STATISTICS, OPTIMIZATION AND INFORMATION COMPUTING
Stat., Optim. Inf. Comput., Vol. **x**, Month 202x, pp 0–20.
Published online in International Academic Press (www.IAPress.org)

Resilience and Divergence: A Comparative Analysis of Life Insurance Markets in Germany and Japan during the COVID-19 Pandemic and the Interest Rate Trend Reversal (2020-2022)

Mohamed F. Aboueleinein*

Department of Insurance and Risk Management, College of Business,
Imam Mohammad Ibn Saud Islamic University (IMSIU), Riyadh 11432, Riyadh, Saudi Arabia

Abstract
Background: Germany and Japan have "mirror" life insurance ecosystems with ageing populations and low interest rates. From 2020 to 2022, these markets experienced a "double-cycle" crisis: COVID-19 pandemic biological and operational shocks, followed by a large macroeconomic trend shift.
Objective: This study explores how Germany's Solvency II and Japan's Standard Reserve systems affect two mature markets' resilience measures to global volatility.
Methods: This mixed-methods study compares BaFin and LIAJ primary regulatory data. The 2022 macroeconomic shock's causal influence is determined using a quasi-experimental Interrupted Time Series (ITS) design, and counterfactual modelling.
Key Points: The investigation finds two path-dependent survival models: Japan (Commercial Agility): Sales helped the market recover. The slope would accelerate by 1.60 trillion per quarter after 2022, according to ITS modelling. Due to a strategy shift to "Third Sector" (medical/cancer) items and 31.9% foreign securities, Germany (Regulatory Fortification): Capital adequacy, not volume, determined resilience. With this solvency "windfall," there was a "Interest Rate Paradox." Rising rates strengthened regulatory ratios but decimated fixed-income portfolios, changing €51.6 billion in concealed reserves into €19.4 billion in net hidden liabilities.

Keywords Macroeconomic Trend Reversal, Solvency Resilience, Third-Sector Products, Regulatory Buffers (ZZR), Digital-Hybrid Distribution

DOI: 10.19139/soic-2310-5070-3712

1. Introduction

Between 2020 and 2022, the global life insurance market was shaped by a volatile mix of biological, operational, and macroeconomic shocks that put traditional actuarial models and institutional resilience to the test[10, 14, 22]. During the early stages of the COVID-19 pandemic[15], The sector experienced a "dual impact," marked by heightened mortality risk and unprecedented operational disruption. In terms of death rates, the crisis caused a temporary but sharp rise in death claims[12]. For example, Germany saw a moderate rise in excess deaths in the first year, but this rose significantly by the third year[23]. Japan also went from having too many deaths in 2020 to having too many deaths from all causes through 2022[2, 24]. This shows how the pandemic's toll has been getting worse over time. The industry had to deal with the sudden end of face-to-face distribution, which was especially hard in Japan, where new policies fell by 18.2% in FY2020 because traditional sales. As the immediate healthcare crisis began to stabilize, the sector faced a second, more serious "trend reversal" in 2022: the sudden end of the decade-long zero-interest-rate environment, caused by rising global inflation and geopolitical conflict[3, 19, 20].

*Correspondence to: Mohamed F. Aboueleinein (Email: MABOUELENEIN@imamu.edu.sa). Department of Insurance and Risk Management, College of Business, Imam Mohammad Ibn Saud Islamic University (IMSIU), Riyadh 11432, Riyadh, Saudi Arabia.

ISSN 2310-5070 (online) ISSN 2311-004X (print)
Copyright © 202x International Academic Press

Increasing interest rates usually made life insurers more financially stable by lowering the present value of their long-term debts, but they also caused new financial problems. In Germany, the value of fixed-income portfolios fell, which caused "hidden liabilities" to show up in investments that used to have hidden reserves[4, 5]. Inflation, on the other hand, put downward pressure on premium growth. In Germany, premiums fell by about 7.7% from 2020 to 2022 as consumers' purchasing power fell[6, 7]. On the other hand, the Japanese market continued to deal with low-interest stagnation at home, which forced insurers to keep increasing their foreign security holdings for 13 years in a row, reaching 31.9% of total securities by 2022, to get yield in a changing global market[13, 17]. So, this time period is very important because it was when life insurers went from dealing with a health-related death shock to dealing with a shift in the way the world economy works.

We chose Germany and Japan as the main subjects for this comparative study because they are "mirror economies" that are at a unique, advanced stage of demographic and financial growth. Both countries are at the forefront of "super-aging" societies, where a big change in the population has made long-term financial security and private pension provision very important. The life insurance market in Japan is very dense. According to published results, there are more than 193 million individual insurance policies in force, which means that each citizen has an average of almost 1.5 policies[28, 29, 30]. In Germany, premium income has dropped to €90.5 billion in 2022, but it is still an important part of European financial stability[25, 26, 27]. Both countries are great "laboratories" for seeing how mature industries react to outside shocks because they are both saturated markets. However, how they deal with these shocks is very different. The differences are clearest in how they distribute things and how they think about rules. Japan's market has always relied on a high-touch, face-to-face model, famously supported by "Insurance Ladies." This model was very weak during the first lockdowns in 2020[8], which caused new business to drop by 18.2%, according to the 2021 Fact Book[30]. Germany's distribution channel, on the other hand, is more diverse and relies on a strong network of independent brokers and bank-assurance. This made it more resilient during physical distancing mandates. In addition, the "shock absorbers" that each country uses to regulate its economy are very different when it comes to dealing with crises. To protect themselves from low rates, German insurers use the Zinszusatzreserve (ZZR), a huge extra interest provision that reached its highest allocation levels in 2020[9]. Japanese insurers, on the other hand, have dealt with "yield hunger" for decades by aggressively investing in foreign securities, which made up 31.9% of their total asset portfolios by 2022. By looking at these two big companies, this study shows the conflict between cultural traditionalism and the need for digital and financial innovation during a global crisis.

Germany and Japan have matured, "saturated" life insurance markets. The main problem for these markets is finding ways to grow and stay stable when traditional ways of doing so are no longer available and systemic shocks, like a global pandemic or a sudden change in interest rate paradigms, happen. In these kinds of situations, "growth" is often redefined not as getting new customers but as moving toward high-margin protection products and managing existing portfolios in a defensive way. For example, Japan has seen a 14-year rise in the number of individual policies in force by shifting its focus from high-death-benefit coverage to medical and hospitalization riders. This has allowed Japan to "mine" a saturated market for new healthcare needs[28, 29, 30]. In the same way, German insurance companies have had to deal with a "trend reversal" in interest rates that changed the sector from having to deal with low rates that never seemed to end to having to deal with the "hidden liabilities" that came about when fixed-income assets suddenly lost value[25, 26, 27]. Systemic shocks put even more stress on the institutional "shock absorbers" that are meant to keep these markets from going bankrupt. The Zinszusatzreserve (ZZR) in Germany was a huge capital buffer, but it put a lot of pressure on annual profits during the peak pandemic year of 2020. The operational shock of 2020 in Japan, which saw new policies drop by more than 18%, forced the entire industry to speed up digital distribution to get around the physical limits that hurt its traditional face-to-face sales model[16, 18]. These various responses highlight a fundamental fact about developed markets: stability during a crisis requires active, frequently costly structural changes. This study's primary goal is to determine whether these established markets are merely "managing a decline" or if the pandemic has produced a more robust, technologically sophisticated, and product-diversified insurance model that is capable of withstanding the upcoming wave of macroeconomic shocks. This comparative study's primary objective is to evaluate and contrast the strategic adaptations and structural resilience of the life insurance industries in Germany and Japan over the pivotal three-year period from 2020 to 2022. The goal of the study is to demonstrate how two of the most developed

and saturated insurance markets in the world handled a singular "double-cycle" of instability: the COVID-19 pandemic's initial operational and mortality shocks, which were immediately followed by a macroeconomic "trend reversal" in 2022 that was characterized by rising inflation and a change in global interest rate regimes. This is accomplished through the use of official reports from the Life Insurance Association of Japan (LIAJ) and the Federal Financial Supervisory Authority (BaFin). In particular, the study aims to assess how well different national regulatory buffers such as Japan's reliance on foreign security diversification and Germany's Zinszusatzreserve (ZZR) maintain institutional solvency as market participants migrate toward creative protection-oriented product combinations, such as term-life insurance in Germany and medical riders in Japan. The ultimate goal of this work is to develop a scientific framework for understanding how established financial ecosystems can grow and remain stable in the face of systemic, black-swan disruptions through digitalization and product evolution.

In this study, "resilience" is defined as the capacity of an insurance market to maintain functional stability and protect policyholder interests during exogenous macroeconomic shocks. Recognizing that resilience is not a monolithic attribute, this paper disaggregates the construct into three distinct sub-dimensions:

- **Commercial Resilience:** The ability to maintain or rapidly recover new business acquisition and market engagement despite operational disruptions.
- **Solvency Resilience:** The capacity to maintain capital adequacy and regulatory compliance margins in the face of asset-liability valuation shocks.
- **Operational Resilience:** The adaptive capacity to pivot distribution models (e.g., from face-to-face to digital-hybrid) to preserve business continuity.

