ASSESSING THE POTENTIAL OF DECENTRALISED FINANCE AND BLOCKCHAIN TECHNOLOGY IN INSURANCE

August 2023

THE GENEVA ASSOCIATION

INSURANCE FOR A BETTER WORLD

ASSESSING THE POTENTIAL OF DECENTRALISED FINANCE AND BLOCKCHAIN TECHNOLOGY IN INSURANCE

Ruo (Alex) Jia
Director New Technologies & Data, The Geneva Association
Associate Professor of Insurance, Peking University

The Geneva Association

The Geneva Association was created in 1973 and is the only global association of insurance companies; our members are insurance and reinsurance Chief Executive Officers (CEOs). Based on rigorous research conducted in collaboration with our members, academic institutions and multilateral organisations, our mission is to identify and investigate key trends that are likely to shape or impact the insurance industry in the future, highlighting what is at stake for the industry; develop recommendations for the industry and for policymakers; provide a platform to our members and other stakeholders to discuss these trends and recommendations; and reach out to global opinion leaders and influential organisations to highlight the positive contributions of insurance to better understanding risks and to building resilient and prosperous economies and societies, and thus a more sustainable world.

Photo credits:
Cover page – Karsten Winegeart on unsplash

Geneva Association publications:
Pamela Corn, Director Communications
Hannah Dean, Editor & Content Manager
Kelly Gailey, Communications & Events Manager

Suggested citation: The Geneva Association. 2023.
Assessing the Potential of Decentralised Finance and Blockchain Technology in Insurance.
Author: Ruo (Alex) Jia. August.

www.genevaassociation.org

Contents

Foreword 5

Executive summary 6

1. Introduction 8

2. DeFi/blockchain insurance: The fundamentals 12
- 2.1 Concepts, key features and underlying technologies 13
- 2.2 DeFi/blockchain insurance vs. conventional insurance 17
- 2.3 Insuring DeFI/blockchain exposures 18

3. The DeFi/blockchain insurance market: Cases and empirics 19
- 3.1 Overview 20
- 3.2 Nexus Mutual: A DeFi insurance alternative for a new business model 21
- 3.3 B3i: Blockchain re/insurance for efficiency 23
- 3.4 AnnChain (ZQAlink): Blockchain insurance for new business opportunities 24
- 3.5 Summary of case studies 25
- 3.6 Empirical evidence: Impact of DeFi/blockchain insurance 26

4. DeFi/blockchain for more inclusive insurance 28

5. Hurdles and risks 32

6. Conclusions and recommendations 36

Appendix 39

References 40

ACKNOWLEDGEMENTS

This publication is a product of the New Technologies & Data work stream of The Geneva Association, sponsored by LEE Yuan Siong, Group Chief Executive & President, AIA Group.

We are grateful to the following experts and executives who made themselves available for interviews or provided editorial contributions:

- Michael Drobac, Director of Global Legal, Compliance and Regulatory, AIG
- Atsushi Izu, Head of London Innovation Lab, Dai-ichi Life
- Hugh Karp, Founder, Nexus Mutual
- Christoph Krieg, Strategy Manager, ZA Tech
- Caleb Rockstone, Innovation Consultant at Reinsurance Solutions, Swiss Re
- Bruno Scaroni, Group Head of Business Development & Innovation, Generali
- Bill SONG, CEO, ZA Tech
- Blythe Walker, Chief Technology Officer, Renaissance Re
- Lutz Wilhelmy, Risk & Regulation Advisor, Swiss Re
- Jiahua (Java) XU, Associate Professor on Blockchain Insurance, University College London
- Sheng YANG, CEO, ZQAlink
- Tong YU, Professor of Finance, University of Cincinnati

We would also like to thank the members of the working group, established in support of our New Technologies & Data research activities, namely: Nida Gorkem (Ageas); Tom Gerritsen, MinWoo LEE (AIA); Esra Öge (AKSigorta); Tim Skates, Owen Morris (Aviva); Camille Nibéron (AXA); Raman Murali (Chubb); Jenny Williams (Convexin); Noriyoshi Hosokawa, Jiro Kamiko, Shin Nakayama (Dai-ichi Life); Ryan Cole (Everest Re); Bruno Scaroni, Gianfranco Vecchiet (Generali); Chris Dolman (IAG); Chris Reid (Intact Financial Corporation); Andrés Hevia (MAPFRE); Hiroyuki Hara, Toshifumi Takase (Nippon Life); Jing XIAO (Ping An); Anna Mejlerö (Swiss Re); Carla Marnet (VidaCaixa); and Adriano Chioetto (Vittoria Assicurazioni).

