - is number of deaths of year t ,

ci_t - is number of critical illnesses of year t .

The present value of future cash flows is calculated as follows

$$PVFCF_t = \sum_{t=1}^n \left[\frac{CF_t^{BoP}}{(1+r_{t-1})^{t-1}} + \frac{CF_t^{EoP}}{(1+r_t)^t} \right] \quad (12)$$

where

$PVFCF$ - present value of future cash flows,

CF_t^{BoP} - cash flow at the beginning of the year t ,

CF_t^{EoP} - cash flows at the end of year t .

r - locked in 1-year risk free interest rate,

t - time period – year.

Determining of CSM and RA

Contractual service margin (CSM) is part of the liability of insurance contracts and represents the unearned profit that the insurer will recognize when it provides services under the insurance contracts in the future. At initial recognition, the insurer measures the CSM at an amount that is recognized in balance sheet and not income statement (IFRS 17, 2020). The CSM corresponds to the difference between cash inflows and cash outflows, factoring the risk adjustment and discounting to time zero. Once the insurance contract period, the service margin must be fully written off and recorded in the income statement. The contractual service margin cannot be reported as a negative value. In case the difference between present value of cash flows and risk adjustment from non – financial risk has a negative value, then it is a loss component, that is reported in the income statement as a loss (Yousuf et al., 2021).

The CSM calculation is performed for the initial valuation using the GMM (General model measurement) method

$$\begin{aligned} CSM_0 &= PVFCF_0 - RA_0 > 0 \\ LC_0 &= PVFCF_0 - RA_0 < 0 \end{aligned} \quad (13)$$

where

$PVFCF_0$ - present value of the future cash flows at initial recognition,

RA_0 - risk adjustment for non-financial risk at initial recognition,

LC_0 - loss component at initial recognition.

The insurance coverage units provide a pattern for the releasing of the contractual service margin over time by using the amortization factor AF_t ,

where

$$AF_t = \frac{CU_t}{\sum_{t=1}^n PVCU_t} \quad (14)$$

CU_t - coverage units for the period t ,

$\sum_{t=1}^n PVCU_t$ - the sum of all coverage units for the remaining period (Zelinová et

al.,

2022a).

IFRS 17 does not specify the exact methods for calculating insurance coverage units, but it does provide guidelines within which to operate. One approach is to work with the amount of insurance benefits that are to be paid in the insured events (England et al., 2019). The benefit amounts are determined for each type of insurance coverage based on the maximum amount that the policyholder might receive. The expected duration of insurance coverage is

determined by the expected number of policies for each type of main coverage/risk separately. It is used to express the probability that insurance events occur only to the extent that they affect the expected duration of the contracts in the group. The calculation of *CU* is as follows

$$CU_i = \sum_{i=1}^n SA \times no_pols_if_i \quad (15)$$

where

SA - sum assured for all insurance coverage,

no_pols_if_i - an expected number of insurance contracts in force.

IFRS 17 does not prescribe specific techniques that insurers should use to assess risk adjustments for non-financial risks. However, to fulfill its intended purpose, IFRS stipulates that the assessment should adhere to the following characteristics:

- a risk with a lower frequency and higher severity will result in a higher risk adjustment compared to a risk with a higher frequency and lower severity,
- for the same type of risk, a contract with a longer duration has higher risk premiums than a contract with a shorter duration,
- risks with a broader probability distribution will have higher risk adjustments than risks with a distribution based on estimates,
- the less information about the insurer's current estimates and trends is available, the higher the risk adjustment. (Páleš et al., 2021).

Longer experience reduces uncertainty, which decreases risk adjustment value. One method for risk adjustment calculations is the Cost of Capital method, commonly used by most insurance companies. However, some insurance companies determine the risk adjustment amount using fixed percentage based on projected cash - flows or simpler calculations of Value at Risk or Conditional Value at Risk. In the modelling, we expressed the necessary capital by applying the shocks specified by the Solvency II methodology for the selected risks. The risks affecting term life insurance are mortality risk, expense risk, and lapse risk. These risks have correlation coefficients, shown in Table 4. For Critical Illness, the morbidity is added, and dependency coefficients are shown in Table 5.