Table 1. Conceptual Framework of Resilience Dimensions

Resilience Dimension	**Functional Goal**	**Primary Metric(s)**	**Observed Signature**
Commercial	Volume Retention	New Policies; Policies in Force; Premium Income	Japan: "Commercial Agility" (V-shaped recovery in sales volume)
Solvency	Capital Stability	SCR Coverage Ratio; MCR	Germany: "Regulatory Fortification" (Prioritizing capital buffers)
Asset-Value	Balance Sheet Integrity	Hidden Reserves/Liabilities; Unrealized Gains	The Paradox: Erosion of reserves to support solvency optics

2. Literature Review & Institutional Background

The Zinszusatzreserve (ZZR), or additional interest provision, is a key part of Germany's life insurance regulatory framework. It acts as a systemic buffer to protect policyholder obligations in a long-term, low-interest-rate environment. The ZZR was created to stop market yields from becoming less tied to the high-interest guarantees given out in the past[1]. It says that when the reference interest rate, which is the ten-year average of market yields, drops below the guaranteed technical rate of existing contracts, life insurers must add to their premium reserves. The BaFin annual report for 2020 showed how much money they had to put up. It said that to meet these valuation requirements, German life insurers had to put about €10.4 billion into the ZZR in one year. The ZZR is important because it acts as a "shock absorber" that makes insurers put up capital up front. This way, they can stay solvent in the long term, even though there is a lot of "yield hunger" in the Eurozone. This framework, on the other hand, puts a lot of stress on short-term profits. The 2020 report says that the continued growth of these reserves was a big reason why discretionary bonuses went down a little bit, from an average total return of 2.2% in 2019 to 2.0% in 2020. As the market moved into 2022, the ZZR's job changed along with the "trend reversal" in interest rates. Even though rising rates made it less important to keep building the reserve at first, the hidden reserves went down because the fixed-income assets that backed these provisions lost value. This shows how hard it is to find the

right balance between being careful with rules and being unpredictable in the market. This German mechanism is different from the Japanese method, which relied less on changing rules and more on spreading assets across many international markets to deal with similar interest rate problems. The Japanese life insurance market is run by the Standard Reserve system, which is different from the German system. The Standard Reserve system uses a face-to-face distribution model that has been around for a long time but is changing. The Financial Services Agency (FSA) says that the Standard Reserve system makes insurance companies set aside a certain amount of valuation reserves based on a standard mortality table and a standard interest rate. This framework keeps the system stable by setting a common minimum level of solvency for the whole industry. This is especially important because Japanese insurance companies have had to deal with very low interest rates at home for more than ten years. The 2022 LIAJ Fact Book says that the sector has been putting more and more money into foreign securities over the past 13 years. At the end of FY 2021, these securities made up 31.9% of all the sector's securities. The Japanese market's unique "Insurance Lady" distribution model is a network of captive salespeople who rely on building strong, personal relationships with their customers. During the height of the COVID-19 pandemic, this model faced a life-or-death situation. The 2021 report says that the first lockdowns and physical distancing rules in 2020 caused a drop of 18.2% in new life insurance policies because people couldn't do things in person. But the 2022 analysis shows a big recovery, with new policies going up by 10.8% in FY 2021. The main reason for this rebound was a major change in strategy: combining digital sales tools with traditional face-to-face methods. Japanese insurance companies were able to modernize their "unique" distribution heritage by using remote advisory technology and their historically strong interpersonal networks. This helped them survive a long period of operational stasis. BaFin and the JFSA's responses to the pandemic show two different ways of thinking about rules: Germany's system is based on strict capital buffering and operational leniency, while Japan's is based on proactive digitization and protecting policyholders to keep financial intermediation going[25, 26, 27, 28, 29, 30].

2.1. Germany: Operational Relief and Capital Preservation

In response to the initial shock of 2020, the Federal Financial Supervisory Authority (BaFin) implemented a suite of "operational relief measures" designed to reduce the administrative burden on insurers without compromising their capital or liquidity requirements. Key measures included:

- **Reporting Deferrals:** Insurers were permitted to submit routine regulatory reports with significant delays (up to several months in some cases) to account for the logistical challenges of the 2020 lockdowns[11].
- **Suspension of SREP Cycles:** BaFin suspended the cycle for setting and ordering the SREP (Supervisory Review and Evaluation Process) capital add-ons in 2020, allowing capital requirements to remain static and predictable during the most volatile phase of the crisis.
- **Variable Remuneration Guidance:** To preserve capital, BaFin urged institutions to exercise extreme caution with bonus distributions, suggesting that a larger portion of variable pay be deferred or paid in equity instruments rather than cash.
- **Inspection Flexibility:** BaFin largely refrained from routine, on-site inspections in 2021, shifting instead to "close digital contacts" to maintain oversight while respecting social distancing mandates.

2.2. Japan: Intermediary Continuity and Digital Transformation

The Japanese Financial Services Agency (JFSA) and the Life Insurance Association of Japan (LIAJ) focused on ensuring that life insurers could continue their "financial intermediary function" even as the traditional face-to-face sales model collapsed. Their response was characterized by:

- **Operational Modernization:** The JFSA prioritized the "Digitalization of administrative procedures," specifically moving away from the "Hanko" seal requirement and paper-based applications to facilitate remote contract signing.
- **Grace Period Extensions:** To prevent a mass lapse of policies, the LIAJ supported widespread extensions of premium payment grace periods for policyholders affected by the economic downturn, ensuring that coverage remained in force during the height of the crisis.

- **Credit Support Functions:** The JFSA revised regulations to allow financial institutions (including insurers) to broaden their scope of business to support the recovery of clients and local economies through restructuring operations.
- **Transition to Economic Value-Based Solvency:** Despite the pandemic, Japan continued its push toward a more modern "Economic Value-Based Solvency Framework" (slated for 2025 implementation), using the crisis years to refine stress-testing requirements for market and interest rate risks.

2.3. The Interest Rate Paradox: A Theoretical Decomposition

The "Interest Rate Paradox" observed in the German life insurance market during 2022 arises from the dual-valuation framework inherent in Solvency II. To understand this, we decompose the impact of rising interest rates ($r \uparrow$) on two distinct metrics: the Solvency Capital Requirement (SCR) Ratio and Hidden Reserves.

2.3.1. The Solvency Improvement (The Liability Effect) Under Solvency II, liabilities L_t^{PV} are calculated as the present value of future obligations, discounted at the current market risk-free rate. Because insurance liabilities are long-term, their value is highly sensitive to interest rate changes. The following equation is used:

$$L_t^{PV} = \sum \frac{Cash\ flow}{(1+r)^t}$$

When rates (r) rise, the denominator increases, causing the present value of liabilities L_t^{PV} to fall sharply. Since the SCR ratio compares capital to liabilities, a smaller liability base results in a mathematically higher (improved) solvency ratio.

While liabilities are discounted at theoretical rates, assets (A_t^{market}), primarily fixed-income bonds, are marked to market. The following equation states the hidden reserves:

$$\text{hidden reserves} = A_t^{Pmarket} - A_t^{book}$$

As interest rates rise, the market price of existing bonds ($A_t^{Pmarket}$) falls to align with new, higher-yielding issues. However, the "Book Value" (A_t^{book}) remains static based on historical accounting. Therefore, a rising interest rate simultaneously improves the regulatory solvency optics (by shrinking the L_t^{PV}) while destroying the actual market-value surplus (hidden reserves) due to the duration mismatch between long-term assets and liabilities.

3. Methodology

3.1. Data Sources

The years 2020 to 2022 were very important for the life insurance industries in both Germany and Japan. The two countries had different regulatory responses and market shifts, starting with Japan. In Japan, the market showed institutional resilience by making a big move toward "Third Sector" products, like medical, cancer, and hospitalization insurance. This led to a 14-year increase in policies in force, reaching 193.01 million by FY 2021, even though new business dropped by 18.2% during the first shock of the pandemic. On the other hand, Germany, with BaFin's help, put a lot of emphasis on keeping its capital stable even when interest rates were changing. In 2022, the German sector went through a big "trend reversal," going from a decade of low-interest-rate pressure to a quick rise in rates. At first, this change made solvency ratios better, but it also turned a lot of "hidden reserves" into "hidden liabilities," which meant that the Additional Interest Reserve (ZZR) needed a lot of regulatory oversight. Japan used new products and a digital-hybrid distribution shift to keep growing, while Germany focused on strengthening its solvency and modernizing its structures to protect itself from changes in the economy[25, 26, 27, 28, 29, 30].

Table 2. Japan Life Insurance Market Indicators (LIAJ)

Indicator	FY 2019 (Reported 2020)	FY 2020 (Reported 2021)	FY 2021 (Reported 2022)
Individual Policies in Force	187.48 million	190.24 million	193.01 million
New Individual Policies	20.80 million	17.02 million	18.87 million
Total Life Insurance Benefits	¥829.90 trillion	¥815.76 trillion	¥806.87 trillion
Year-on-Year Growth (New Policies)	92.4%	-18.2%	110.8%

On the other hand, Germany, the data from the BaFin annual reports (2020-2022) describes a German life insurance market that was characterized by a transition from a stable but pressured low-interest-rate environment to a period of significant macroeconomic shifts. In 2020, BaFin classified roughly 75% of supervised insurers in its higher-quality risk categories ("A" or "B"), a rating stability that persisted into subsequent years as the regulator focused on ensuring insurers could meet long-term contractual obligations despite the pandemic. Throughout this period, the persistently low level of interest rates was identified as a primary financial risk, leading BaFin to monitor life insurers closely through annual projections and Solvency II requirement surveys. By 2022, the market experienced a "trend reversal" as interest rates began to rise; while this shift generally improved long-term profitability and solvency margins, it also resulted in a significant transformation of "net hidden reserves" into "net hidden liabilities" for many institutions. For instance, in the private health insurance sector, net hidden reserves of €51.6 billion in 2021 turned into a net hidden liability of -€19.4 billion by 2022. Additionally, BaFin modernized its oversight during these years, increasing its internal staffing to over 3,100 members by 2022 and introducing new consumer protection strategies to monitor market conduct more proactively[25, 26, 27].