Thanks also to Pieralberto Treccani (The Geneva Association) and Yiwen (Eva) Zhang (Peking University) for their invaluable research support.

Foreword

In our increasingly interconnected world, where rapid technological development continues to reshape the global landscape, decentralised finance (DeFi) supported by blockchain technologies has emerged as both an opportunity and challenge for the insurance industry. We are pleased, with this report, to provide an analysis of key considerations for insurers.

DeFi and blockchain technologies are ushering in a new era of smoother customer experience and easier claims management. By facilitating inclusive insurance solutions, they may play a transformative role in empowering underserved communities. They also enable policyholders to share data more securely with insurers and others – protecting sensitive information in transactions and fortifying the industry against fraudulent activities.

The positive knock-on effects of DeFi and blockchain technologies for insurance customers are coming into focus. We call this the potential 'Triple-A Impact': enhanced Accessibility, with insurance services provided completely online; improved Affordability, as a result of reduced operational costs for insurers; and increased Attractiveness, with a simpler customer experience. Faster and more reliable claims processing and increased data transparency can, conceivably, foster greater trust in insurers.

However, alongside the attraction of DeFi and blockchain, we must be mindful of their nascent nature and inherent risks. Issues around regulatory compliance, scalability and cyber vulnerabilities are top of mind.

To support insurers in navigating these challenges, this report explores real-word use cases and lessons already learned from early adopters, and projects how DeFi/blockchain in insurance may develop. We hope that the report guides insurers and insurtechs in harnessing the full potential of DeFi and blockchain technologies while managing related challenges with prudence and foresight.

Jad Ariss
Managing Director
The Geneva Association

Executive summary

'We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run.'

Amara's Law

Decentralised finance (DeFi)[1] and blockchain technology[2] have the potential to improve the efficiency of traditional insurance, enable new business models and open up new opportunities in insurance. They may also improve the accessibility, affordability and attractiveness of insurance and make insurance more inclusive.

Specifically, DeFi/blockchain technologies could reduce administrative costs and streamline insurance processes by eliminating the need for intermediaries; increase transparency by enabling transparent and immutable records, thus enhancing trust and reducing fraud in insurance transactions; and improve accessibility and inclusivity by facilitating underserved populations' participation in risk-sharing arrangements and access to coverage that was previously unavailable to them.

DeFi and blockchain technologies have the potential to improve efficiency and enable new business models in insurance, as well as make insurance more inclusive.

Case studies and empirical evidence, however, suggest that the potential benefits of DeFi and blockchain applications in insurance (DeFi/blockchain insurance[3] hereafter) have not yet been fully realised. DeFi/blockchain insurance is mainly present in large, competitive markets; remains niche; and is concentrated in specific non-life segments such as crypto-related risks. The expected efficiency gains and new business opportunities have not yet materialised, and enthusiasm about and confidence in investing in DeFi/blockchain insurance have suffered from recent crypto failures. So far, DeFi/blockchain insurance has neither driven major growth of the insurance market nor significantly improved financial inclusion.

What is the outlook for DeFi and blockchain in insurance? In the short term, and practical hurdles notwithstanding, addressing specific pain points of existing insurance practices, such as issues around trust, operational cost and transparency, should be the major focus for DeFi/blockchain insurance. This will require the development and implementation of DeFi and blockchain technology in close collaboration with other insurtechs, using appropriate management approaches. Technically, however, this will not be straightforward as blockchain is generally not a technology that can be easily explored to patch existing IT systems.

In the long term, based on observations from other financial sectors, DeFi/blockchain technology could become an integral part of the insurance value chain. It could become a resource, platform and ecosystem for building new business models and seizing new insurance opportunities. Insurers may come to recognise blockchain as a new ecosystem, i.e. for building and selling insurance products, which could insure both pure on-blockchain risks and off-chain

1 DeFi describes the infrastructure, processes and technologies developed to disintermediate financial services (see Feng et al. 2022; Feng 2023). It is a set of alternative financial markets, products and systems that operate using crypto assets and smart contracts based on blockchain or similar technology (see FSB 2022). DeFi deploys smart contracts to execute a variety of financial services activities on a blockchain without financial intermediaries, with payments often made through crypto assets in digital wallets (see Oliver Wyman 2022).

2 Blockchain is a distributed database or so-called ledger that is shared among the nodes of a computer network. It is best known for its role in cryptocurrency and DeFi systems. See BIS 2022.