Table 4: Risks for term insurance

Correlation matrix	Mortality	lapse	expenses
mortality	1	0	0.25
lapse	0	1	0.5
expenses	0.25	0.5	1

Source: Solvency II, European Union, 2009

Table 5: Risks for rider's Critical illnesses

Correlation matrix	mortality	morbidity	lapse	expenses
mortality	1	0.25	0	0.25
morbidity	0.25	1	0	0.5
lapse	0	0	1	0.5
expenses	0.25	0.5	0.5	1

Source: Solvency II, European Union, 2009

When calculating the risk adjustment, we chose a confidence level for the Value at Risk (VaR) of 70%. The VaR percentile represents the probability that the actual outcome will be less than the VaR value for the selected time period and is therefore equal to the target confidence level. The risk adjustment is defined as the difference between the VaR and the best estimate, which represents the present value of future cash flows as part of the fulfilment of cash flows. In the paper, we work with the values of the shock scenarios for non-financial risks offered by Solvency II at a confidence level of 99.5% in one year. Using a standardized normal distribution with parameters $\mu = 0$ and $\sigma = 1$, we adjusted the shock applied to 70% confidence level. The formula for distribution function is:

$$\phi(z) = \frac{1}{\sqrt{2\pi}} \times \int_{-\infty}^z e^{-t^2/2} dt \quad (16)$$

That will result for term insurance to an increase in mortality up shock by 3.05% instead of 15% used in Solvency II, an increase in cancellations in lapse mass shock by 10.18% instead of 40% used in Solvency II, and an increase in expenses by 1.9% instead of 10%, with a subsequent increase in inflation by 0.2% instead of 1%. In the case of critical illnesses with a 4.05% reduction in mortality down shock, instead of 20%, an increase in morbidity of 7.13% in the first year instead of 35%, 5.09% in the following years instead of 25%, shock for cancellation and inflation are same as for term insurance. Based on these shock scenarios, we express the value of additional capital using capital requirements.

$$\begin{aligned} NFR_t^{mt} &= PVFCF_t^{mt} - PVFCF_t \\ NFR_t^l &= PVFCF_t^l - PVFCF_t \\ NFR_t^e &= PVFCF_t^e - PVFCF_t \\ NFR_t^{md} &= PVFCF_t^{md} - PVFCF_t \end{aligned} \quad (17)$$

where

NFR_t^{mt} - Non – financial risk – mortality value of additional capital in a shock scenario with increased mortality,

NFR_t^{md} - Non – financial risk - morbidity, value of additional capital in a shock scenario with increased mortality,

NFR_t^l - Non – financial risk – lapse, value of additional capital in a shock scenario with increased cancellation,

NFR_t^e - Non – financial risk - expenses, value of additional capital in a shock scenario with increased costs and inflation,

$PVFCF_t^{mt}$ - Present value of Future cash flows, after applying shock for mortality,

$PVFCF_t^{md}$ - Present value of Future cash flows after applying shock for morbidity,

$PVFCF_t^l$ - Present value of Future cash flows after applying shock for lapse,

$PVFCF_t^e$ - Present value of Future cash flows after applying shock for expenses and inflation.

The value of the total capital for term insurance expressed by mortality, lapse and cost shocks is determined by the relationship similar, defined in Solvency II, (2015)

$$RA_t = NFR_t = \sqrt{\sum_{i,j} CorrL_{(i,j)} \cdot NFR_t^{mt} \cdot NFR_t^l \cdot NFR_t^e} \quad (18)$$

where

$CorrL_{(i,j)}$ - correlation parameter for life insurance underwriting risk shown in Table 4.