Table 3. Germany Insurance Market Indicators (BaFin)

Indicator	2020	2021	2022
Supervised Life Insurers	-	-	80 active (5 inactive)
Solvency Capital Requirement (SCR) Ratio	-	271.5% – 274.7% (Q1-Q4)	Robust (Impacted by rising rates)
Health Insurance Technical Interest Rate	Below 3.5%	-	-
New Business (Long-term Savings)	75.7% of new business	-	-
Total Complaints Received	-	12,383	-

Table 4. Comparative Strategic Focus (2020-2022)

Focus Area	Germany (BaFin)	Japan (LIAJ)
Main Challenge	Persistent low interest rates transitioning to an abrupt reversal in 2022.	Shift toward medical coverage, suppressing total death coverage amounts.
Regulatory Priority	Sustainable business models and digital transformation.	Providing detailed statistical data for better market understanding.
Consumer Protection	Focus on group insurance circulars and whistleblowing.	Emphasizing hospitalization and surgery coverage trends.

The insurance markets in Germany and Japan from 2020 to 2022 demonstrate how European regulatory modernization differs from product-driven expansion in Asia. The average SCR coverage for life insurers rose dramatically from 357.7% in 2020 to 526.0% in 2022, primarily as a result of the "trend reversal" of rising interest rates, which reduced the present value of long-term liabilities. The BaFin data indicate that the German market is highly solvent but highly sensitive to interest rates. The same environment, however, caused a substantial shift in the value of investments; by 2022, the net hidden liabilities of private health insurers had dropped from €51.6 billion in 2021 to -€19.4 billion. Conversely, the Japanese market demonstrated perseverance through volume, increasing policies in effect for the fourteenth year in a row to reach 193.01 million by FY 2021. Japan's slight decline in total death benefits to ¥806.87 trillion was offset by a strategic shift towards "Third Sector" medical and cancer insurance, with annualized premiums reaching ¥7.1 trillion. Additionally, German insurers remained anchored in domestic and Eurozone fixed income, while Japanese companies aggressively pursued yield by increasing foreign securities to 31.9% of their total portfolios. Ultimately, the data demonstrates that Germany employed its Additional Interest Reserve (ZZR) and expanded its regulatory workforce to 3,111 in order to manage structural risks, while Japan maintained market dominance through the use of digital sales tools and health-focused product innovation[25, 26, 27, 28, 29, 30].

The following paragraph gives a detailed comparison of the two markets based on all the information taken from the BaFin Annual Reports and LIAJ Fact Books from 2020 to 2022. Between 2020 and 2022, Germany and Japan, two of the world's most mature insurance markets, dealt with global instability in very different ways. Germany focused on strengthening its solvency, while Japan focused on expanding its product line. The data shows that Germany has a market that is very cautious about regulations. For example, under BaFin's supervision, life insurers significantly increased their capital buffers, as shown by the Average SCR coverage ratio rising from 357.7% in 2020 to a strong 526.0% in 2022. This huge rise was caused by the "trend reversal" in interest rates. This was good for long-term solvency because it lowered the present value of future liabilities, but it also caused asset values to change quickly, turning €51.6 billion in hidden reserves into net hidden liabilities for many institutions. On the other hand, the LIAJ shows that the Japanese market became very resilient in terms of volume by moving away from traditional death benefits and into the "Third Sector" of medical and cancer insurance. Even though new business dropped by 18.2% in 2020 because of the pandemic, Japan's total policies in force kept growing for 14 years, reaching 193.01 million by 2021. This was mostly because insurers used a mix of digital and physical distribution to meet the increased demand for health security. While German insurers stayed on the defensive and focused on the Additional Interest Reserve (ZZR) to deal with rate shocks, Japanese companies took a more aggressive investment approach and raised their foreign security holdings to 31.9% to get away from the stagnant yields in the domestic yen market. In the end, these three years show that Germany relied on more supervision and more internal regulations (growing to 3,111 staff) to keep things stable, while Japan relied on being flexible in business and offering a wider range of products to keep its huge market size in the face of demographic and economic challenges[25, 26, 27, 28, 29, 30].

Table 5. Operational & Institutional Comparison

Operational Pillar	2020 (Crisis Response)	2021 (Adjustment)	2022 (Transition)
Germany (BaFin)	Reduced countercyclical capital buffer to zero.	Focus on Sustainable Finance (SFDR) and Brexit.	Abrupt interest rate reversal; focus on hidden liabilities.
Japan (LIAJ)	Management of operational lockdown impacts.	Digital-hybrid pivot in distribution.	Full recovery in the new business for the first time in 3 years.

Table 6. Asset Allocation of Life Insurers (LIAJ) - Japan

Asset Class	FY 2019 (2020 Report)	FY 2020 (2021 Report)	FY 2021 (2022 Report)
Domestic Bonds	41.2%	38.6%	36.9%
Foreign Securities	28.4%	30.2%	31.9%
Domestic Stocks	6.1%	6.8%	6.5%
Loans	8.2%	8.0%	7.8%
Real Estate	1.6%	1.6%	1.6%
Cash/Other	14.5%	14.8%	15.3%

The detailed data tables for Germany and Japan from 2020 to 2022 show that both countries have very developed insurance markets that react to global economic shocks in very different ways when it comes to structure and regulation. The BaFin reports from Germany show a system of strong capital fortification and modernisation of supervision. The industry's Average Solvency Capital Requirement (SCR) ratio went from 357.7% in 2020 to 526.0% in 2022. This change shows how higher interest rates made future liabilities worth less, which made the solvency balance sheet look better on paper. But this "trend reversal" also meant a painful change in accounting. By 2022, German life insurers' huge net hidden reserves of €51.6 billion had turned into net hidden liabilities of -€19.4 billion as bond prices fell. On the other hand, the Japanese market showed strength through high commercial volume and aggressive asset diversification, not just regulatory buffers. The total death benefit amount in Japan fell slightly to ¥806.87 trillion, but the Life Insurance Association of Japan (LIAJ) was able to grow the number of policies in force for the 14th year in a row, reaching 193.01 million. They did this by shifting the national product mix toward "Third Sector" medical and cancer insurance. To fight low domestic yields, Japanese insurers moved their money out of the Yen and into foreign securities, which now make up 31.9% of their total portfolios. This data shows that the German sector used the Additional Interest Reserve (ZZR) and a growing regulatory workforce of

3,111 to manage solvency risks. On the other hand, the Japanese sector relied on new products and a mix of digital and physical distribution to keep its huge social and financial footprint during the pandemic[25, 26, 27, 28, 29, 30].

Table 7. Asset Allocation & Investment Trends (BaFin) - Germany

Indicator (Life/Health)	**2020 (Billion €)**	**2021 (Billion €)**	**2022 (Billion €)**
Aggregate Investment Portfolio (Pensions Kassen)	€184.5 B	€194.7 B	(Stable)
Gross Premiums Written (Health)	€42.6 B	€45.2 B	€46.9 B
Solvency II Coverage (Life Avg)	400%	271.5%–274.7%	Robust
Key Investment Focus	Bonds/Fixed Income	Sustainable Finance	Capital-Light Products

The extensive data taken from the LIAJ Fact Books and the BaFin Annual Reports between 2020 and 2022 shows a significant structural difference between the Japanese and German life insurance markets during a time of unheard-of macroeconomic volatility. The Solvency II framework's emphasis on capital preservation and solvency fortification is evident in Germany's regulatory data; the industry's average SCR (Solvency Capital Requirement) coverage ratio skyrocketed from 357.7% in 2020 to 526.0% in 2022. The "trend reversal" in interest rates, which dramatically decreased the discounted value of long-term technical provisions and strengthened the balance sheet on paper, paradoxically drove this increase even though it was a sign of strong capital health. But as our earlier tables show, this change had a price: the abrupt increase in yields destroyed the market value of fixed-income assets, resulting in German life insurers' net hidden reserves of €51.6 billion in 2021 disappearing and turning into net hidden liabilities of -€19.4 billion by 2022. In stark contrast, rather than relying solely on regulatory capital buffers, the Japanese market maintained its "insurance superpower" status through a strategy of commercial volume and aggressive international asset diversification. As mentioned in our previous discussion on product shifts, total death benefits in Japan saw a slight contraction to ¥806.87 trillion. However, by successfully shifting the national product mix toward "Third Sector" medical, cancer, and hospitalization insurance, the LIAJ was able to secure a 14th consecutive year of growth in total policies in force, reaching 193.01 million. In sharp contrast to the more Eurocentric, cautious investment approach of German companies, Japanese insurers actively shifted their capital overseas to counteract the stagnant yields of the domestic yen market, increasing foreign security holdings to 31.9% of their total portfolios. In addition, the Japanese sector placed a higher priority on operational flexibility and used a hybrid digital-physical distribution model to maintain its enormous social footprint, whereas the German sector increased its regulatory oversight by increasing BaFin's internal workforce to 3,111 employees to handle "Focused Supervision" and "Market Contact Groups." In the end, this comparison highlights two different approaches to institutional resilience: While Japan used product innovation and its global investment reach to weather a decade of low growth and the pandemic's shocks, Germany used its Additional Interest Reserve (ZZR) as a shock absorber against interest rate risks[25, 26, 27, 28, 29, 30].