3 Figure 2 in Section 2.1 defines DeFi/blockchain insurance in three layers. In the narrowest sense, it refers to a blockchain-enabled, mutual risk-sharing arrangement without a centralised financial intermediary, so called DeFi insurance or decentralised insurance. In a broader sense, it includes insurance products that use smart contracts and/or other blockchain techniques as the means of delivering conventional insurance services, so-called blockchain insurance. In the broadest sense, blockchain insurance also includes insurance activities that use blockchain techniques to improve operational efficiency and/or to develop new business opportunities.

conventional risks. Ultimately, it could also formalise the current informal risk-sharing systems used by the un(der) insured and narrow the insurance protection gap.

Realising the potential benefits of DeFi/blockchain insurance comes with regulatory, business and technical hurdles and risks. These include regulatory caution about the experimental nature of DeFi/blockchain insurance, the immaturity of the blockchain ecosystem, the lack of digital literacy, issues with scalability and integration with legacy IT systems, and data privacy concerns.

Incumbent re/insurers should carefully balance the short-term cost of investing in technology with the long-term potential of DeFi/blockchain insurance. They should dynamically weigh the pros and cons of DeFi/blockchain insurance by continuing to test the waters with pilots due to: 1) the potential of DeFi insurance to disintermediate and transform traditional insurance business models, at least in the long run and 2) the new revenues generated by providing improved services (e.g. risk assessment, pricing, risk management, claims management), which are likely to emerge for incumbent re/insurers that actively invest in the DeFi/blockchain transformation, similar to banks generating new revenues from off-balance-sheet services.

For incumbent re/insurers, starting with a DeFi/blockchain insurance pilot that addresses the pain points of existing business models or developing a new line of business in a new market are likely to be valid strategic options. Startups should identify business opportunities where DeFi/blockchain technology has a competitive advantage, such as crypto-related covers and e-credit insurance in supply chain finance.

1 Introduction

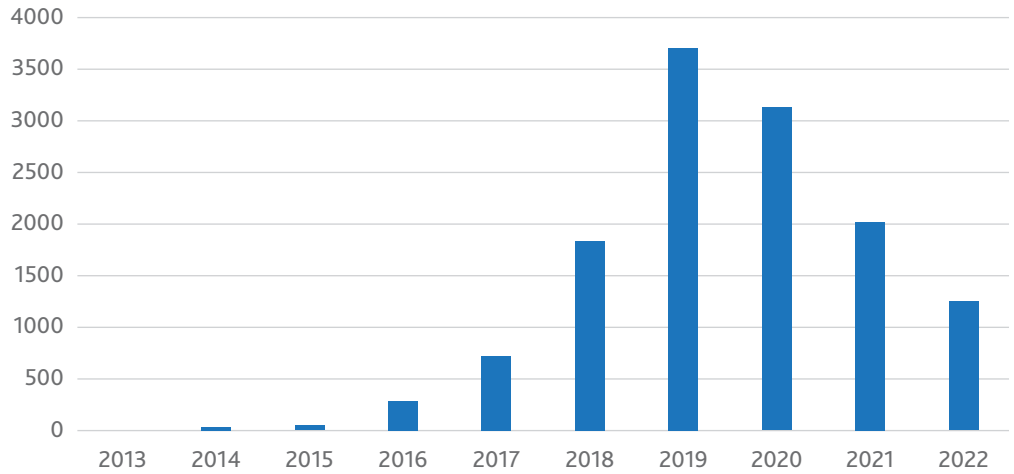
Introduction

DeFi and blockchain technologies can address pain points in insurance, such as lack of trust, high transaction costs and the tension between confidentiality and transparency.

Decentralised finance (DeFi) and blockchain technology can address traditional pain points in insurance, such as lack of trust, high transaction costs and the tension between confidentiality and transparency. Ultimately, DeFi and blockchain could potentially transform the insurance industry by reducing operational costs, facilitating the development of new business models and opening up new insurance opportunities, for example in inclusive insurance.[4,5]

DeFi and blockchain technology have undergone rapid development in the past decade, including in insurance applications. As shown in Figure 1, the number of newly granted blockchain insurance patents has increased significantly in recent years. Between 2019 and 2021, during the crypto boom, there was much optimism around DeFi/blockchain developments in insurance and blockchain insurance patents peaked during that time. In 2022, however, when crypto markets experienced major devaluation and failures, the outlook on DeFi/blockchain-related markets became more pessimistic and the number of blockchain insurance patents dropped. Global venture funding for blockchain and crypto companies reached a record high in Q1 2022 but then declined for three straight quarters due to the crypto winter coupled with rising interest rates and macroeconomic pressures.[6] Investors were reluctant to continue financing DeFi/blockchain insurance technologies given the uncertainty around near-term profitability and scalability prospects.