The value of the total non – financial risk for critical illness of supplementary insurance expressed by mortality, morbidity, cancellation and cost shocks will be determined by the relationship, like Solvency II, (2015)

$$RA_t = NFR_{SLTh} = \sqrt{\sum_{i,j} CorrSLTH_{(i,j)} \cdot NFR_t^{mt} \cdot NFR_t^{md} \cdot NFR_t^l \cdot NFR_t^e} \quad (19)$$

where

$CorrSLTH_{(i,j)}$ - correlation parameter for Health SLT underwriting risk shown in Table 5.

Results and discussion

The above assumptions and mathematical relationships can be used to project the future development of the insurance contract portfolio. For term insurance, we consider the number of contracts to be 1,000 for simplification, contracts for women will be used, for critical illness insurance we consider 900 units.

Table 6 shows the decrements involved in the calculation of cash flows for term insurance and Table 7 for critical illness, mortality tables and incidence rates used for projecting of claim cash – flows are specific for women and not unisex which were used in premium pricing, because insurance companies use for best estimates mortality tables for calculation of insurance liabilities.

Table 6: Projection of decrements for term insurance

Year	Age	Probability of mortality	Probability of lapses	is	Number of deaths	Number of lapses
t	x	$q(x)$	$s(x)$	$l(t)$	$d(t)$	$s(t)$
θ				1,000		
1	50	0.0020	0.1000	898.20	2.00	99.80
2	51	0.0022	0.0900	815.56	1.98	80.66
3	52	0.0026	0.0800	748.37	2.12	65.08
4	53	0.0032	0.0700	693.75	2.39	52.22
5	54	0.0033	0.0700	643.06	2.29	48.40

Source: own processing based on mortality tables, Statistical Office of the Slovak Republic, 2025

Table 7: Projection of decrements for critical illness

Year	Age	Probability of mortality	Probability of lapses	Probability of critical illness	Number of alive	Number of deaths	Number of critical illnesses	Number of lapses
t	x	$q(x)$	$s(x)$	$i(x)$	$l(t)$	$d(t)$	$ci(t)$	$s(t)$
θ					900			
1	50	0.0020	0.1100	0.0022	797.64	1.80	1.98	98.58
2	51	0.0022	0.0990	0.0026	715.22	1.75	2.07	78.59
3	52	0.0026	0.0880	0.0030	648.63	1.86	2.15	62.59

Year	Age	Probability of mortality	Probability of lapses	Probability of critical illness	Number of alive	Number of deaths	Number of critical illnesses	Number of lapses
4	53	0.0032	0.0770	0.0037	594.55	2.08	2.40	49.60
5	54	0.0033	0.0770	0.0038	544.88	1.96	2.26	45.46

Source: own processing based on mortality tables, Statistical Office of the Slovak Republic, 2025

Table 8 shows the variables entering the cash flow calculation according to formula 11. The profit margin is 38.07%, so the product is profitable. In this case, the insurance company should create a CSM and gradually release it throughout the insurance period.

Table 8: Cashflows for portfolio of insurance contracts

Premium (€)	Sum insured (€)	Acquisition costs (€)	Administrative costs (€)	Cost of claims settlement (€)	Cash-Flows (€)
782,200	199,000	536,100	29,500	357	17,243
698,188	202,495	-	97,002	381	398,310
630,269	213,310	-	88,920	416	327,623
575,213	239,735	-	82,093	483	252,901
530,486	227,435	-	76,381	468	226,202
3,216,356	1,081,975	536,100	373,896	2,106	1,222,280
				Profit margin:	38.07%

Source: own processing

We use the GMM method to value the cash flows of portfolio, according to formulas (11) and (12). Cash flows were distributed and discounted based on their timing within the period. At the beginning of the period (BoP) there were premium and acquisition costs. At the end of the period (EoP) there were administrative costs, insurance claims and costs of claims settlement.