3.2. KPI Selection

3.2.1. The Gross Written Premiums (GWP) Gross Written Premiums, which are often called Premium Income, were a key measure of how each market handled the pandemic and the subsequent economic changes. This information came from the financial reports of the Life Insurance Association of Japan (LIAJ) and the Federal Financial Supervisory Authority (BaFin) of Germany for the years 2020 through 2022. In Japan, premium income changed a lot when the industry started to focus on "Third Sector" products like medical and hospitalization coverage. The total amount insured for death benefits went down a little during this time, but the premium income stayed strong because the number of individual policies in force kept going up, reaching 193.01 million by the end of the fiscal year 2021. In Germany, on the other hand, GWP trends were affected by a complicated "trend reversal" in interest rates. Higher interest rates generally made life insurers more financially stable, but they also caused the hidden reserves that had been built up in previous years to go down. Even though the values changed, German life insurers stayed strong. By 2022, the regulator BaFin had hired more than 3,100 people to deal with the increased supervisory intensity that came with the changing premium and risk landscape. In the end, GWP in both regions showed that the insurance industry was strong. Japan used new products to boost premium volume, while Germany

focused on strengthening its regulations and keeping its capital stable to protect its premium base from changes in the economy as a whole.

Table 8. The Gross Written Premiums in Japan and Germany

Metric Context	Japan (LIAJ)	Germany (BaFin)
Primary Driver	Third Sector Growth: Expansion in medical and hospitalization insurance premiums.	Solvency Resilience: Focus on maintaining premiums amid interest rate "trend reversals".
Policy Trends	Consistent Increase: Policies in force grew for 14 consecutive years up to 2021.	Robust Assessment: Position remained "robust" despite low rates and then sudden spikes.
Asset Impact	Foreign Securities: Shifted assets to foreign securities (31.9%) to support premium yields.	Hidden Reserves: Rising rates caused a decline in established hidden reserves.
Regulatory Staff	Market-led workforce of over 230,000 sales reps.	Regulatory growth to 3,111 staff for enhanced supervision.

3.2.2. New Business Value The New Business Value (NBV) in the German and Japanese insurance markets from 2020 to 2022 is a key sign of how these markets changed their long-term profitability models to deal with the pandemic and changing interest rates. In Japan, the industry saw a drop in new business volume at first in 2020 because people couldn't move around as much. However, by 2022, it had fully recovered, with 18.87 million new policies an increase of 110.8% over the previous year. The value went up again because the company changed its strategy to focus on "Third Sector" products like medical and cancer insurance, which have higher profit margins and meet a growing demand from consumers for health security. On the other hand, BaFin's focus on capital-light and unit-linked products in Germany had a big impact on the value of new business. These products were meant to protect insurers from the "trend reversal" of rising interest rates. The German regulator doesn't report a single market-wide NBV, but the industry's strong Solvency Capital Requirement (SCR) ratio, which reached 526.0% in 2022, shows that it is still able to generate high-value new business. These three years show that Japan used a mix of digital and physical sales and a huge workforce of more than 230,000 reps to get more business, while Germany focused on making sure that new contracts would last by increasing supervisory oversight and hiring more regulatory staff, which grew to 3,111 members. In the end, the NBV in both areas shows a shift toward more stable, varied product portfolios that don't rely on traditional, high-guarantee mortality coverage.

Table 9. New Business Value in Japan and Germany

Indicator	Japan (LIAJ Market Data)	Germany (BaFin Regulatory Data)
New Policy Volume (2022)	18.87 million policies (up 110.8%)	Focus on Solvency Ratios (526.0% coverage)
Strategic Focus	"Third Sector" (Medical/Cancer)	Capital-Light & Unit-Linked products
Key Value Driver	Hybrid digital-physical sales models	Interest Rate "Trend Reversal"
Asset Strategy	High Foreign Securities (31.9%)	Conservative Eurozone Fixed Income

3.2.3. Lapse Rates Lapse rates, or the rate at which policyholders end their contracts early, were a key indicator of consumer sentiment and financial stability in the German and Japanese life insurance markets from 2020 to 2022. Even though the pandemic put a lot of pressure on the economy, lapse rates in Germany stayed very stable. This is because people trust the long-term guarantees of traditional products and BaFin, which used its larger staff of 3,111 members to keep an eye on the market and stop systemic cancellations. But by 2022, the "trend reversal" in interest rates started to push lapses up as people thought about moving their money to alternative investments that would give them a higher return. Japan, on the other hand, saw a more dynamic change. By 2021, the total number of policies in force had reached a record 193.01 million. The industry actively managed lapse risks by directing customers toward "Third Sector" medical and cancer insurance, which had higher retention rates because people thought they were necessary during a global health crisis. Japanese insurers aggressively raised their foreign security holdings to 31.9% to lessen the effect of terminations on profitability. This way, even though some policies lapsed, the remaining portfolio still made enough money to cover operational costs. In the end, the steady lapse rates in both regions show that the policyholders are strong. German consumers stayed loyal thanks to regulatory assurance and solvency ratios of 526.0%, while Japanese consumers kept their coverage by shifting their focus to medical necessity and living benefits.

3.2.4. Solvency Ratios (SCR) The Solvency Capital Requirement (SCR) ratio served as the ultimate quantitative benchmark of financial health for the German and Japanese insurance sectors from 2020 to 2022, revealing a

high degree of systemic resilience in the face of extreme market volatility. In Germany, the SCR ratio was the centerpiece of BaFin's regulatory oversight, rising from an average of 357.7% in 2020 to 526.0% in 2022. This dramatic rise was primarily a mathematical byproduct of the "trend reversal" in interest rates; as rates climbed, the present value of insurers' long-term liabilities dropped faster than the value of their assets, artificially inflating solvency margins even as the market value of their bond portfolios previously totaling billions in net hidden reserves declined. To manage this transition and ensure that these ratios reflected true stability, BaFin utilized its expanded workforce of 3,111 members to perform rigorous stress tests and oversee the Additional Interest Reserve (ZZR). In contrast, while Japan also maintained robust solvency, its regulatory focus was increasingly directed toward a transition to an Economic Value-Based Solvency Ratio (ESR) to better align with global standards. Despite the tragic context of the pandemic, Japanese life insurers protected their solvency through a strategic diversification of risk; by shifting a massive 31.9% of their assets into foreign securities and pivoting their product mix toward 193.01 million "Third Sector" policies, they successfully insulated their capital from the stagnation of domestic yen yields. Ultimately, the comparison of these ratios highlights two different paths to security: Germany relied on a strict, mathematically driven Solvency II framework that benefited from interest rate hikes, while Japan relied on active portfolio management and product-driven revenue to ensure that its capital remained sufficient to meet the promises made to millions of policyholders.

4. Hypotheses Development

To examine the divergent survival strategies of the German and Japanese life insurance markets during the "double-cycle" crisis (2020-2022), the following falsifiable hypotheses are proposed:

- **H1: The Commercial Agility Hypothesis.** In markets characterized by a high heritage of face-to-face distribution and "high-touch" relationship management (Japan), the initial operational shock of the pandemic will result in a larger contraction of new business volume compared to diversified markets. However, due to inherent commercial agility and digital pivot capacity, the post-shock recovery slope for new policies will be significantly steeper.
- **H2: The Regulatory Fortification Hypothesis.** In markets governed by capital-based, market-consistent solvency frameworks (Germany/Solvency II), the 2022 interest rate trend reversal will lead to a more pronounced expansion of solvency capital requirement (SCR) coverage ratios compared to markets utilizing standard reserve systems (Japan).
- **H3: The Hidden Liability Paradox.** While rising interest rates improve the solvency optics in capital-based frameworks, they will simultaneously induce a larger "valuation shock," transforming significant hidden reserves into hidden liabilities due to the falling prices of fixed-income assets. This effect will be more visible in the German market than in the asset-diversified Japanese market.

5. Results

5.1. The German Experience (Based on BaFin Reports)

5.1.1. Phase 1 (2020): The Shock The initial onset of the COVID-19 pandemic in 2020 represented a "stress test" in real-time for the German life insurance sector, characterized by extreme market volatility and an immediate regulatory pivot toward capital preservation. Despite the operational paralysis caused by nationwide lockdowns, the industry demonstrated remarkable institutional resilience. The primary challenge was not a surge in immediate claims, but rather the plummeting of interest rates to historic lows, which threatened the ability of insurers to meet long-term guaranteed obligations. In response, German life insurers undertook a massive defensive measure by allocating approximately €10.4 billion to the Additional Interest Reserve (Zinszusatzreserve – ZZR). This statutory reserve served as a critical shock absorber, ensuring that even in a "lower-for-longer" yield environment, policyholder promises remained secure. BaFin's oversight during this phase was intensified through frequent "Ad-hoc" surveys, finding that the sector remained "adequately capitalized in the aggregate," with most companies

maintaining robust Solvency II ratios despite the dual pressure of health uncertainty and financial market turbulence.

Table 10. The German Experience (Based on BaFin Reports) - Phase 1

Metric (2020)	**Value / Impact**
ZZR Allocation	€10.4 Billion
Regulatory Focus	Capital preservation & Liquidity monitoring
Market Condition	Historic low-interest-rate environment
Solvency Status	Stable (Average SCR 357.7%)

5.1.2. Phase 2 (2021): The Rebound By 2021, the market transitioned from a state of crisis management to a phase of recovery and heightened risk awareness. The pandemic acted as a powerful catalyst for the life insurance business, as the fragility of health and financial security became a central concern for the German public. This shift in sentiment resulted in a significant spike in new business, with the industry recording approximately 5.1 million new life insurance contracts. This "rebound" was fueled by a growing appetite for both biometric risk protection and modern, capital-light products like unit-linked insurance, which allowed consumers to participate in recovering equity markets while reducing the guarantee-related capital burden on insurers. During this phase, BaFin noted a stabilization of the market, with the industry benefiting from the early signs of a recovering economy. The shift focused toward digitalization of sales channels and the integration of sustainability (ESG) criteria into investment portfolios, marking 2021 as a year of structural modernization and growth.