FIGURE 1: NUMBER OF BLOCKCHAIN INSURANCE PATENTS GRANTED IN THE PAST DECADE



Source: Patsnap Analytics[7]

4 Inclusive insurance refers to insurance products that target un(der)served populations. Microinsurance is a subset of inclusive insurance, which enables low-income groups (rather than all un(der)served groups) to access insurance. See MAPFRE 2020.
5 Feng et al. 2022; Feng 2023.
6 CB Insights 2023.
7 As shown in Figure 7, the number of blockchain insurance patents cover those granted by the World Intellectual Property Organization (WIPO) and the European Patent Office (EPO). They cover 18 markets and are obtained from 170 patent databases (https://analytics.zhihuiya.com/status/).

DeFi and blockchain technology are expected to improve financial infrastructure in ways that could increase demand for insurance.[8] For example:

Identity verification. DeFi and blockchain technology offer solutions to people who have no legal identity and enable identification of individuals without revealing private information.
Monetary transfers. Digital wallets based on a public blockchain enable remote and instantaneous monetary transfers to and from the unbanked.
Peer-to-peer connection. DeFi/blockchain bridges the geographical gap between individuals with similar financial needs.
Automated contract execution. Blockchain-based smart contracts[9] enable automated execution of financial transactions without human interference, which not only reduces operational costs but also enhances trust among stakeholders.

These DeFi/blockchain-based advancements enable additional access to and improve the affordability of insurance. DeFi/blockchain applications could also simplify insurance, making it more attractive.

On the flip side, recent failures of DeFi/blockchain pilots in insurance suggest that the short-term hurdles and risks must not be underestimated. In 2022, B3i, the re/insurance industry's blockchain initiative, became insolvent due to failure to raise new capital. This highlights the challenges associated with achieving expected efficiency gains and profitability in mass adoption in the short term.

DeFi and blockchain technology could improve financial infrastructure and insurance demand in the long term. But short-term challenges related to efficiency gains and profitability could hinder mass adoption.

The crashes of stablecoin[10] TerraUSD and crypto exchange FTX have also challenged overall confidence in the DeFi system in the short term. The Terra crash resulted from design failure and reflects the immaturity of blockchain technology. The FTX scandal suggests that traditional pain points, such as agency problems,[11] incompetence and fraud, are also present in self-proclaimed decentralised systems.[12]

These developments have led insurers and investors to doubt:

- Whether DeFi/blockchain applications in insurance will achieve the expected scale and efficiency gains in the foreseeable future;
- Whether DeFi/blockchain technology is mature and safe enough for mass insurance applications;
- The extent to which DeFi/blockchain insurance will benefit and/or challenge the traditional insurance industry.

Given the potential benefits and opportunities of DeFi/blockchain applications in insurance and the risks and challenges they pose, it is important to thoroughly assess the impact of DeFi/blockchain on insurance and what it will take to harness DeFi/blockchain technology for a more efficient and inclusive insurance market. With that in mind, this report analyses current developments in DeFi/blockchain insurance and assesses its potential as well as business and regulatory implications. Existing studies on DeFi/blockchain insurance are largely qualitative discussions of its benefits and challenges; evidence-based case studies or empirical analyses are lacking. This report aims to fill this gap.

We also briefly discuss the new risks introduced by applications of DeFi/blockchain technologies in various industries and the potential insurance coverage for them. Insuring blockchain-related risks falls under the scope of cybersecurity and cyber insurance, and therefore will not be covered in this paper.

The rest of the report is structured as follows. Section 2 describes the concepts and key features of DeFi/blockchain insurance and compares it with conventional insurance. Section 3 analyses three representative DeFi/blockchain insurance cases in practice and reports empirical evidence regarding the impact of DeFi/blockchain on the development and inclusiveness of insurance. Section 4 analyses the potential of DeFi/blockchain technology for more inclusive insurance. Section 5 addresses the risks and challenges associated with DeFi/blockchain insurance. Section 6 concludes with business and regulatory recommendations.