Table 9: Amounts of CSM, RA

PV Future cash flows BoP	Risk free rate (forward curve) (%)	Risk adjustment BOP (€)	Release RA (€)	CSM BoP (€)
-1,185,481	3.357	66,817	2,663	1,118,664
-1,199,773	2.027	64,154	21,245	861,974
-811,630	1.939	42,910	17,491	624,231
-487,524	2.083	25,419	13,431	402,970
-232,796	2.215	11,988	11,988	195,752
-3,917,204			66,817	

Source: own processing

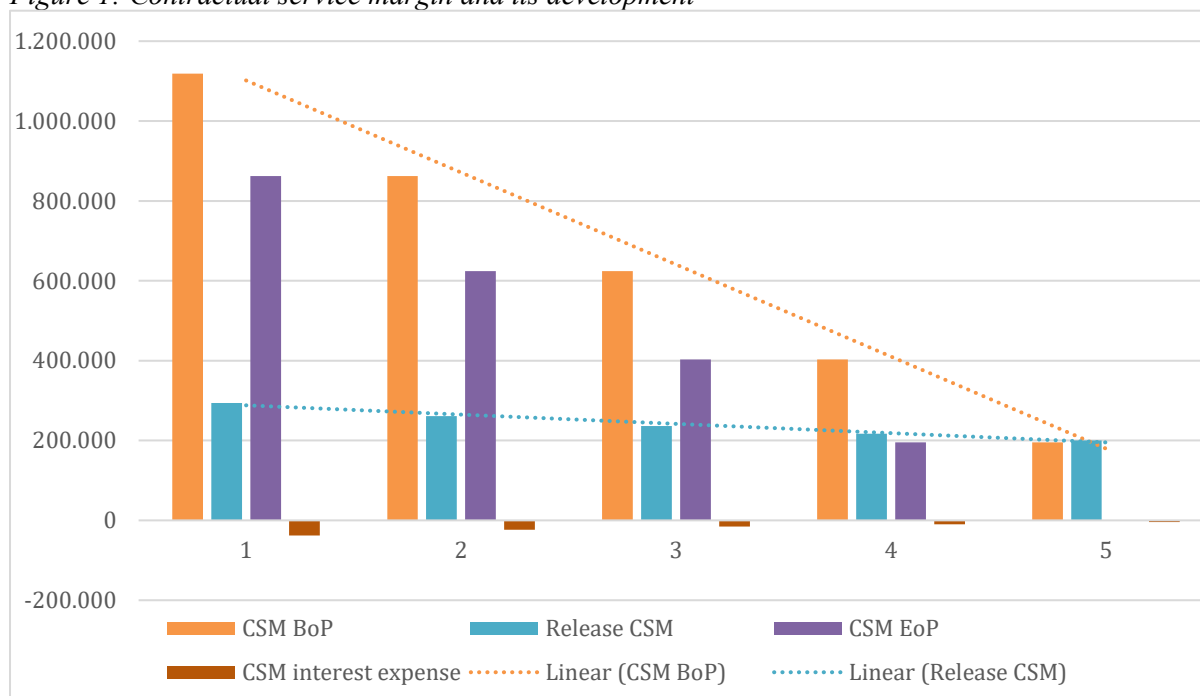
The present value of coverage units is used to calculate the amortization factor by which the CSM is released over the entire period. At the end of the period, the entire CSM and RA must be released in the income statement. CSM interest expense is calculated by unwinding effect of the present values CSM at beginning by applying the locked-in interest rate for corresponding year. The sum of the CSM interest expense and sum of the CSM at initial recognition is together sum of release CSM.