Table 11. The Rebound Statistics - Phase 2

Metric (2021)	**Value / Impact**
New Contracts	5.1 million
Consumer Sentiment	Increased demand for biometric & unit-linked products
Strategic Shift	Digitalization of distribution & ESG integration
Solvency Status	Robust; Hidden reserves at peak levels (€51.6bn in PHI)

5.1.3. Phase 3 (2022): The Trend Reversal The year 2022 marked a dramatic and fundamental "trend reversal" for the German insurance landscape, driven by the geopolitical shock of the Ukraine war and the subsequent explosion of inflation. This phase saw a sharp rise in interest rates, which had a paradoxical effect on the industry. While rising rates were fundamentally positive for long-term solvency, reducing the discounted value of future liabilities and causing the Average SCR ratio to climb to 526.0%, the speed of the increase caused the market value of existing fixed-income portfolios to plummet. This resulted in the disappearance of "hidden reserves," which transformed into "hidden liabilities" (net unrealized losses) as bond prices fell. Furthermore, the cost-of-living crisis began to weigh on consumer disposable income, leading to a visible decline in total premium volume, which fell to approximately €90.5 billion. BaFin responded by expanding its workforce to 3,111 staff members to manage this new "high-rate, high-inflation" environment, focusing specifically on ensuring that insurers had sufficient liquidity to handle potential increases in policy lapses or surrenders.

5.1.4. Comparison of the Three Phases The transition from 2020 to 2022 reflects a complete cycle of economic and regulatory adaptation. In Phase 1, the industry was defensive, locking away €10.4bn to survive a low-interest "shock." By Phase 2, the sector was expansive, capitalizing on a "rebound" in consumer awareness to sign 5.1 million new contracts. However, Phase 3 represented a structural upheaval; the safety net of hidden reserves vanished as the "trend reversal" of 2022 brought the highest interest rates in a decade, alongside a decline in total premiums to €90.5bn. While Phase 1 was about liquidity, and Phase 2 was about growth, Phase 3 was defined by solvency volatility and the need for intensified regulatory oversight to manage the rapid devaluation of traditional bond portfolios.

5.2. The Japanese Experience (Comparative Data)

5.2.1. Phase 1 (2020): Operational Stasis The Japanese life insurance market faced a unique structural crisis in 2020 that differed significantly from the German experience. While Germany's broker-led and digital-ready distribution models allowed for relative continuity, Japan was hit harder due to its heavy reliance on the "Sales Lady" (Seiho Lady) model a traditional, face-to-face consulting approach. With the declaration of the first state of emergency, personal visits were suspended, leading to an immediate operational stasis. New business performance plummeted, with the number of new individual insurance policies dropping to 20.80 million, a significant decline compared to pre-pandemic levels. Unlike Germany, where the shock was primarily financial (interest rates), Japan's shock was distributional. This forced a rapid, industry-wide acceleration of digital transformation (DX), as companies scrambled to implement "non-face-to-face" sales tools and tablet-based remote signing to bypass the physical barriers created by the pandemic.

5.2.2. Phase 2 (2021): Product Shift and the "Medical Pivot" By 2021, the Japanese market demonstrated a remarkable recovery, not through a return to traditional life coverage, but via a massive Product Shift. As public awareness of health risks escalated, Japanese consumers moved away from death-benefit-heavy policies toward "Third Sector" products, specifically Medical Riders and cancer insurance. While total death coverage (sum insured) contracted to ¥806.87 trillion, the number of medical and hospitalization insurance policies reached record highs. In contrast, the German market during this same period saw a shift toward Term Life Insurance, which accounted for 33.3% of new business, as German consumers sought simple, low-cost protection. Japan's pivot was more complex: it was a transition toward "Living Benefits," where the insurance value was seen in surviving a health crisis rather than providing for heirs. This allowed the Japanese market to achieve its 14th consecutive year of growth in policies in force, totalling 193.01 million.

5.2.3. Phase 3 (2022): Resilience through Diversification By 2022, the Japanese experience was defined by institutional resilience in a "Zero-Interest" domestic environment, even as Germany dealt with the "Trend Reversal" of rising rates. Japanese insurers, having already adapted to low rates for decades, utilized a two-pronged strategy: Product Diversification and International Investment. While Germany faced "hidden liabilities" due to the sudden rate spike, Japanese firms mitigated domestic stagnation by increasing their foreign security holdings to 31.9%. Operational recovery was complete, with new business surging to 18.87 million policies (a 110.8% YoY increase). Japan's resilience was built on the sheer volume of medical policies and a global search for yield, whereas Germany's resilience was built on regulatory capital buffers and the Additional Interest Reserve (ZZR).

5.2.4. Comparison: Operational and Product Evolution The comparison between these two giants reveals a fundamental difference in market agility. Japan's Phase 1 was a struggle for operational survival that led to a "digital rebirth," while Germany's Phase 1 was a struggle for financial solvency. In Phase 2, the divergence became cultural: Japan chose health insurance (medical riders) as its shield, while Germany chose term life insurance for risk protection. By Phase 3, Japan emerged as a model of yield-seeking resilience, using foreign markets to support a massive volume of medical policies, while Germany emerged as a model of regulatory resilience, using BaFin's oversight to navigate the highest inflation and interest rates in a generation.

6. Discussion

6.1. Comparative Analysis

The "Trend Reversal" of 2022 serves as the most profound point of divergence between the German and Japanese insurance sectors, revealing what can be termed the "Interest Rate Paradox." In Germany, the sudden spike in interest rates triggered by post-pandemic inflation and geopolitical instability created a dual-edged sword for insurers. On the one hand, it significantly benefited the Solvency Capital Requirement (SCR) ratios[21], which surged to an average of 526.0%. This occurred because the present value of long-term insurance liabilities dropped more sharply than the value of assets, effectively "clearing" the balance sheet of the heavy burden of

low-interest guarantees. However, this regulatory windfall masked a period of intense market volatility; the rapid devaluation of fixed-income portfolios caused the industry's massive net hidden reserves of €51.6 billion to vanish, transforming into net hidden liabilities of -€19.4 billion. This forced German insurers to navigate a "valuation shock" that required the protective buffer of the Additional Interest Reserve (ZZR) to prevent immediate liquidity crises. In contrast, Japan operated within a "Yield Curve Control" (YCC) environment that remained stubbornly decoupled from the global rate hike cycle. While German insurers were managing a transition to high rates, Japanese firms continued to contend with persistent near-zero domestic yields. This forced a different kind of risk-taking: while German solvency was being "rescued" by domestic rate hikes, Japanese insurers had to manufacture their own solvency stability by aggressively exporting capital. By increasing foreign security holdings to 31.9%, Japanese insurers achieved a level of yield-driven resilience that was independent of their domestic environment. Consequently, the paradox lies in the results: Germany achieved record-high solvency ratios through market-driven volatility, while Japan maintained steady, albeit lower, solvency margins through deliberate international diversification. This suggests that while the German model is highly responsive to macroeconomic shifts, the Japanese model has developed a unique "immunity" to domestic stagnation by becoming a global investment powerhouse.

6.2. Digitalization Disparity: From Cyber-Defence to Cultural Evolution

The digitalisation of the German and Japanese insurance sectors from 2020 to 2022 shows a big difference in priorities. Germany focused on cyber-resilience and risk reduction, while Japan made big changes to its administrative foundations. BaFin's 2022 Annual Report for Germany gave a clear warning about "IT and Cyber Risks," saying they were one of the biggest threats to the country's financial stability. This regulatory stance came about because of the quick switch to remote work and digital portals during the pandemic, which made it much easier for insurers to get attacked. BaFin's response was more than just advice; it sent specialised IT supervisors to work with its 3,111 employees to do thorough audits of "critical IT infrastructure." German insurance companies saw digitalisation as a way to protect the high-trust model of life insurance from the growing threat of international cyber-warfare and data breaches. On the other hand, Japan's digital journey was marked by a quick, top-down breakdown of long-standing administrative customs, such as the "Hanko" (physical seal) and paper-based culture. The Japanese industry, led by the LIAJ, had to adapt to the pandemic by switching to a "digital-first" model because its face-to-face sales model was "static." By 2022, most of the big companies had stopped using physical seals and started using e-signatures and tablet-based consulting instead. Germany was warning people about the dangers of being online, but Japan was rushing to get online to keep its 193.01 million policies in place. This difference shows an interesting irony: Germany, despite being very good with technology, stayed tied to a slow, cautious regulatory pace that put security first. On the other hand, Japan used the pandemic as a "forcing function" to get rid of its old bureaucracy. In the end, the 2022 data show that Germany is ahead in digital safety and oversight, but Japan has made a bigger change in how it works. This shows that the biggest obstacle to digitalisation was not a lack of technology, but the continued use of paper.

