TURUN YLIOPISTO

The Insurance markets' reactions to endogenic and exogenic shocks

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Bachelor's thesis
in Economics

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University of Turku
13 December 2024

Kanditutkielma
Oppiaine: Taloustiede
Tekijä: Pyry Kuosmanen
Otsikko: The Insurance markets' reactions to endogenic and exogenic shocks
Ohjaaja: KTT Timo Virtanen
Sivumäärä: 30
Päivämäärä: 13.12.2024

Tässä kandidaatintutkielmassa tarkastellaan endogeenisten ja eksogeenisten sokkien vaikutuksia vakuutusmarkkinoihin teoreettisesta näkökulmasta hyödyntäen myös finanssikriisiä ja Ukrainan sotaa havainnollistavina esimerkkeinä.

Avainsanat: Vakuutusmarkkinat, endogeeninen sokki, eksogeeninen sokki, AIG, American International Group, finanssikriisi, Ukrainan sota.

Bachelor's thesis

Subject: Economics
Author(s): Pyry Kuosmanen
Title: The Insurance markets' reactions to endogenic and exogenic shocks
Supervisor(s): D.Sc. Timo Virtanen
Number of pages: 30
Date: 13.12.2024

In this Bachelor’s thesis, the insurance markets' reaction to the endogenous and exogenous shocks are observed from a theoretical point of view and afterwards using the 2007-2008 Financial crisis and the Ukraine war as concrete examples.

Keywords: Insurance markets, Endogenic shocks, exogenic shocks, AIG, American international group, The Financial crisis, The Russo-Ukrainian war

TABLE OF CONTENTS

1 Introduction

Insurance markets act to redistribute the cost of unexpected losses. Thus, insurance ought to be seen to encourage investors and entrepreneurs to engage in the broader economy. The insurance industry promotes active perspiration in all sectors of the economy, and by extension, a robust insurance system can be seen as a promotor of high economic activity.

Since insurance premiums are calculated based on the time up to date information, if there were to be a sizeable unforeseen event, it would have large and potentially catastrophic ramifications upon the insurer and by extension, the ensured, thus forcing the ensured parties to possibly renegotiate their insurance policies with another party or scale down their operations slowing down the economy (Sinha and Ahmad, 2009).

This thesis was motivated by an interest in finding out in which way, if any, the insurance markets react to the difference in imperfect information caused by endogenic shocks compared to imperfect information caused by exogenous shocks. This idea came to me as I was pondering the first period of large-scale uncertainty in my living memory (the COVID-19 pandemic and the Russian invasion of Ukrainian heathland) and my wish to compare to the 2007-2008 Financial crisis of which I was too young to understand but in the aftermath of which I have been growing up.

The thesis will consist of a theory section, a section discussing the effects of shocks endogenous for the financial markets, a section discussing the nature and effect of shock exogenous to the market, and finally, a section for concluding these findings.

In the theory section, the attempt is to give the reader a broad overview of the theory, terminology and general workings of the insurance market to allow them to understand without an issue the insurance sector's reaction to shocks studied in the later part of the thesis. The objective is to also allow readers to in future better understand the insurance market in case they are in a position where a deeper understanding of the market would be of utmost importance.

In the section concerning endogenous shocks, the reader is introduced to the financial instability hypothesis, which has been used to explain the repeating nature of financial crashes contrary to the efficient market hypothesis. After that, the general model for endogenous market shocks is discussed, and at the end of the section, the 2007-2008 Financial crisis is used as a case concrete example of endogenous shocks' effects on the insurance industry.

In the section concerning exogenous shocks, attention is first directed to a brief study on general exogenous shock effects in the insurance industry and, afterwards, to the study of the 2022 Russo-Ukrainian war's effects on the insurance industry.

In the final section, I will conclude my findings.

1.1 AI disclosure

For checking spelling and punctuation, Grammarly and Word spellcheck were used.

To find suitable synonyms to avoid repetition, Grammarly and Ludwig. guru were used.

Word proofreading and Grammarly were used to improve general readability.

ChatGPT’s and Ludwig. guru’s rewrite functions were consulted in order to improve the structure of the subchapters 2.2.3 and 2.3.2.

2 Theory of the Insurance Markets

2.1 Central Concepts and Terminology

2.1.1 Uncertainty

In economic theory and in relation to insurance markets, uncertainty is defined as the absence of perfect knowledge concerning future events. This lack of knowledge can vary across parties; it can be shared equally and identically or affect parties unequally. Additionally, the degree of uncertainty and its universality can differ between insurance types.

For example, in the case of home insurance, the uncertainty concerning future events (e.g., natural disasters, robberies, or destructive accidents) affects the buyer and seller in approximately equal measures. Neither party possesses significantly more information about future events.

In contrast, in the case of health insurance, the policyholder has access to detailed knowledge of and the ability to influence their own lifestyle, so they are less affected by uncertainty. This asymmetry introduces challenges to insurance providers that can be addressed by mathematical and statistical modelling. (Gracias and Shad, 2024)

2.1.2 Adverse Selection and Moral Hazard

In his paper, The Market for "Lemons": Quality Uncertainty and the Market Mechanism George Akerlof (1970) uses the market for used cars as an allegory to illustrate how asymmetric information can lead to market inefficiencies. Akerlof shows that when sellers have more information about the quality of their product than buyers, participants are incentivized to misrepresent or conceal information, thereby undermining trust. This dynamic explains the frequent co-occurrence of adverse selection and moral hazard in markets.