8 Allen et al. 2022.
9 A smart contract, also called a computational contract, is an immutable and self-executing protocol that records terms and conditions in the form of a computer programme that can automatically monitor, execute and enforce a contractual agreement free of human interference. See IBM 2023.
10 Stablecoin is a type of cryptocurrency designed to maintain price parity with other physical assets, such as USD or gold. See Harvey et al. 2021.
11 Agency problems refer to the conflict of interest between shareholders and the management team of a firm, where the management may act in its own, rather than the shareholders', best interests.
12 See Box 1, which presents in detail the failures of TerraUSD and FTX and the short- and long-term implications on DeFi/blockchain insurance.

Box 1: Failure of TerraUSD and FTX and the implications for DeFi/blockchain insurance

2022 was an excessively hazardous year for cryptos. Two events had a significant impact on DeFi/blockchain: the collapse of TerraUSD/LUNA, a large stablecoin, in May; and the bankruptcy of the once third-largest crypto exchange, FTX, in November. These major failures have had negative short- and medium-term effects on DeFi and DeFi/blockchain insurance, but may help shape DeFi/blockchain insurance in the long run.

TerraUSD failure. Launched in 2018, TerraUSD (UST) was once the largest non-collateralised stablecoin. Unlike fiat-backed or crypto-collateralised stablecoins, TerraUSD maintained its dollar value through a simple arbitrage algorithm: *UST 1 ≡ USD 1 worth of LUNA*. LUNA is the companion coin of Terra, designed to balance and maintain the value of Terra. The collapse of TerraUSD was caused by a substantial drop in LUNA, a common volatility in the crypto market, making it impossible to maintain TerraUSD's dollar value. Consequently, on 7 May 2022, the price of UST fell to 35 cents and the price of LUNA further fell to a few cents by 12 May 2022. The two cryptocurrencies fell into a downward spiral due to their inherent design defect: the absence of collateralisation through either physical or digital assets. When UST was depegged from USD 1, Luna Foundation Guard, the non-profit organisation responsible for overseeing Terra's ecosystem, deployed USD 3.5 billion from its reserves to repeg UST to the U.S. dollar. However, the reserve buffer was quickly exhausted. On 25 May 2022, a new LUNA was issued, called Terra 2.0 by investors, and UST and LUNA decoupled.

Collapse of FTX. Established in 2017, FTX was a centralised exchange for buying and selling cryptos. The failure of FTX was triggered by an article published on 2 November 2022 stating that Alameda Research, a trading firm affiliated with FTX and owned by FTX Chief Executive Sam Bankman-Fried, held a significant amount of FTX's exchange token, FTT, which was used as collateral for Alameda liabilities. This led Binance, a leading crypto exchange, to announce that it was to sell all of its FTT holdings. On 11 November 2022, FTX filed for Chapter 11 bankruptcy protection. Failure of internal controls, missing fiduciary responsibilities for clients and concentrated holding of own FTT cryptos were the main drivers of FTX's collapse.

Implications for DeFi and DeFi/blockchain insurance. The failures of TerraUSD and FTX reminded people of the fragility of DeFi products and ecosystems. Such concerns are harmful for DeFi/blockchain insurance in the short and medium term. This is confirmed by the negative reactions of cryptocurrency prices: Bitcoin dropped by 18% in May 2022 and 20% in November 2022; Ethereum dropped by 27% in May 2022 and 23% in November 2022. On a brighter note, however, the mistakes made in both cases – design errors in smart contracts and corporate governance failures – became visible and addressable in a new market. None of them point to structural flaws of DeFi or DeFi/blockchain insurance.

Contributed by Prof. Dr. Tong YU, University of Cincinnati

2 DeFi/blockchain insurance: The fundamentals

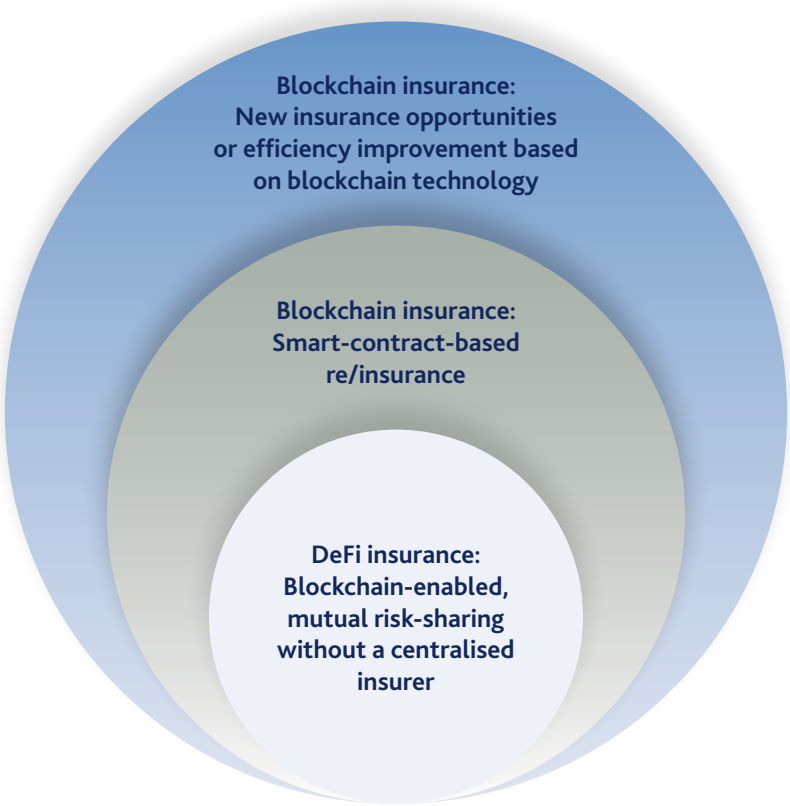
DeFi/blockchain insurance: The fundamentals