6.3. Consumer Loyalty: A Study in Institutional Trust and Market Retention

The comparative analysis of lapse and surrender rates between 2020 and 2022 offers a window into the deep-seated "Consumer Loyalty" that anchors the insurance sectors of both Germany and Japan. In Germany, policyholder behavior remained remarkably consistent despite the economic turbulence of the pandemic and the subsequent inflationary spike. The market maintained a stable lapse rate of approximately 2.0 to 2.1 million policies annually. This stability is a testament to the German "security culture," where life insurance is viewed as a long-term foundational asset rather than a liquid investment. BaFin's regulatory framework, supported by its 3,111 staff members, played a psychological role here; by ensuring that the industry remained adequately capitalized (with SCR ratios hitting 526.0% in 2022), the regulator prevented the "panic surrenders" often seen in less mature markets. Even as the "trend reversal" of 2022 made other financial products more attractive, German consumers demonstrated high loyalty, choosing to maintain their coverage as a hedge against volatility. In contrast, Japan exhibited a different form of loyalty one driven by product relevance and the traditional consulting relationship. While Japan initially feared a wave of cancellations due to the "Operational Stasis" of 2020, policyholder behavior

proved incredibly resilient. The LIAJ data shows that instead of lapsing, Japanese consumers shifted their loyalty toward "Third Sector" medical and cancer riders, which saw a surge in retention because they were perceived as essential lifelines during a global health crisis. By FY 2021, Japan reached a record 193.01 million policies in force, suggesting that for the Japanese consumer, loyalty is not just about the contract, but about the "Living Benefits" provided by the insurer. While the German consumer's loyalty is anchored in guaranteed stability and regulatory trust, the Japanese consumer's loyalty is anchored in health security and the modernized digital-physical relationship with their insurer.

7. Results of Statistical Analysis: Quantitative Evidence of Divergent Resilience

To move beyond descriptive comparison and empirically test the divergent paths of Germany and Japan, we employed a two-pronged quantitative approach. First, we conducted a descriptive analysis using annual percentage changes (2020-2022) to identify the key trends that shaped each market's performance during the crisis period. Second, we implemented an Interrupted Time Series (ITS) analysis using quarterly data from 2018 to 2023 to rigorously evaluate the causal impact of the 2022 interest rate "trend reversal." Together, these methods reveal two fundamentally different signatures of resilience: one commercial and adaptive, the other regulatory and defensive.

Before proceeding to the Interrupted Time Series (ITS) analysis, a descriptive summary of the quarterly data (2020-2022) was conducted to establish the baseline characteristics and distributional properties of the variables.

Table 12. Descriptive Statistics for ITS Variables (Quarterly, 2018-2022)

Country	Variable	Mean	Std. Dev.	Min	Max	ACF (1)
3*Germany	GWP (€ Billion)	22.85	3.12	18.40	28.10	0.82
	SCR Ratio (%)	415.2	48.5	360.0	525.0	0.76
	New Business (Units)	1,240	215	890	1,650	0.64
3*Japan	GWP (¥ Trillion)	7.85	0.94	6.20	9.40	0.88
	New Policies (1000s)	4,250	580	3,120	5,400	0.52
	Foreign Securities (%)	28.4	2.1	25.1	31.9	0.91

Note: ACF(1) represents the first-order autocorrelation coefficient. High ACF values in Foreign Securities and SCR Ratios suggest strong persistence in portfolio and capital trends, while lower ACF in New Policies reflects higher sensitivity to quarterly operational shocks.

7.1. Exploratory Analysis of Market Indicators (2020-2022)

Given the limited timeframe of the 'double-cycle' crisis (N=3), the following analysis is presented as exploratory descriptive patterns rather than inferential statistical evidence. These values highlight potential directional trends during the observation period but lack formal statistical significance. With only three annual observations (2020-2022), our correlation coefficients lack the statistical power required for definitive causal claims. They are best understood as descriptive indicators that illuminate patterns that align remarkably well with the qualitative evidence from BaFin and LIAJ reports and point toward the underlying mechanics of each market's survival strategy.

Table 13. Germany Market Response (2020-2022)

Indicator	2020	2021	2022	2-Year Trend
Gross Written Premiums (GWP)	€103.2 bn	€101.9 bn	€97.1 bn	-5.9%
Policies in Force	81.1 million	80.1 million	79.4 million	-2.1%
SCR Coverage Ratio (Avg)	357.7%	425.4%	526.0%	+168.3 pp
Benefits Paid	€101.4 bn	€112.5 bn	€111.4 bn	+9.8%

Table 13 illustrates the "Regulatory Fortification" model dominant in the German market. While Gross Written Premiums (GWP) and total policies in force showed moderate volatility (-4.71% and -0.87% respectively in 2022), the average SCR coverage ratio demonstrated a significant upward trajectory, rising by over 23% in 2022 alone. This descriptive pattern suggests that German insurers prioritized capital adequacy and solvency resilience as a primary defense mechanism against the 2022 interest rate trend reversal, effectively trading short-term premium growth for long-term balance sheet stability.

Table 14. Japan Market Response (FY2020-FY2022)

Indicator	**FY 2020**	**FY 2021**	**FY 2022**	**2-Year Trend**
Premium Income	¥30.1 trillion	¥32.8 trillion	¥34.6 trillion	+14.9%
New Policies	16.9 million	18.8 million	18.9 million	+11.8%
Policies in Force	190.2 million	193.0 million	196.1 million	+3.1%
Benefits Paid	¥28.4 trillion	¥26.8 trillion	¥29.5 trillion	+3.8%

The annual percentage changes in Table 14 reflect the "Commercial Agility" of the Japanese life insurance sector. Despite a sharp 18.2% contraction in new business during the initial 2020 pandemic lockdowns, the market demonstrated a robust "V-shaped" recovery with an 11.24% increase in new policies by 2021. The consistent positive growth in policies in force (averaging 1.5% annually) highlights a volume-based survival strategy. This trend illustrates the market's successful pivot toward "Third Sector" medical and cancer products to maintain engagement in a stagnant macroeconomic environment.

7.2. Interrupted Time Series Analysis: The Causal Impact of the 2022 Trend Reversal

While the descriptive analysis reveals patterns of association, it cannot tell us whether the 2022 interest rate shock caused the changes we observe. To address this question, we employed an Interrupted Time Series (ITS) design, a quasi-experimental approach widely used in insurance research to evaluate the effects of discrete interventions on longitudinal data. Using quarterly data from Q1 2018 to Q4 2023 (24 observations per country), we modeled the trajectory of key market indicators before and after the 2022 trend reversal. The model was specified as:

$$Y_t = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \epsilon_t$$

Where:

- Y_t represents the outcome variable (GWP, SCR ratio, new policies, etc.)
- X_1 is a continuous quarterly time index
- X_2 is a dummy variable (0 for pre-2022, 1 for 2022 onwards)
- X_3 measures quarters since the intervention
- X_4 include bond yields, inflation, and GDP growth

This specification allows us to estimate three critical parameters:

- β_1: The pre-intervention trend (how the market was evolving before the rate shock)
- β_2: The immediate level change following the intervention
- β_3: The change in slope (growth rate) after the intervention

Table 15. ITS Results - Germany

Variable	Metric	Coefficient	95% CI	p-value	Std. Effect Size
3*Germany GWP	Pre-Trend (β_1)	-0.099	[-0.154, -0.044]	0.001	-0.11
	Immediate Change (β_2)	-5.884	[-11.209, -0.559]	0.031	-0.34
	Slope Change (β_3)	-0.273	[-1.075, 0.529]	0.504	-0.08
3*Germany SCR	Pre-Trend (β_1)	2.075	[1.836, 2.314]	¡0.001	0.42
	Immediate Change (β_2)	-14.198	[-32.132, 3.736]	0.121	-0.15
	Slope Change (β_3)	19.649	[16.734, 22.564]	¡0.001	0.88
3*Germany New Business	Pre-Trend (β_1)	-16.649	[-19.756, -13.542]	¡0.001	-0.52
	Immediate Change (β_2)	359.343	[96.695, 621.991]	0.007	0.61
	Slope Change (β_3)	-29.298	[-66.959, 8.363]	0.128	-0.22

7.2.1. Germany: The Interest Rate Paradox Quantified **Notes:** Robust standard errors. Seasonality: All models include quarterly seasonal dummy variables. Standard Errors: HAC robust standard errors were used. Standardized Coefficients (β_{std}) are provided for cross-variable comparison.

The ITS results for Germany provide striking empirical confirmation of the "Interest Rate Paradox" described throughout this paper. Gross Written Premiums experienced a significant immediate decline of approximately €5.88 billion at the moment of the trend reversal (p¡0.05), controlling for pre-existing trends and macroeconomic conditions. This captures the immediate shock of rising rates on consumer demand and premium income. The pre-trend was already negative (-0.099 per quarter, p¡0.01), but the intervention accelerated this decline, consistent with the cost-of-living pressures and portfolio revaluations documented in BaFin's 2022 report. The SCR Coverage Ratio tells a dramatically different story. While there was no significant immediate change at the intervention point, the slope increased by an extraordinary 19.6 percentage points per quarter after the trend reversal (p¡0.01). This is the mathematical reflection of rising rates: as the discounted value of future liabilities plummeted, solvency ratios soared. The pre-trend was already positive (2.08 per quarter, p¡0.01), but the post-intervention acceleration is nothing short of remarkable, explaining how German solvency ratios reached 526.0% by year-end 2022. New Business showed a significant immediate increase of approximately 359,000 policies (p¡0.05) at the intervention point, followed by a negative (though non-significant) trend afterward. This initial spike may reflect a "flight to safety" effect, consumers seeking guaranteed products amid economic uncertainty. At the same time, the subsequent decline captures the erosion of purchasing power documented in the qualitative data.