Adverse selection arises from asymmetric information where one party possesses more knowledge than the other, leading to suboptimal market outcomes. For instance, in his book The Economics of Money, Banking, and Financial Markets, Frederic Mishkin (2019) demonstrates how adverse selection in loan markets can cause a breakdown of transactions. Lenders, unable to differentiate between high-risk and low-risk borrowers, may raise interest rates or restrict credit access altogether, deterring low-risk borrowers while attracting high-risk ones.

This creates a "market for lemons" effect where only undesirable transactions remain, eroding overall market efficiency.

Moral hazard, on the other hand, occurs when one party exploits uncertainty to gain additional utility at the expense of another. In insurance markets, this is observed when individuals with a higher probability of filing claims acquire disproportionately more insurance coverage. For example, those in high-risk categories might purchase extensive policies, knowing their likelihood of filing a claim is greater. Insurers, who typically cannot perfectly assess everyone's risk profile, are forced to raise premium prices to cover potential losses. This, in turn, drives away low-risk individuals, leaving a pool of predominantly high-risk customers.(Akerlof, 1970; Mishkin, 2019)

Together, adverse selection and moral hazard highlight the inherent challenges of asymmetric information in insurance and other markets, underscoring the importance of mechanisms (e.g., signaling, screening, and regulation) to mitigate their effects (Akerlof, 1970; Mishkin, 2019).

2.1.3 Residual Insurance Market

Residual insurance markets refer to the situations in which an insurer would choose to opt out of giving out insurance policies for a reason like a high density of consumers with a high probability of insurance loss (Dumm, Eckles and Halek, 2013). The most common reason for an insurer to choose to opt out of a given market sector is either due to regular adverse selection or if the insurer would withdraw a policy previously purchased by high-risk types, and this would drive higher-risk types to buy policies previously sold to low-risk types and therefore making policy unprofitable (Wilson, 1977).

2.1.4 Reinsurance

In the context of insurance markets, reinsurance refers to the practise in which an insurance firm decides that additional stability is required in their insurance policy offerings and decides to insure their position with another insurance provider to cover them in the case of a claim unforeseen large in value or quantity (e.g. unforeseen large flood or wildfire). In many cases, the reinsurance contract is subdivided into multiple packages, which have differing and reasonably specific terms, thus allowing the contract to be relatively low cost to the incurred party and relatively low risk to the party issuing the policy. (Boyer and Dupont-Courtade, 2015.)

The reinsurance market is even compared to other financial markets, which is extremely complex due to reinsurance policies being issued globally and because each subdivided policy can be re-issued multiple times. The complex and interlocking system gives the insurance market high resistance to all, but the most violent economic shocks since the reinsurance network allows these shocks to be absorbed by most of the global market; in the situation of the most aggressive shock, this interconnectivity can lead to these interlocking policies to collapse simultaneously. (Boyer and Dupont-Courtade, 2015.)

In the wake of great financial turmoil, reinsurance is a considerable way to promote economic recovery since it provides more stability to insurance markets by backing the insurance sector, thus restoring belief in it and encouraging economic activity. Reinsurance can also be seen as a way to stimulate economic growth by purchasing reinsurance contracts from sectors of geographical areas in better financial situations; since reinsurance contracts are relatively safe instruments, this can provide positive cash flow to companies recovering from economic shocks. (Culp and O'Donnell, 2009.)

2.2 Pricing Risk

2.2.1 Stress Testing and Scenario Analysis

Since the insurance industry operates with significant amounts of uncertainty, it is essential for any given firm to conduct stress testing and scenario analysis on their insurance pools. The function of a stress test is to analyse how well an insurer would perform under extreme but still plausible market conditions (e.g., market crash, recession, or catastrophic event), which would affect the factors of premium pricing. (IAA, 2013.)

International Actuarial Association (IAA) stress testing scenarios are divided into three main groups: reverse scenarios, historical scenarios, and synthetic scenarios. The first group reverse scenarios are used to identify a scenario in which a given economic loss is decided, and based on a given loss size and structure, analysts build a scenario which would lead to that (i.e. to determine what level of unexpected life insurance claims could lead to insurer becoming insolvent within next ten to twenty years. (IAA, 2013.)

Second group Historical scenarios are based on previous existing knowledge or empirical data to model scenarios identical or similar to historical scenarios (i.e. The 2007-2008 Financial crisis, COVID-19 pandemic, or Fukushima Nuclear accident). The most apparent benefits of

historical scenarios are firstly the fact that as real-life historical scenarios, their effects and causes are relatively simple to understand, and this way, scenarios can be modified and understood by the more ley person. The secondary benefit of historical scenarios is the fact that, as a historical event, the recovery from a given crisis and its lingering aftermaths can be studied and more easily incorporated into the scenario model. Historical scenarios are not without flaws since, especially when analysing old data, it is essential to adjust in the model for inter-temporal differences, including but not limited to medical advancement, new technologies, changes in financial regulations, and ever-increasing levels of globalisation. Even with adjustment, historical models may not be adapted perfectly to the modern world, but they still are a valuable part of companies' stress test analysis work. (IAA, 2013.)