Table 10: Development of CSM

CSM BoP	Coverage units in period	PV Coverage Units	Amortization factor AF	Release CSM	CSM EoP	CSM interest expense
1,118,664	95,000,000	373,298,649	25.45%	294,244	861,974	-37,554
861,974	84,791,790	287,641,134	29.48%	260,931	624,231	-23,187
624,231	76,539,200	206,961,101	36.98%	236,486	402,970	-15,225
402,970	69,849,790	132,950,781	52.54%	216,688	195,752	-9,470
195,752	64,415,385	64,415,385	100.00%	200,299	0	-4,547
				1,208,647		-89,983

Source: own processing

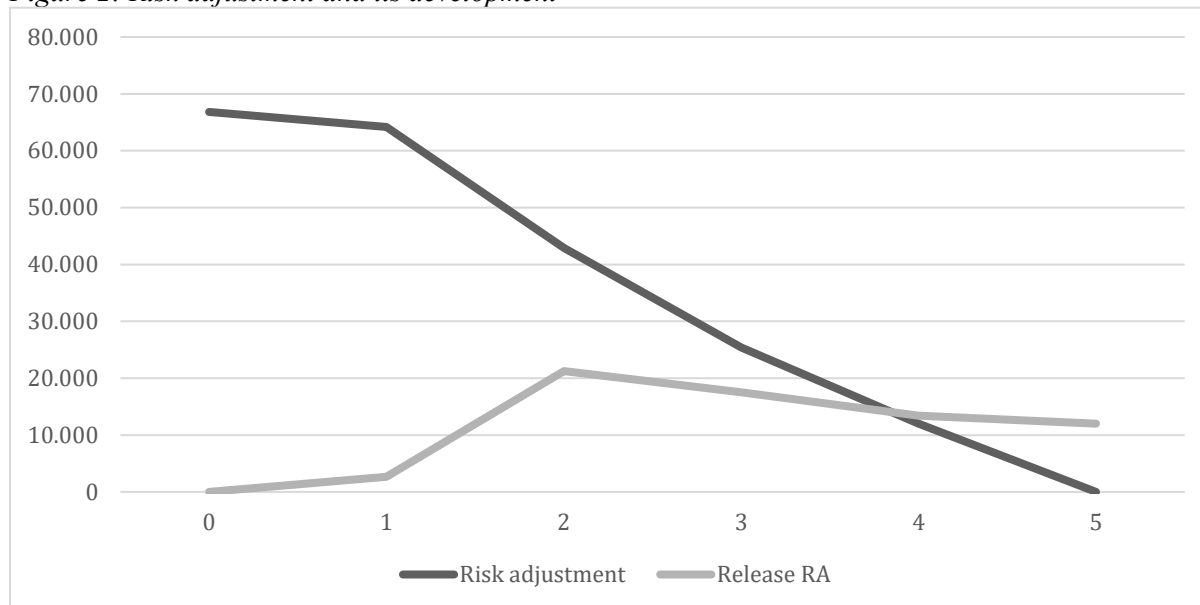
Figure 1: Contractual service margin and its development



Source: own processing

Figure 1 shows the CSM and its release over the years. The amount of released CSM is equal to the amount of CSM created at the initial recognition increased by the interest expenses. All projections are made at the time of initial recognition of a group of insurance contracts. Figure 2 represents development of risk adjustment from non – financial risk and its releasing value. Regarding the confidence level, Solvency II determines the risk margin based on the Solvency Capital Requirement (SCR) and applies a predefined cost-of-capital rate. In contrast, IFRS 17 permits insurers to select a confidence level that aligns with their specific risk profile and business model. This flexibility has resulted in a broader dispersion of confidence levels, typically ranging between 75% and 85%, with an observed industry average of approximately 80 % across both life and non-life insurance portfolios, (EIOPA, 2024).