DeFi insurance refers to a blockchain-enabled, mutual risk-sharing arrangement without a centralised financial intermediary. Blockchain insurance refers to smart-contract-based re/insurance and new insurance opportunities or efficiency gains derived from blockchain technology.

2.1 Concepts, key features and underlying technologies

DeFi/blockchain insurance can be defined in three layers, as shown in Figure 2.[13] These concepts are defined from the supply side, i.e. how DeFi/blockchain technologies enable more effective risk sharing and more efficient insurance supply. Section 2.3 also briefly discusses the new risks induced by applications of DeFi/blockchain technologies in various industries and potential insurance coverage for these risks.

FIGURE 2: DEFI/BLOCKCHAIN INSURANCE



Source: The Geneva Association

13 Using crypto assets and central bank digital currencies for premium and claims payments or as an asset class for investment is not considered DeFi/blockchain insurance in this report. However, if the monetary system evolves towards cryptos and digital currencies, the adoption of and trust in DeFi solutions will change, which may also benefit the insurance system (see BIS 2023). In addition, there are varieties of crypto asset-based savings and other financial products, including funds of tokenised assets (stock, artwork, real estate etc.), regulated Ethereum staking funds and baskets of cryptocurrencies in savings plans. These crypto-based savings and investment products are increasing in volume and may potentially induce new financial risks. These products are, however, not considered DeFi/blockchain insurance in this report.

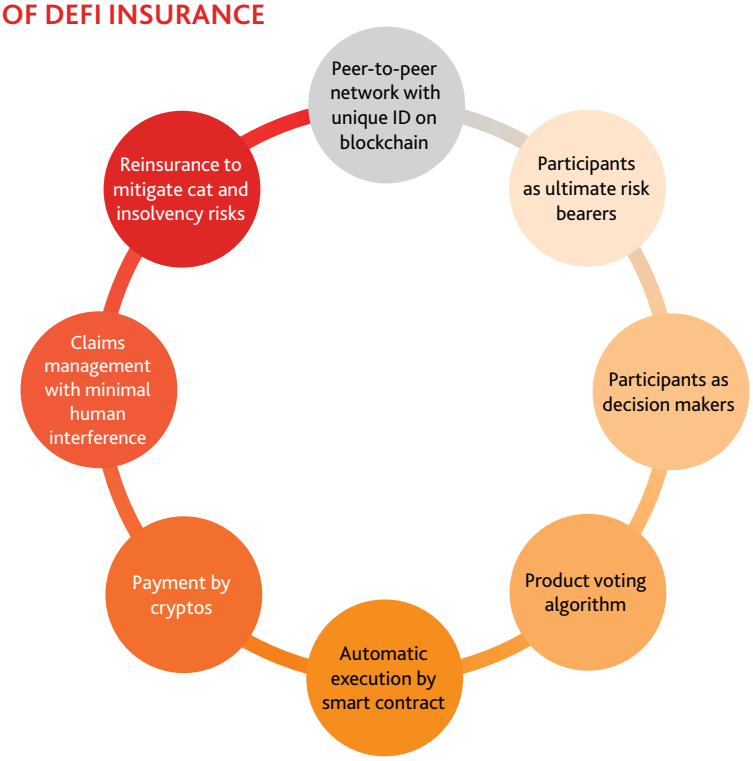
In the narrowest sense, DeFi insurance refers to a blockchain-enabled, mutual risk-sharing arrangement without a centralised financial intermediary, for example peer-to-peer insurance using tokens[14] for premium and claims payments and operating on a public blockchain (e.g. Ethereum) – so-called tokenised or token-based insurance.[15] This narrow concept of DeFi insurance is also known as decentralised insurance. It allows users to transact directly with each other on the blockchain, in theory eliminating the need for an intermediary third party.[16] Such peer-to-peer DeFi insurance is not linked to any incumbent insurance company and serves a group of policyholders with similar insurance needs. The case of Nexus Mutual discussed in Section 3.2 reflects this concept.