The final group named by IAA is the synthetic scenarios, which, in contrast to the historical scenarios, describe yet-to-happen hypothetical scenarios. Thus, synthetic scenarios are more straightforward to tailor to fit the needs of a given stress testing scenario's interest. Since synthetic scenarios model scenarios which have not been observed in history either because given risk factors have not previously existed or by sheer luck, instead of an empirical base for the model, a much greater number of assumptions must be made when compared to historical model, this may make the model less accurate to the real world. Still, modifying the given assumptions will allow for reactively easy production of additional models. (IAA, 2013.)

The IAA (2013) subdivides synthetic models into company-specific, single-event, multi-event, and global scenarios. Company-specific scenarios are interested in stress testing a single company, and this approach is usually preferred in cases where the company is in a unique position due to its product, geographic location, or asset portfolio and thus requires a particular model to test its reaction to a shock.

The second and third subdivisions are single-event and multi-event scenarios, which are broader than company-specific but still more constrained than global scenarios; the difference between single and multiple-event scenarios is on the time scale in single-event scenarios. A single shock has a short and isolated effect on a scenario (i.e., a Hailstorm, a wildfire) in the multi-event-scenario cascading series of events. It has a medium to long-term impact on observed companies (i.e. financial crisis or recession constrained by geography or sector). (IAA, 2013.)

The final sub-division is for the global scenarios, which are used to model global level shock comparable in scale to historical events like the great depression or the Spanish flu. Global

scenarios are characterised by, in addition to their geographically and economically global scale, their long-lasting effects. (IAA, 2013.)

2.2.2 Monte Carlo Simulation

When generating a stress testing model, one helpful method is Monte Carlo simulation, which is derived from the law of large numbers (LLN), where these large numbers represent randomly generated risk factors with selected characteristics and by LLN tend closer to theoretical assumption.

Depending on the chosen application, modified Monte Carlo simulations include but are not limited to Primitive Monte Carlo Simulation (PMC), Antithetic Sampling Monte Carlo (ASMC), and Latin Hypercube sampling (LHS). The PMC model is based on generated random elements to match characteristics of a selected probability distribution; subsequent correlation structure is also integrated into the calculations. Further development in the field of given assets is simulated (e.g. Brownian motion of Levy's model). PMC is then an understandable, accessible and relatively easy-to-use model. (Daníšek Matušková, 2016.)

The ASMC model is a simple yet comprehensive model that is given a random normalised normal distribution's element X and takes this vector companion by multiplying it by coefficient -1. By compiling both aspects into one distribution, it is possible to gain twice the number of random elements, which leads to a decrease in time consumption and provides the model with zero mean and symmetrical distribution. ASMC's main drawback is the fact that it can only be used truing to generate random elements from symmetric probability distributions. (Daníšek Matušková, 2016.)

The LHS is a way of sampling the data whose principal point lies in dividing the given probability distribution into arbitrarily many parts (N) and in any number of dimensions. Then, selection in each sample dimension with a probability of 1/N, repeating the required number of times so that any given part is only chosen once. Like this, LHS can be said to have memory compared to the regular Monte Carlo model, which generates samples without considering any previously chosen and can be said to be a memory sampling technique. Since LHS divides probability distribution into evenly sized pieces and all these parts have an equal chance of being chosen, LHS can be said to have an advantage in the fact that it will give a higher presence to low probability areas on the distribution. (Daníšek Matušková, 2016.)

2.2.3 Bayesian models, Markov chain, and Actuarial price

Bayesian models are statistical tools that adjust baseline probabilities using relevant data to predict outcomes. For example, the probability of serious illness may serve as a starting point in health insurance. This baseline is then adjusted using factors such as age, geographical location, occupation, hobbies, and family medical history. By incorporating these variables, Bayesian models calculate a personalised likelihood of a policyholder filing a claim against the insurer. Insurers can then set premiums at the lowest level to attract customers while minimising the risk of loss from claims. (Sukono et al., 2017; Mourdoukoutas et al., 2024.)

Markov chains, on the other hand, are mathematical systems used to model transitions between "states." In the context of insurance, these states could represent employment status, such as being employed or unemployed. For unemployment insurance, a Markov chain can predict the likelihood of a policyholder transitioning between these states, allowing insurers to price premiums accordingly. (Biagini and Widenmann, 2012.)

In insurance markets, the actuarial price is the theoretically optimal premium calculated based on expected claims and their probabilities. This serves as the foundation for determining the actual price charged to clients. The goal is to balance competitiveness with financial sustainability, ensuring premiums are neither too high to deter customers nor too low to result in significant losses. (Cummins, 1990; Indeed, 2024.)

2.3 General working of insurance markets

The insurance market reduces risk placed upon a single actor and redistributes it upon a large and diversified group of actors. For example, it encourages investors, entrepreneurs, and lenders to participate more actively in the economy and, in this way, promotes economic growth. (Sinha and Ahmad, 2009.)

2.3.1 Role of the insurance market

Insurance markets act as mediators of risk by granting other parties the opportunity to buy insurance policies, exchanging unpredictable significant financial loss for a predictable smaller payment. Money paid to the insurance companies is collected from a large insurance pool, from which policyholders pay claims. When the insurance pool has grown to a large enough size that expected claims can be paid, the insurance companies can invest the pool money to try and increase the insurance pool value, thus generating more money and allowing them to

charge lower insurance premiums and, by this, luring in new customers. (Sinha and Ahmad, 2009.)