Figure 2: Risk adjustment and its development



Source: own processing

Conclusion

In the paper, we presented a proposal for valuing a portfolio of life insurance contracts, detailing the initial recognition procedure and subsequent measurement using the GMM method. The insurance portfolio consists of 1,000 term life insurance contracts, with 900 critical illness supplementary coverage. It discusses the selection of appropriate actuarial assumptions and the compilation of an actuarial base. The valuation of an insurance portfolio leads to several conclusions. Actuarial assumptions play an important part in initial recognition of insurance portfolio, and their appropriate setting at the outset leads to satisfactory outcomes. The contractual service margin represents the profit derived from the portfolio of insurance contracts over the entire duration of insurance services. Consequently, the insurance company cannot immediately recognize it at inception of policy. Instead, it recognizes by gradually releasing portion throughout the duration of policy. With this approach, IFRS 17 ensured that the insurance company recognizes the profit in parts throughout the insurance period. Nonetheless the loss is recognized and reported immediately in the income statement. The risk adjustment reflects uncertainty in insurance contracts arising only from non-financial risks such as uncertainty in level of costs, mortality, morbidity, cancellations and inflation. Figure 2 illustrates the dissolution of the risk adjustment and its value at the beginning of each year. The risk adjustment can be seen as either a reward for insurers bearing risk or an amount to cover expected adverse effects under normal conditions, with solvency capital covering unusual circumstances. In conclusion, setting actuarial assumptions correctly and the accurate valuation of insurance contracts in initial recognition lead both to a saleable and competitive product.

Acknowledgement

This paper has been supported by the Scientific Grant Agency of the Ministry of Education of Research, Development and Youth of the Slovak Republic VEGA 1/0096/23 Selected

risk management methods in implementing partial internal models for determining solvency capital requirements, by ESG grant A-25-103/3020-17 Improving students' knowledge and skills in project management using the IPMA methodology and by VEGA 1/0124/24 Slovakia in the context of the pension index and population ageing index - future perspective.

References

- Alhawtmeh, O.M. (2023). The Impact of IFRS 17 on the Development of Accounting Measurement and Disclosure, in Addition to Improving the Quality of Financial Reports, Considering Compliance with the Requirements of IFRS 4—Jordanian Insurance Companies-Field Study. *Sustainability*, 15(11), 8612. <https://doi.org/10.3390/su15118612>
- Broz Tominac, S. (2023). Effects of the application of IFRS 17 on the financial reporting of insurance companies – the Croatian case. *International Journal of Membrane Science and Technology*, 10(4), 1279–1286. <https://doi.org/10.15379/ijmst.v10i4.2242>
- Deloitte. (2022). *IFRS 17: The new insurance contracts standard*. Retrieved February 15, 2025, from <https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Financial-Services/gx-GPPC-IFRS-17-implementation-guide.pdf>
- England, P.D., Verrall, R.J., & Wüthrich, M.V. (2019). On the lifetime and one-year views of reserve risk, with application to IFRS 17 and Solvency II risk margins. *Insurance: Mathematics and Economics*, 85, 74-88. <https://doi.org/10.1016/j.insmatheco.2018.12.002>
- EIOPA (2024a). *Risk-free rate term structures*. Retrieved February 10, 2025, from https://www.eiopa.europa.eu/tools-and-data/risk-free-interest-rate-term-structures_en#monthly-rfr-calculations
- EIOPA. (2024b). *EIOPA study explores impact of new accounting standard in insurance after first year of IFRS 17's implementation*. European Insurance and Occupational Pensions Authority. Retrieved February 10, 2025, from <https://www.eiopa.europa.eu>
- European Union (2009). *Directive 2009/138/EC of the European Parliament and of the Council of 25 November 2009 on the taking-up and pursuit of the business of Insurance and Reinsurance (Solvency II)*. Brussels: An official website of the European Union. Retrieved February 10, 2025, from <https://eur-lex.europa.eu/legal-content/SK/TXT/PDF/?uri=CELEX:32009L0138&from=en>
- Ewelt-Knauer, C., Kraft, A., & Schneider, J. (2018). The new international accounting standard for insurance contracts (IFRS 17)—A critical analysis of its impact on the insurance industry. *Zeitschrift für die gesamte Versicherungswissenschaft*, 107, 193-226. <https://doi.org/10.1007/s12297-018-0405-6>
- Furrer, H. (2024). Valuing Options Embedded in Life Insurance Contracts. *Review of Financial Studies*, 14(1), 113-147.
- Hull, J.C. (2018). *Options, futures and other derivatives*, 10e. New York: Aufl.
- IASB (2019). *The Transition Resource Group for IFRS 17 Insurance Contracts* <https://www.ifrs.org/content/dam/ifrs/meetings/2019/april/trg-for-ifrs-17/trg-for-ifrs-17-meeting-summary-april-2019.pdf>
- IASB (2020). *IFRS 17 – Insurance contracts*. Retrieved February 10, 2025, from <https://www.ifrs.org/issued-standards/list-of-standards/ifrs-17-insurance-contracts/>
- International Monetary Fund (2020). Accounting standards and insurer solvency assessment in the context of IFRS 17. *IMF Working Papers*. Retrieved February 10, 2025, from <https://www.elibrary.imf.org>
- Krčová, I., Sakálová, K., & Zelinová, S. (2022). Modern methods of determining premiums in life insurance In Slovak: *Moderné metódy určovania poisťného v životnom poistení*. Litomyšl: H. R. G. Czech Republic.
- Statistical Office of the Slovak Republic. (2025). *Mortality tables*. Retrieved February 10, 2025, from <https://slovak.statistics.sk/wps/portal/ext/themes/demography/population/indicators>
- National Bank of Slovakia (2024). *Inflation rate*. Retrieved February 10, 2025, from <https://nbs.sk/inflacia/>
- Palmberg, L., Lindholm, M., & Lindskog, F. (2021). Financial position and performance in IFRS 17. *Scandinavian Actuarial Journal*, (3), 171-197. <http://dx.doi.org/10.1080/03461238.2020.1823464>
- Páleš, M., Smažáková, L., Zelinová, S., Krátka, Z., & Strežo, M. (2021). *Actuarial science [Aktuárstvo]*. Bratislava: Letra Edu, Slovakia.
- PwC (2022). *In the Spotlight - Transition to IFRS 17 - Frequently Asked Questions*. Retrieved February 10, 2025, from https://viewpoint.pwc.com/content/dam/pwc-madison/ditaroot/gx/en/pwc/industry/insurance/in-the-spotlight---transition-to-ifrs-17---frequently-asked-questions/assets/Spotlight_Transition_August_2022.pdf