Table 16. ITS Results - Japan

Variable	Metric	Coefficient	95% CI	p-value	Std. Effect Size
3*Japan GWP	Pre-Trend (β_1)	-0.276	[-0.309, -0.243]	¡0.001	-0.14
	Immediate Change (β_2)	0.762	[0.192, 1.332]	0.009	0.28
	Slope Change (β_3)	1.596	[1.480, 1.712]	¡0.001	0.74
3*Japan New Policies	Pre-Trend (β_1)	-0.231	[-0.380, -0.082]	0.002	-0.18
	Immediate Change (β_2)	2.495	[1.611, 3.379]	¡0.001	0.52
	Slope Change (β_3)	1.065	[0.934, 1.196]	¡0.001	0.61
3*Japan Foreign Securities	Pre-Trend (β_1)	0.298	[0.273, 0.323]	¡0.001	0.38
	Immediate Change (β_2)	0.814	[0.089, 1.539]	0.027	0.22
	Slope Change (β_3)	0.085	[-0.029, 0.199]	0.144	0.09

7.2.2. Japan: Commercial Agility in a Decoupled Environment **Notes:** Robust standard errors. Seasonality: Quarterly seasonal dummy variables included. Robustness: 95% Confidence Intervals calculated using HAC robust standard errors. Effect Size: β_{std} represents standardized coefficients.

The Japanese results stand in stark contrast to the German experience, revealing a market that was not merely resilient to the global rate shock but actively benefited from it. Gross Written Premiums showed a significant immediate increase of ¥0.76 trillion (p¡0.05) following the trend reversal, followed by a dramatic acceleration of ¥1.60 trillion per quarter in the post-intervention slope (p¡0.01). This is remarkable: while German premiums fell,

Japanese premiums rose. The pre-trend was negative (-0.276 per quarter, p¡0.01), reflecting the long-term pressure of domestic stagnation. But the 2022 pivot reversed this trajectory entirely, validating the strategic shift toward "Third Sector" products documented in the LIAJ reports. New Individual Policies tell an even more compelling story. The immediate increase of 2.50 million policies (p¡0.01) at the intervention point, followed by a sustained acceleration of 1.07 million per quarter (p¡0.01), empirically confirms the "commercial rebirth" described in our qualitative analysis. Japanese insurers didn't just survive the pandemic; they emerged with a fundamentally stronger sales trajectory, driven by digital-hybrid distribution and the pivot to medical and cancer products. Foreign Securities Holdings showed a significant immediate increase of 0.81 percentage points (p¡0.05) but no significant change in slope afterward. The pre-trend was already strongly positive (0.30 per quarter, p¡0.01), reflecting Japan's long-term strategy of yield-seeking through international diversification. The 2022 shock appears to have provided an additional immediate push toward foreign assets, but the underlying trend was already established.

7.2.3. Comparative Model: Testing Differential Impact To formally test whether the 2022 trend reversal affected Germany and Japan differently, we estimated a pooled model with interaction terms:

Table 17. Comparative Model Results

Variable	**Coefficient**	**Robust Std. Error**	**P-value**
Time Index	-0.177	0.019	¡0.001
Intervention	-1.481	0.934	0.120
Time Since Intervention	1.267	0.088	¡0.001
Country Dummy (Germany=1)	11.288	0.381	¡0.001
Country × Intervention	-2.279	1.859	0.228
Country × Time Post	-1.577	0.511	0.004
Bond Yield	0.085	1.552	0.956
Inflation	0.385	0.365	0.298
R-squared	0.975		
Adjusted R-squared	0.970		

The key coefficients for testing differential impact are the interaction terms:

Country × Intervention tests whether the immediate effect of the trend reversal differed between Germany and Japan. While the coefficient is negative (-2.28), suggesting a more adverse immediate impact on Germany, it does not achieve statistical significance (p=0.228). Country × Time Post tests whether the slope change after the intervention differed between the two countries. This coefficient is negative and highly significant (-1.58, p=0.004), confirming that Germany and Japan experienced fundamentally different trajectories after the 2022 shock. While Japan's post-intervention slope was positive and accelerating (as shown in the country-specific models), Germany's trajectory was comparatively negative. This provides rigorous statistical confirmation of our central thesis: the 2022 trend reversal triggered divergent responses in two mature insurance markets, with Japan's commercial agility allowing it to thrive while Germany's regulatory fortification created a more complex trade-off between solvency gains and commercial pressure.

7.3. Counterfactual Analysis

To visualize the magnitude of these effects, we conducted a counterfactual analysis—estimating what would have happened to Gross Written Premiums in each country if the 2022 trend reversal had not occurred. The actual performance during the 2022 trend reversal falls outside the 95% prediction intervals, confirming that the observed market divergences are statistically meaningful.

For Germany, the counterfactual analysis reveals that without the 2022 shock, premiums would have continued their gradual pre-trend decline but remained substantially higher than actually observed. By the end of 2023, the gap between actual and counterfactual GWP had widened to approximately €9.4 billion (95% CI: €5.8–13.1 billion) direct estimate of the commercial cost of the interest rate transition.

For Japan, the picture is reversed. Without the 2022 shock, premiums would have continued their pre-trend decline. Instead, actual GWP turned upward, creating a positive gap of approximately ¥1.2 trillion (95% CI: ¥0.7–1.8 trillion) by the end of 2023. This quantifies the commercial benefit Japan derived from a combination of global yield opportunities and successful domestic product pivots.

7.4. Robustness Analysis

To verify the validity of the Interrupted Time Series (ITS) design and ensure that the observed shifts in 2022 were not spurious, the following robustness checks were performed.

7.4.1. Placebo Intervention Test A placebo test was conducted by artificially resetting the intervention point to 2021 Q1 a period of pandemic volatility, but before the 2022 macroeconomic trend reversal. The model yielded non-significant results for both level and slope changes at this false juncture ($p > 0.10$). This confirms that the structural breaks identified in the primary analysis are specifically linked to the 2022 shock and are not artifacts of pre-existing pandemic trends.

7.4.2. Sensitivity Analysis for Lag Structure The primary model assumes an instantaneous market response to the 2022 shock. To test this assumption, alternative lag specifications of one and two quarters were applied. The "Regulatory Fortification" signatures in Germany remained robust and instantaneous. In contrast, Japan's "Commercial Agility" indicators (specifically new policy acquisition) showed higher statistical clarity with a one-quarter lag, suggesting a brief operational interval was required for the market to pivot its sales strategies.

7.5. Summary of Statistical Findings

The quantitative evidence presented in this section supports three main conclusions:

First, the descriptive analysis reveals distinct structural signatures. Japan's market shows a volume-driven resilience pattern, where premium performance is closely tied to new business acquisition. Germany's market shows a regulatory-driven pattern, where premium performance exists in tension with solvency indicators capturing the trade-offs inherent in capital-intensive resilience.

Second, the ITS analysis confirms that the 2022 trend reversal had causally distinct effects. Germany experienced a significant immediate decline in premiums alongside a dramatic acceleration in solvency ratios, which the "Interest Rate Paradox" quantified. Japan experienced significant positive effects on both premiums and new policies, with post-intervention trajectories that diverged markedly from pre-trend expectations.

Third, the comparative model formally confirms divergent trajectories. The significant interaction between country and post-intervention time (p=0.004) provides statistical validation that Germany and Japan followed fundamentally different paths after the 2022 shock paths shaped by their distinct regulatory frameworks, distribution models, and strategic responses to the "double-cycle" crisis. These findings transform our qualitative observations into empirically validated claims. Japan's resilience was an operational and commercial story of agile sales forces, digital transformation, and product pivots that met pandemic-era demand for health coverage. Germany's resilience was a structural and regulatory story of capital buffers, solvency discipline, and a system designed to absorb shocks even when those shocks created accounting contradictions. Both strategies worked. Both markets survived the "double-cycle" crisis intact. But the statistical evidence confirms that survival meant very different things in Tokyo than it did in Frankfurt. In Japan, it meant selling your way through the storm. In Germany, it meant fortifying your way through it.

Based on the empirical findings of the Interrupted Time Series (ITS) analysis and counterfactual modeling, the following evidence-grounded recommendations are proposed:

- **Transition to Hybrid Distribution Models:** Based on the Japan GWP slope change of +1.596 per quarter and the significant recovery in new policy acquisition ($\beta_2 = 2.495$), it is recommended that Japanese insurers prioritize capital allocation toward digital-hybrid distribution channels. The statistical evidence suggests that commercial resilience in mature markets is now driven by "high-touch, high-tech" adaptability rather than traditional face-to-face expansion.

- **Implementation of Counter-Cyclical Capital Buffers:** Given the sharp Germany SCR slope acceleration of 19.65 percentage points per quarter, European regulators should consider implementing counter-cyclical capital buffers. This would help smooth the extreme solvency volatility observed during interest rate reversals and prevent artificial "capital spikes" that do not reflect long-term underlying risk.
- **Active Asset-Liability Management (ALM) for Interest Rate Paradoxes:** The divergence between GWP (-5.884 billion level shift) and SCR stability in Germany necessitates a policy shift toward more dynamic ALM. Insurers must move beyond passive "buy-and-hold" strategies for sovereign debt to mitigate the valuation shocks identified in the 2022 trend reversal.
- **Strategic Focus on "Third Sector" Products:** Linked to the Japanese counterfactual gap, which showed a ¥1.2 trillion recovery above the predicted downward trend, insurers in super-aging societies should accelerate the pivot toward medical and nursing-care products. These "Third Sector" lines proved statistically more resilient to macroeconomic shocks than traditional death-benefit products.

8. Limitations

While the ITS design provides a robust framework for causal inference, the modest sample size of 24 quarterly observations (2017-2022) imposes certain limitations. Specifically, while HAC robust standard errors were utilized to improve credibility, more exhaustive tests, such as high-iteration bootstrapping or complex multi-sector falsification tests, were constrained by the data volume. Future research incorporating a longer post-shock horizon will be essential to confirm the long-term stability of these identified structural signatures.

It should be noted that this study relies on primary regulatory data from BaFin and the LIAJ, which represent the most trusted and consolidated sources for their respective markets, integrating primary data from Eurostat, Destatis, and the MHLW. While these sources provide a comprehensive view of market resilience, a specific limitation is the inability to further disaggregate quarterly excess mortality as a standalone covariate within the integrated regulatory data. Future research using raw demographic datasets may provide additional insights into the isolated impact of mortality spikes on premium lapse rates.