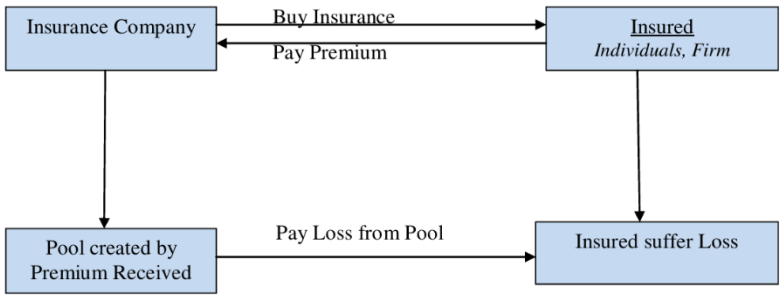

Figure 2.1 Simplified model of insurance markets(Sinha and Ahmad, 2009)

2.3.2 Pricing of the premiums

The pricing of insurance premiums varies between insurers but can generally be broken into four components: the cost of paying for losses, the cost of operating and maintaining the investment pool, the expected risk of insurance position or the resources needed to honour unexpected claims and earnings from the investment pool (see Figure 2.2). Investment earnings are used to supplement cash flow from premiums. During periods of positive returns, insurers can lower premiums to offer more competitive pricing. However, heavy reliance on investment earnings to pay claims introduces vulnerability. Significant market shocks could ripple across the economy, affecting insurers' ability to meet claims, especially once which would be expected to act synchronised with market movements (e.g. business protection or trade credit insurance). (Sinha and Ahmad, 2009.)

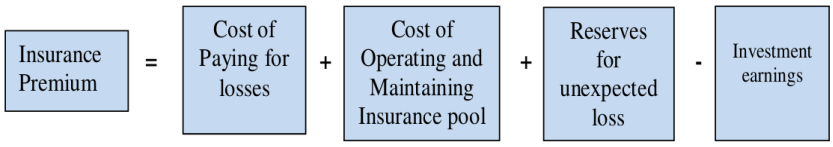

Figure 2.2 Simplified pricing structure of insurance premium (Sinha and Ahmad, 2009)

The cost of paying for losses is calculated using actuarial pricing, often performed with advanced models like the Bayesian model or Monte Carlo Markov chains. These models use probability to predict an average policyholder’s likelihood of making a claim. For example, a Bayesian model might assess the probability of unemployment or illness based on factors like age or job sector. Monte Carlo simulations, which generate thousands of random scenarios,

are used to estimate average costs over time by applying the law of large numbers, thus granting the insurer a more generally useful view of the position. (Hu and Yang, 2009.)

Insurers rely on stress testing and scenario analysis to calculate reserves for unexpected losses. These tools evaluate vulnerability to unforeseen events, such as pandemics, wars, or market crashes. Scenario analysis also helps assess how previous insurance policies would perform under new conditions. For instance, a shift in technology or geopolitical changes might invalidate previous loss probabilities. Identifying these risks allows insurers to retract unprofitable policies and replace them with more accurately priced ones. (Gross, 2021.)

3 Endogenic Shock

Endogenous shocks refer to unexpected market actions that are generated and amplified within the market instead of originating outside of the market. Markets are subjected to both types of shocks, but in most cases, endogenous shocks tend to cause more damage. Since endogenous shocks, by their very nature, are generated and amplified by the market itself, they create compounding effects as the shocks cause market changes, which, in turn, lead to further market changes. (Danielsson and Shin, 2002.)

An example of an endogenous shock is the classic Dutch tulip crash of 1637, where the extremely overheated tulip trade collapsed almost overnight as traders reacted to each other's fears of initially slowing rises in prices and eventually the complete collapse of the trade. Endogenous shocks can affect anything within the market where participants' actions influence others in a closed feedback loop. (Danielsson and Shin, 2002.) Examples of modern endogenic shocks are the Great Depression, the financial crisis, and the early 1990s Finnish depression.

3.1 The Financial Instability Hypothesis

Hyman Minsky's financial instability hypothesis was an obscure and unimportant theory that explained how long stretches of prosperity tend to sow seeds for economic crisis. Minsky could be seen to have been posthumously vindicated after the 2007 Financial crisis; his theory became the subject of intense and widespread interest. (The Economist, 2016.)

The financial instability hypothesis (FIH) can differ from most equilibrium models, especially the efficient market hypothesis, since the market is supposed to "deal with" the destabilising elements in these models. FIH can be summarised by saying, "Stability is destabilising", and it suggests that economies are by their very nature unstable, and periods of stability encourage economic overextension, which adds instability to the economy. (Nikolaidi, 2021.)

In FIH, Minsky categorises actors into Hedge, Speculative, and Ponzi regimes. In the Hedge regime, actors have expected cashflows that can cover and exceed interest payments and principal repayments combined, even in a case that a slight economic downturn occurs. Thus, debt financing is not necessary to repay accrued debt, and by extension, the Hedge regime's agents remain the most stable of the three regimes. The Speculative regime is defined as agents whose expected cash flow is sufficient to cover the payment for the interest but not the

payments for the principal of their debt. Thus, they must take on more debt to cover payment for their current principal payments; a Speculative regime can sustain their debt payments if the economy does not face a downturn. The third and final regime in FIM is the Ponzi regime, which is defined by its debt, in which interest and principal payments bought exceed their expected cash flow and, therefore, are dependent upon the continuous economic growth and increase in value of their assets. The Ponzi regime would face a financial downfall if the growth rate slowed down, making this regime extremely financially fragile. (Nikolaidi, 2021.)