Such DeFi insurance systems involve two steps. First, the participants exchange risks with each other to achieve risk diversification via the blockchain. Then, they transfer the risks beyond the risk-bearing capacity of participants to third parties, e.g. via reinsurance.[17] The total value locked (TVL)[18] in DeFi insurance remains very small at just above USD 500 million (as of October 2022), accounting for 0.5% of the TVL in the entire DeFi ecosystem.[19]

DeFi insurance can be described by the following eight features:[20]

1. It is a peer-to-peer network with a unique ID on a blockchain for each policyholder.
2. The participants (instead of a centralised insurer) are the ultimate risk bearers.
3. The participants also make ultimate underwriting and claims decisions (no delegation to a central planner).
4. Product terms and conditions are pre-agreed by participants via a voting algorithm.
5. Smart, immutable, temper-proof contracts automatically execute the pre-agreed terms and conditions.
6. Payments of premiums and claims are made via cryptos through a blockchain wallet.
7. Underwriting and claims adjustment are largely automated with minimal human interference; rules are agreed by member voting; member voting may be applicable for claim disputes.
8. Reinsurance may be arranged to cover catastrophe risk and to mitigate insolvency risk. This may also be decentralised in order to maximise risk diversification.

FIGURE 3: FEATURES OF DEFI INSURANCE



Source: Alwis and Jinasena [21]

14 A token, also called a crypto token, is a type of crypto asset. A token represents an asset or interest that has been tokenised on an existing cryptocurrency's blockchain. For example, the token NXM is built on Ethereum, ETH's blockchain; the token TerraUSD is built on the Terra blockchain. It is often used to raise funds/capital for projects, for example a peer-to-peer insurance programme. For details, see Frankenfield 2023.
15 Cousaert et al. 2022.
16 Alwis and Jinasena 2022.
17 Feng et al. 2022; Feng 2023.
18 TVL is the total value of digital assets that are locked or staked in a particular DeFi platform. It is a measure of size for a DeFi application. See Stepanova et al. 2021.
19 Feng et al. 2022; Feng 2023.
20 Alwis and Jinasena 2022.
21 Ibid.

In a broader sense, blockchain insurance includes insurance products that use smart contracts and/or other blockchain techniques as the means to deliver conventional insurance services, for example parametric cover and health insurance. The smart contract automates the settlement of claims, excluding any human interference, and therefore improves the trust between policyholders and insurers. In the health insurance context, a blockchain connects policyholders (i.e. patients), hospitals and re/insurers by sharing patients' medical information without revealing their identities, improving transparency among stakeholders. The case of B3i discussed in Section 3.3 is an example of this broader concept.

In the broadest sense, blockchain insurance also includes insurance activities that use blockchain techniques to improve operational efficiency and/or to develop new business opportunities. Blockchain technology can be applied to any part of the insurance value chain; for example, to improve internal information sharing and to verify identities[22] and claims. Decentralised, country-level pension databases may improve information sharing as well as data security. Blockchain technology can also facilitate supply chain finance and its associated credit insurance, and be used to explore crypto-related risk coverage and new types of services such as financing brokerage receivables. Annchain (ZQAlink) described in Section 3.4 is a case in point for this concept.

The benefits of smart contracts extend to all parties in the insurance system, including customers, insurers and regulators.

The original and most well-known application of blockchain is Bitcoin, so-called Blockchain 1.0. Bitcoin gave rise to many different cryptocurrencies, crypto assets and stable coins, which secure online payments through a distributed ledger system without a bank or other financial intermediaries. Cryptos can be part of mainstream insurance services and used as tools for premium and claims payments as well as invested assets for pioneering insurers. Cryptos have experienced a few boom and bust cycles. The value of bitcoin, which partially reflects market demand and business acceptance of blockchain applications, peaked in 2021 and then plummeted following the collapse of TerraUSD and FTX.[23]