9. Conclusion and Summary

The comparative analysis of the German and Japanese life insurance markets between 2020 and 2022 reveals a profound divergence in how mature "mirror economies" navigate systemic shocks. While both nations faced identical global stressors, the operational paralysis of the COVID-19 pandemic and the macroeconomic volatility of the 2022 interest rate "trend reversal," their paths to resilience were dictated by distinct regulatory priorities and cultural distribution norms. The Japanese model demonstrated remarkable commercial agility. Facing an initial 18.2% collapse in new business due to the suspension of traditional face-to-face sales, the sector underwent a digital-hybrid rebirth. The statistical evidence validates this pivot, showing a strong positive correlation ($r = 0.749$) between Gross Written Premiums and the acquisition of new individual policies. By shifting focus to "Third Sector" products, medical and cancer insurance, and diversifying 31.9% of assets into foreign securities, Japanese insurers maintained volume-based stability. This suggests that Japan's resilience is primarily fuelled by market adaptability and the persistent strength of its revamped distribution networks. Conversely, the German model exemplified regulatory fortification. Rather than focusing on volume expansion, the German sector prioritized capital adequacy through the defensive mechanics of the Zinszusatzreserve (ZZR). The nearly perfect correlation between Gross Written Premiums and the SCR Coverage Ratio ($r = 0.944$) highlights a market where stability is anchored in solvency rather than sales. The 2022 interest rate spike triggered an "Interest Rate Paradox": while it eliminated the need for further ZZR allocations and bolstered SCR ratios to a staggering 526.0%, it simultaneously transformed €151.4 billion in hidden reserves into a net liability of €19.4 billion. Ultimately, this study concludes that there is no singular blueprint for insurance resilience. Japan's resilience was operational and commercial, driven by the agility to sell in a crisis, whereas Germany's was structural and regulatory, driven by the capacity to buffer capital. As these super-aged societies continue to navigate an era of "higher-for-longer" interest rates, the

divergence observed here offers a critical lesson for global policymakers: maturity in a financial sector does not lead to uniformity, but rather to specialized survival strategies rooted in a nation's specific institutional and cultural DNA.

9.1. Recommendations for Insurers

Based on the divergence observed in 2022, insurers in these mature markets should adopt the following strategic priorities:

9.1.1. For German Insurers (Managing "Hidden Liabilities")

- **Portfolio Re-Balancing:** With net hidden reserves of €51.6bn transforming into €19.4bn in hidden liabilities, insurers must actively manage the duration risk of their fixed-income portfolios to prevent liquidity crunches during further rate spikes.
- **Capital-Light Pivot:** Shift away from traditional high-guarantee products toward unit-linked or capital-light pension models to reduce the burden of future ZZR allocations.

9.1.2. For Japanese Insurers (Managing "Market Saturation")

- **"Living Benefits" Innovation:** Continue the pivot from death-benefit coverage (which contracted to ¥806.87 trillion) toward high-margin medical and hospitalization riders that meet the needs of an aging population.
- **Global Diversification:** Maintain the aggressive search for yield by expanding foreign security holdings (currently at 31.9%) to remain independent of domestic Yen stagnation.

9.2. Future Outlook: The Long-Term Impact of the 2022 Pivot

The 2022 interest rate pivot marks the end of the "low-for-long" era and the beginning of a Solvency-Volatility era. For Germany, the long-term outlook is one of transition; the high solvency ratios provide a "breathing room" to modernize business models, but the industry remains sensitive to the rapid devaluation of bond portfolios. For Japan, the 2022 pivot confirmed that the domestic market cannot sustain the industry alone, cementing the need for a"Digital-Hybrid" sales force and a global investment mindset. As we move toward 2025, both markets will likely converge on digital resilience. BaFin's intensified focus on IT/Cyber risks and Japan's post-Hanko digitalization suggest that the next frontier of insurance stability will not be found in the balance sheet, but in the security and efficiency of the digital infrastructure.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work, the author used Gemini (Google) to refine the English language and improve the overall clarity and flow of the manuscript. This technology was employed solely for linguistic editing and structural proofreading, as English is not the author's native language. After using this tool, the author reviewed and edited the content as needed and takes full responsibility for the final version of the manuscript and the accuracy of the research findings presented herein.

REFERENCES

1. Albrecht, P.J.Z.f.V.Z., *Versagt die Bundesregierung beim Erklären der Zinszusatzreserve?* 2015. **66**(8): p. 243-244.
2. Amengual, O. and T.J.R.i. Atsumi, *COVID-19 pandemic in Japan*. 2021. **41**(1): p. 1-5.
3. Ando, M., et al., *Fiscal responses to the COVID-19 crisis in Japan: the first six months*. 2020. **73**(3): p. 901-926.
4. Battista, A.J.B.B., *From enforcement to dissolution. The unexpected final chapter of "the life" of "a life" insurance company*. 2024. **97**(4): p. 83-97.
5. Blom, A.G., et al., *The Mannheim Corona study: life in Germany in a state of emergency: Report for March 20 to July 09, 2020*. 2020.
6. Briefings, O.A.J.E.E., *Euro-area activity will slow sharply or even contract*. 2022(oxan-db).

7. Clemens, M., S. Junker, and L.J.D.W.R. Pagenhardt, *German economy only slowly emerging from the pandemic*. 2021. **11**(37): p. 276-280.
8. Daniel, T.Y.N., *High-Touch versus High-Tech: Is the Insurance Agent still relevant in Singapore?*
9. Eckert, C.J.J.o.R. and F. Management, *Dealing with low interest rates in life insurance: An analysis of additional reserves in the German life insurance industry*. 2019. **12**(3): p. 119.
10. Fadun, O.S., T.O.J.G.J.o.E. Oluwaleye, and D. Studies, *Life insurance development and economic growth: a case study of Nigeria (2000-2022)*. 2023. **4**(1): p. 162-181.
11. Farina, I., et al., *Farina, I. Masella, C. Sangiorgi, D.(2021) Positioning Social Prescribing in the scenario of community-based interventions for the transformation of mental health services for children, adolescents and young people: a review. Book of Abstract "Health Management: managing the present and shaping the future" European Health Management Association (EHMA) Annual Conference, 2021, pg. 29*. 2021.
12. Feinhandler, I., et al. *Predictors of death rate during the COVID-19 pandemic*. in *Healthcare*. 2020. MDPI.
13. Iizuka, N.J.E., Culture and H.J.S. Bimonthly, *Can a 2% Inflation Rate Be Maintained?* 2024. **43**(4).
14. Kolinets, L., et al., *Financial and institutional aspects of insurance market development under conditions of pandemic 2020-2021 and war 2022-2023: case of Ukrainian insurance companies*. 2023: p. 97-110.
15. Kosack, E., et al., *Information management in the early stages of the COVID-19 pandemic*. 2021. **34**(1): p. 20-44.
16. Levi-Bliech, M., et al., *Implementing a sales support app to complement face-to-face interaction: An empirical investigation of business value*. 2020. **30**(3): p. 266-278.
17. Miyamoto, H.J.T.E.V., *Government Debt and Monetary Policy Perspectives in Japan*. 2023. **20**(1): p. 131-134.
18. Murata, K.J.I.J.o.I.E., *A FUNDAMENTAL STUDY ON DIGITALIZING SALESPERSON BEHAVIOR IN FACE-TO-FACE SALES IN A COSMETICS STORE*. 2018. **25**(1).
19. Nakatoh, S., et al., *Trends in the incidence of hip fractures and osteoporosis treatment in Japan (FY2012-FY2023)*. 2026. **21**(1): p. 16.
20. Ogawa, E., *The case of Japan*, in *Economic Policy and the Covid-19 Crisis*. 2021, Routledge. p. 165-187.
21. Rihal, J.K., *Evaluation of the use of the Solvency II Standard Formula to calculate Solvency Capital Requirements (SCR)*. 2021, Doctoral dissertation, Tilburg University.
22. Segodi, M.P. and A.B.J.R. Sibindi, *Determinants of life insurance demand: Empirical Evidence from BRICS Countries*. 2022. **10**(4): p. 73.
23. Staerk, C., T. Wistuba, and A.J.B.P.H. Mayr, *Estimating effective infection fatality rates during the course of the COVID-19 pandemic in Germany*. 2021. **21**(1): p. 1073.
24. Watanabe, M.J.S.t., *The COVID-19 pandemic in Japan*. 2020. **50**(8): p. 787-793.
25. *BAFIN 2020*. Available from: https://www.bafin.de/SharedDocs/Downloads/EN/Jahresbericht/dl_jb_2020_en.pdf?__blob=publicationFile&v=2.
26. *BAFIN 2021*. Available from: https://www.bafin.de/SharedDocs/Downloads/EN/Jahresbericht/dl_jb_2021_en.pdf?__blob=publicationFile&v=3.
27. *BAFIN2022*. Available from: https://www.bafin.de/SharedDocs/Downloads/EN/Jahresbericht/dl_jb_2022_en.pdf?__blob=publicationFile&v=3.
28. *Life Insurance Fact Book (2020)*. 2020. Available from: https://www.seiho.or.jp/english/statistics/trend/pdf/2020.pdf.
29. *Life Insurance Fact Book (2020)*. Available from: https://www.seiho.or.jp/english/statistics/trend/pdf/2020.pdf.
30. *Life Insurance Fact Book 2021*. 2021. Available from: https://www.seiho.or.jp/english/statistics/trend/pdf/2021.pdf.