Minsky states in FIH that during periods of economic stability, borrowers and lenders are incentivised to take and accept more risk. Consequently, agents who started as Hedges gradually transformed into Speculative agents and later into Ponzi agents. This is because when agents leverage their positions more, the possible returns are higher compared to lover leverage or using only one's own money. When the economy continues to grow, borrowers and lenders grow increasingly used to the notion of expected granted return, and thus, in their seek of profits, they become more willing to accept higher risk. (Nikolaidi, 2021.)

3.2 Characteristic effects on the insurance sectors

As an absorber of economic shocks and a redistributor of risk, the insurance industry plays a crucial role during economic crises. An endogenous school often leads to wide-reaching losses. these losses arise from a drastic increase in insurance claims issued by policyholders and from the decline in the value of insurance providers' non-insurance investment pool revenue. (Danielsson and Shin, 2002; 2002; Danielsson, Shin and Zigrand, 2011.)

Compared to the finance and banking sectors, insurance providers are generally more resilient to endogenous shocks due to their long-term investment strategies. These longer investment horizons allow the insurers to retain their portfolios instead of being forced to liquidate assets during a market downturn. (Danielsson and Shin, 2002; 2002; Danielsson, Shin and Zigrand, 2011.)

Insurance providers specialised in a sector or geographical area directly impacted by the shocks may find increased insurance claims to be overwhelming, leading to forced liquidation of assets and, in the worst cases, even to a liquidity crisis, which could lead to firms' bankruptcy. To shield themselves from such fate, insurance providers will buy and sell reinsurance policies for their own positions or the position of other firms. (Danielsson and Shin, 2002; 2002; Danielsson, Shin and Zigrand, 2011.)

3.3 The 2007-2008 Financial Crisis and American International Group

The Financial crisis was the largest endogenic crisis since the great depression caused by the Wall Street crash of 1929. When studying the financial crisis, the role of the insurance sector has its avid supporters who believe it acted as an absorber of market shock and, by extension, acted to mitigate even worse aftermath. On the other hand, some see the insurance industry as one of the great enablers of the recession by issuing credit default swaps, which were one of the great contributors to the crisis. For these reasons, it is of utmost importance to study the insurance industry's reaction to the 2007-2008 financial crisis. (Schich, 2010.)

For purposes of a more concise and concentrated view of the financial crisis, I have chosen to observe the onset of the crisis by concentrating on American International Group and its subsidiaries who were, by their size and through their entanglement in the financial markets thanks to their practice of issuing credit default swaps and Securities lending, made such an important counterpart to banks that US government felt obligated to bail them out in order to safeguard the entire financial system (Schich, 2010; Ferris, 2015).

3.3.1 American International Group

Before the onset of the financial crisis, AIG (American International Group) and its subsidiaries were seen as one of the largest companies and insurance providers in the world, with $ 1 trillion in assets under management and providing services to over 76 million customers in 130 countries.

In the years leading up to the financial crisis, approximately 90% of AIG’s net revenue was provided by the group's insurance activities. During these times, AIGFP (American International Group Financial Products) had managed to gather a sizable portfolio of credit default swaps and multiple different types of investment instruments, mainly mortgage derivates. These investments were quite profitable in the rising housing market, which governed the economy before the onset of the financial crisis. In the ever-rising housing market, AIGFP issued more and more credit default swaps without properly pricing the risk in an attempt to maximise the revenue generated. Since the credit default swaps were not priced accordingly, the mortgage issuers were approving increasingly sub-prime lenders since the AIGFP and insurers like it were willing to accept the risk on the mortgage for a fraction of the appropriate price. (Sinha and Ahmad, 2009; Schich, 2010; Ferris, 2015.)

As the subprime mortgages started to default systematically and thus the holders of credit default swaps started to exercise their positions, the losses from AIGFP's investment caused the firm's counterparties to issue margin calls to cover AIGFP's liabilities for which the parent company AIG was grantor, magnitude and amount of these calls exceeded AIG's cash reserves and as a result, AIG faced a liquidity crisis. (Sinha and Ahmad, 2009; Schich, 2010; Ferris, 2015.)

In addition to the losses suffered by the AIGFP, the life insurance companies under AIG also suffered sizable losses because of intra-group investments and through life insurance group investments handled by AIGSLP (American Investment Group Securities Lending Program). To increase the investment portfolio profit, life insurance companies under AIG began to lend out securities owned by the life insurance companies to counterparties, which were, in most cases, banks and brokerage firms. In the beginning, these lendings were quite risky operations, lending the securities in exchange for a modest premium, but in time, these gradually morphed into higher-risk operations. (Ferris, 2015.)

To increase efficiency, instead of having insurance companies manage their own investments, AIG established a new subsidiary, AIGSLC (American Insurance Group Securities Lending Corporation). This company managed two separate insurance pools for regulatory reasons. One poll consisted of the assets under USA-based insurers and the other held investments for insurers located outside the USA. In 2005, without informing the life insurance companies, AIGSLC decided to start shifting the structure of insurance portfolios from highly liquid low-risk positions into Residential mortgage-backed securities (RMBS), which already in 2005 were considered high-risk investment instruments. When questioned by the life insurance companies if the portfolio was exposed to subprime mortgages, AIGSLC gave false testimony and claimed the risk management to be of high quality. In reality, the risk management models were relatively simple and lacked the ability to appropriately consider future write-downs or collateral calls, more sophisticated models were not utilised until late 2006, when most of the exposure to RMBS was already gathered. (Schich, 2010; Ferris, 2015.)