- Spigarska, E. (2020). Recognition and Valuation of an Insurance Contract in the Perspective of IFRS 17. *Zeszyty Naukowe Uniwersytetu Ekonomicznego w Krakowie*, 5(989), 69–81. <https://doi.org/10.15678/ZNUEK.2020.0989.0504>
- The International Financial Reporting Standards Foundation (2024). *IFRS 17. Insurance contracts*. IASB, 2020. Retrieved February 10, 2025, from <https://www.ifrs.org/issued-standards/list-of-standards/ifrs-17-insurance-contracts/>
- Widing, B., & Jansson, J. (2018). *Valuation practices of IFRS 17*. Retrieved February 10, 2025, from <https://www.diva-portal.org/smash/get/diva2:1190206/FULLTEXT01.pdf>
- Yousuf, W., Stansfield, J., Malde, K., Mirin, N., Walton, R., Thorpe, B., Thorpe, J., Iftode, C., Tan, L., Dyble, R., Pelsser, A., Ghosh, A., Oin, W., Berry, T., & Er, C. (2021). The IFRS 17 contractual service margin: a life insurance perspective. *British Actuarial Journal*, 26(2), 1–105. <https://doi.org/10.1017/S1357321721000015>
- Zelinová, S., Blahušíaková, M., & Šoltéssová, T. (2022a). Proposal for the Measurement of Reinsurance Contracts under IFRS 17. *Ekonomický Časopis/Journal of Economics*, 70(3), 284-304. <https://doi.org/10.31577/ekoncas.2022.03.04>
- Zelinová, S., & Teplanová, P. (2022b). Different Methods of Releasing the Contractual Service Margin. In Slovak: Rôzne spôsoby rozpúšťania zmluvnej servisnej marže. *Matematika, informační technologie a aplikované vědy: MITAV 2022*, Brno, Czech Republic, 1-12.