AIG's and its life-insurance subsidiaries' exposure to the RMBS peaked in 2007 when approximately 11% of its $400 Billion in assets were invested as RMBS, just as the sub-prime mortgage crash was to happen. AIG had developed an imbalance with assets and liabilities. AIG's counterparts were allowed to return leased assets at short notice, but AIG had invested the counterpart's cash in soon-to-be non-liquid RMBS; thus, when the subprime crisis began,

AIG was left in a liquidity crisis trying to fulfil its multiple subsidiaries' obligations. In 2008, AIG's credit rating was downgraded, which led its creditors to issue margin calls. Because of AIG's portfolios' considerable exposure to the RMBS and a general slowdown of market action, AIG was incapable of liquidating enough of its assets to provide adequate collateral for its counterparts. To prevent a larger economic catastrophe, the Federal Government of the USA decided to buy 80% of AIG for $85 billion in order to allow it to fulfil its obligations to creditors. (Sinha and Ahmad, 2009; Schich, 2010; Ferris, 2015.)

Contemporary reports raise questions concerning the reason for abandoning low-risk strategies and embracing higher-risk operations in the years following the financial crisis. The financial instability hypothesis became a widely accepted theory to explain the gradual shift from safe investments to higher-yield yet riskier positions. (The Economist, 2016.)

4 Exogenic Shocks

Exogenic shocks refer to shocks originating from outside of the system. In the context of this work, they refer specifically to shocks originating outside of the insurance, banking and finance sectors. This outside effect can include such things as change in politics (i.e. change in legislation, regulation, or policy), market action, which would mean the introduction of a disruptive product, hazardous product, or other unforeseen event which would increase market volatility, or rise in crime or violent conflict. (Makalani, Ferreira-Schenk and Dickason-Koekemoer, 2022.)

One of the more researched areas of the exogenic crisis is the effects of war on insurance markets (Vicente, 1995). Generally speaking, exogenous shocks are complex to model, and thus, it is a widely studied area with models specialised to a given application. The most commonly used models for exogenic shocks are based on the Marshal-Olkin distribution, a multivariable exponential distribution. (Mai, Schenk and Scherer, 2016.)

4.1 How exogenic crises affect markets

Regarding exogenic shocks to insurance markets, two opposing investor expectations occur at and around catastrophic events (e.g. natural disasters, terrorist strikes, or military conflicts). Short-term expectations of losses arising from unexpected high insurance claims or cash flow disruption from insurer investments or premium payments. The opposing long-term growth expectations are based on the belief that catastrophic events cause an increase in demand for insurance policies and a rise in the premiums for those policies. If the insurance firm's long-term gains surpass the short-term losses, the insurer can be said to have benefitted from the crisis. (Martins, Correia and Gouveia, 2024.)

4.2 The Russo-Ukrainian War

In this section, attention is given to the Russo-Ukrainian War's first year and the way it affected insurance markets in different sectors. This is to give the readers a holistic understanding of exogenous shock effects on the insurance markets by anchoring theory to a practical example.

4.2.1 Property and Business Interruption Insurance

From the beginning of Russia's intervention in February of 2022 to 22.8.2022, the Kyiv School of Economics approximated that direct damages to the residential- and non-residential buildings and the Ukrainian infrastructure have totalled USD 113.5 billion, approximately 113 000 residential buildings have been damaged or destroyed totalling to $47 billion, and simultaneously direct damages to Ukrainian business has been estimated to total $13B. The total economic damages consisting of indirect losses such as war-related defence and social spending, drop-in economic activity and outflow of labour were estimated as $564-600 billion. Despite this, the insurance claims have been limited mainly because of the low rate of insurance penetration in the Ukrainian market, the value of lower-incurred insurance, and, most importantly, widespread coverage exclusion for war-related activities. Coverage for war-related activities must, in most cases, be added explicitly to an insurance policy or as an additional policy in the form of political violence coverage, which grants coverage from the risk associated with war and civil instability in most cases. Coverage also includes strikes and revolutions; these policies will cover damage sustained to property and, in some cases, can also cover indirect losses such as forced shutdown of businesses or their suppliers. These political violence policies are separated from political risk insurance, which covers risks and losses connected to governmental policy action, such as losses suffered from tightening regulations, forced divestment, or non-payment from government groups. (OECD, 2022.)

4.2.2 Marine Insurance and Aviation Insurance

After the beginning of the war, physical risk to ships and aeroplanes has risen drastically over Ukraine. In the black sea and the Sea of Azov, all vessels are at risk of being targeted by missile fire from being misidentified by fire control centres or by missiles' own targeting systems; maritime traffic is also at a constant risk of contracting a sea mine. At the beginning of the war, the death of sailors and the sinking of cargo ships caused an increase in premium rates for vessels travelling to and from Ukrainian ports. (OECD, 2022.)

For assets of great value, such as ships and planes, coverage for the damage to the hull may be acquired; for aeroplanes, these policies are covered for a fixed length of time; for ships, maritime hull insurance can also be acquired for each voyage separately. Maritime hull insurance does not include coverage for war-related activities (e.g. war, piracy, and seizure of the vessels), unlike ships' cargo, which maritime cargo insurance automatically covers the war-

related risk. War insurance can be bought separately for a low flat rate; without additional policy or approval, war insurance does not cover activities within the Lloyd's Market Association Marine Joint War Committee; these additional coverages are usually purchased for one week at a time. (OECD, 2022.)

On the eve of the war, the joint war committee declared the Black Sea and the Sea of Azov as listed areas and voided all policies, not especially covering these areas. Expected damages were estimated to be high since premiums rose from industry standards of 0.0025% vessel value to 1-2% and, in some cases, even reaching up to 5% of the value, leaving some operators unable to afford these new sizable premiums. The premium rise was unusually high since, in 2019, premiums rose to 0.9% after Iranian ship seizures were seen as excessive. (OECD, 2022.)

Due to the Black Sea and Sea of Azor being restricted areas, insurance losses from hull damage will remain reasonably low, but losses can arise from other types of claims, (i) trapping and blocking issues, due to seas being restricted and unsafe ships ending up as stranded or unrecoverable after an extended period of time will be eligible for insurance claims, (ii) losses linked to terminals and sea ports, such as damage to equipment, buildings and other infrastructure, (iii) losses linked to cargo (e.g. spoilage or destruction). Losses from maritime insurance will take a long time to realise and be fully catalogued, but they are expected to be around $ 2-5 billion, trapping losses estimated at approximately $ 1 billion; losses linked to cargo are expected to remain low compared to other claims. (OECD, 2022.)

After the start of the war, the world has been spared from the tragedy of aviation crashes related to the war, and thus, insurance claims have been related to the planes being stranded in Russia. Under the sanction imposed by the EU in February of 2022, all sale, supply and transference of aviation or space industry-related technology was prohibited to Russia; this required all EU-based aeroplane leasing companies to terminate their contracts with Russian airlines, which totalled 513 aeroplanes worth in total approximately $ 10 Billion. Laving of these sanctions caused Irish aviation authorities to suspend and Bermudas aviation authorities to revoke certificates of airworthiness, as places where most of the places were registered, all planes in Russia became illegal to fly. To keep airlines operational, Russia passed a law allowing planes leased to Russian airlines to be re-registered in Russia. Russia still claims to recognise the foreign ownership of these aircraft and offered compensation for leased planes that cannot be returned, but as this would constitute a sale of aircraft to Russia, it would

violate the EU sanctions. By international aviation law, planes must be registered by their owner, and planes cannot be registered in more than one state. (OECD, 2022.)

Registration to another jurisdiction without proper notice, in most cases, will void an aeroplane insurance policy. Under aircraft leasing agreements, the leasing airline must purchase primary coverage for the hull of the plane and additional war coverage. Additionally, the leasing firm will purchase a contingent policy to cover the situation in which the primary insurance is found insufficient. Additionally, war insurance can be purchased as well, and the leasing firm usually purchases contingency policies for their entire aircraft. Russia's law allowing planes to be re-registered in Russia has led leasing companies to file claims for their re-registered planes. AerCap (a large aircraft leasing firm) has alone made $3.5 billion in claims for 100 re-registered planes. (OECD, 2022.)

4.2.3 Trade Credit, Cyber, and Political Risk Insurance

In cases of exogenous crisis, insurance markets are faced with losses other than mere physical damage to property and infrastructure. In the case of the Russo-Ukrainian war, these effects stem mostly from imposed sanctions and foreign currency exchange restrictions, leading to losses from insurers who have issued policies for credit insurance or political risk insurance. As a part of Ukraine's 24th of February martial law declaration, the Ukrainian central bank declared a mandatory waiting period for all foreign currency trade, which was not especially in the best interests of the country's mobilisation efforts. As part of Russia's sanctions, most banks have been excluded from the SWIFT payment network; as a countermeasure, Russia has also banned all foreign currency transactions without government approval. These payment restrictions have sizably increased the risk of payment defaults for companies connected to Ukrainian or Russian markets. Trade credit insurers who have provided policies for companies participating in exporting goods or services have been seen to slow down or completely stop issuing new policies for companies in Ukraine or Russia. The reduction of new policies can be explained by trade credit insurance, a more common practice to lower coverage on short notice. An insurer that has chosen to withdraw from the Russian market may also consider a hit to its reputation if it decides to continue covering Russian-based businesses. (OECD, 2022.)

Considerable losses from credit insurance are still expected. Just German insurance provider Allianz has set aside $100 million as reserves for claims related to trade credit claims stemming from the war. War exclusion clauses may limit some insurers' losses from claims made

from Ukraine, but from claims made from neighbouring countries or Russia, these will not provide protection since war is not waged there. (OECD, 2022.)

In addition to the losses from trade credit claims, there exists a sizable possibility for claims stemming from political risk insurance policies; these policies can guarantee coverage from such events as (i) currency inconvertibility caused by situations like Ukrainian central banks' halt on foreign currency trading or Russia's execution from the Swift network. (ii) Confiscation, nationalisation, or expropriation, as Russia did to the aeroplanes leased to Russian airlines. (iii) Contract frustration, which will grant coverage in cases where governmental policy leads to an inability to fulfil the contract, such as the inability to deliver goods to Russia because of sanctions. These political risk policies can be bought to fit the needs of the incurred, such as short-term (e.g. one to two weeks) coverage for a business deal or long-term (e.g. many months or years) coverage for purposes of infrastructure projects. (OECD, 2022.)

Contrary to most other insurance types, political risk insurance cannot be cancelled or altered by the insurer during the contract term. This leaves insurers uniquely vulnerable to exogenous crises, and thus, losses from political risk insurance are expected to be approximately $ 2 billion. The exact estimate is hard to create since, in most cases, political risk insurance has clauses to keep the nature and, in some cases, even the existence of the contract confidential. (OECD, 2022.)

After the beginning of the war, there has been a substantial increase in insurance loss risk generated by cyber-attacks; most attacks have primarily been aimed towards critical infrastructure, banks, governmental departments, and telecommunication firms. As expected, attacks have been noted in Russia and Ukraine but also in countries neighbouring Russia or Ukraine and countries which have been listed as "unfriendly toward Russia." Some additional cube attacks have been noticed in other geographic areas of the world like the USA, but there is not believed to be a serious risk of broad cyberwarfare; if one were to manifest, then estimated damages could total $ 20 billion or more. (OECD, 2022.)

Since modern cyber risk has operators sponsored by Ukraine, Russia, third-party nations, and independent operators, it is often hard to know how and, if any, war exclusion clauses can be used in case of cyber-attacks. The Lloyd's Market Association 2021 created an "illustrative model to help insurance providers draft policy clauses to answer questions about cyber-attacks relations to war-exclusion clauses; widespread usage of these classes is still unknown due to their new presence. (OECD, 2022.)

If it is deemed that the war-exclusion clause cannot be exercised, insurance providers with a sizable presence in Ukraine's critical infrastructure or banking sector can face significant losses. Since the usage of war exclusion is still unknown, reasonable estimates of losses have not been made public. (OECD, 2022.)

5 Conclusions

This thesis examined the differences in the insurance markets' reaction to endogenous and exogenous shocks by conducting a literature review of the theoretical concepts which govern the insurance markets and by studying the effects of endogenic and exogenic shocks through practical examples. Endogenic shocks are learned through the 2007-2008 financial crisis through the fate of the insurance giant AIG (American International Group), and exogenic shocks by examining the insurance markets' reactions to the first year of the Russo-Ukrainian war.

The theoretical section begins by explaining the basic concept of uncertainty, which leads to concepts of adverse selection and moral hazard, which stand as the main reasons for the need to model uncertainty in insurance markets. Brief mention is given to residual markets, which are often governmental programs that offer insurance to people to whom private insurance providers would be hesitant to grant coverage. As a last concept to apply to insurance markets broad working, reinsurance is explained to spread the risk of uncertainty more broadly and this way, reducing likely loss and risk suffered by each insurer.

After this theoretical overview, the focus is on concepts essential to risk pricing. It started by explaining the practice of stress testing and scenario analysis by highlighting its three main types, which are reverse, historical, and synthetic scenarios. As a bridge from scenario analysis to the preceding method, Monte-Carlo simulation is introduced, and it is explained how it can be applied to gain certainty through the law of large numbers. As a final part of the risk pricing section, Bayesian models, Markov chains and actuarial pricing are all introduced as a collection to highlight how risk pricing is a complex amalgam of multiple techniques and practices.

Finally, the theoretical section gives a generalised overview of how insurance markets work as a holistic unit and concludes with an example of how risk-prising techniques could be used to reach an optimal premium price for an insurance policy.

After the theoretical section has been concluded, attention is directed to endogenic shocks and to Hyman Minsky’s financial instability hypothesis. This hypothesis rose in popularity after the 2007-2008 financial crisis as a way to explain endogenic crises' tendency to happen repeatedly and for similar reasons. With knowledge of the financial instability hypothesis, the

focus is placed on the American International Group whose role in the financial crisis makes it a useful focal point in the examination of the crisis.

Finally, the thesis examines exogenic shocks by first briefly familiarising the insurance market with the modelling of exogenic shocks and their reactions to them. Afterwards, the main focus is given to the insurance markets' reaction to the onset of the Ukrainian war by observing its effect on multiple insurance sectors.

5.1 General Findings and Possible Further Study

Based on the studies and reports gathered in this thesis work, it can be said with mild confidence that insurance markets tend to have less violent reactions to exogenous such compared to endogenic. When considering that insurance markets act as a mediator and absorbers of risk and market shock, it can be inferred that insurance markets are more than capable of absorbing all but most violent exogenic shocks with acceptable losses.

Endogenic shocks generally have longer lasting and endogenously compounding effects, which insurance providers generally are not well suited to handle since endogenic crises will have negative and long-lasting effects on all insurance providers' operations. This leads to greater than expected loss, which, if devolving into a liquidity crisis, as in the case of AIG, can, in most cases, lead to the collapse of insurance providers, which in the worst-case scenario can start a domino effect, bankrupting multiple firms.

Possible continuations from this thesis could consist of a deeper study on insurance marketers' reactions to endogenous and exogenous shocks either through focusing exclusively on one or another or by trying to develop a way to model this shock. Alternatively, one could repeat the general structure and question of this thesis, but instead of insurance markets, the focus could be on the finance of the banking sector.

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