Blockchain 2.0 (e.g. the Ethereum) enables smart contracts. For insurance, the contract has always been the core product. It is the promise sold and provides peace of mind for policyholders. The complexity of insurance contracts and their policy terms, however, make it difficult for consumers, and sometimes even regulators, to understand and make best use of the cover, limiting insurance demand and supply. Consumers often perceive insurance as opaque and inflexible. As such, the potential benefits of smart contracts extend to all parties in the insurance system, including customers, insurers and regulators. The spectrum ranges from transforming text to code to the all-important automation of insurance processes, from quotations, policy administration and claims to contract renewal. It is also worth noting that smart contracts and their enabling Blockchain 2.0 technology have made signficant progress on energy efficiency: Bitcoin (i.e. Blockchain 1.0) has been blamed for consuming a huge amount of energy; Blockchain 2.0 has largely reduced this problem.

22 Identity insurance enhances credit of the insured, e.g. refugee identity insurance enhances credit for refugees and enables them to engage in various social and financial activities. Risk-based premiums motivate refugees to acquire more quality attestations. Sometimes the premiums are subsidised by NGOs. See CMS 2015.

23 https://cn.bing.com/search?q=bitcoin&PC=U316&FORM=CHROMN

Figure 4 summarises the potential benefits of smart contracts for customers, insurers and regulators.[24]

FIGURE 4: POTENTIAL BENEFITS OF SMART CONTRACTS

Source: Goodenough and Salkind

As the foundation of DeFi/blockchain insurance, smart contracts are expected to improve the trust between transaction parties and the efficiency of business transactions. Smart contracts can also mitigate moral hazard (e.g. parametric insurance) and help with fraud detection, process automation and operational efficiency. They also allow for instantaneous and automatic execution of claims payments, which improves the customer experience.[25] Certain regulations could also be codified into smart contracts, which would enable firms to monitor compliance, and even complete regulatory reporting in an automated way.[26]

24 Goodenough and Salkind 2021.
25 Popovic et al. 2020.
26 Hirschfield and Duric 2022.

Blockchain and insurance connect individuals as part of a network. They also share the objective of building trust among individuals.[27] Blockchain facilitates efficient, encrypted and untampered information sharing among stakeholders of insurance. Using health insurance as an example, hospitals and doctors can upload medical bills and diagnoses on a blockchain that is connected to insurers, policyholders and potentially reinsurers and brokers/agents, without revealing the name or ID number of the policyholder. Identity verification for payment of the claim can be carried out by protocols (smart contracts) on the blockchain. Blockchain technology thus addresses traditional pain points such as issues around privacy and transparency when it comes to decisions on claims and validation of medical records.

2.2 DeFi/blockchain insurance vs. conventional insurance

The modern, centralised insurance business model is a formalisation of the informal, mutual risk-sharing arrangements in ancient civilizations. Merchants across the Mediterranean Sea, for example, shared the loss of a ship among several shipowners based on mutual trust and without a centralised intermediary. Similar risk-sharing arrangements are known from caravans on the ancient silk road.[28] Compared to this model, centralised insurance has three major advantages:

1. Economies of scale with more efficient **risk pooling**.
2. Economies of scope with more efficient **risk diversification** across lines of business and geographical regions.
3. Better **risk management** on the back of risk-based underwriting and pricing.

However, three pain points affect the centralised insurance model:

1. **Trust:** On the one hand, the information advantage of policyholders can lead to adverse selection and moral hazard. On the other hand, individuals may be concerned about insurers' ability and/or willingness to pay claims.[29]
2. **High transaction costs:** The expense ratio reflects the transaction cost of a centralised insurance model. Sales, underwriting and claims management are labour intensive and thus costly.[30]
3. **Transparency:** The operations of insurance companies, including claims and capital management decisions, can be a black box for policyholders.[31]

DeFi and blockchain technology could potentially revive mutual risk-sharing by addressing and easing some of the pain points mentioned above.[32] For example, blockchain-based identity and evidence systems improve the efficiency and effectiveness of verifying underwriting information and claims, making exchange of information between parties easier. This offers a way to reduce information asymmetry, improve trust and transparency between policyholders and insurers, and ultimately reduce the transaction costs of insurance. DeFi/blockchain insurance may also improve the accessibility and customisation of insurance products.[33]

Currently, there are two opposite views on DeFi/blockchain insurance and how it compares to the centralised insurance business model. Optimists believe that DeFi/blockchain may revolutionise the insurance industry in general and inclusive insurance in particular due to its reliance on decentralised networks of computers around the world, instead of existing centralised banking and insurance systems.[34] It is possible (and to some experts, very likely) that DeFi/blockchain will increase in use in the mainstream banking/insurance industry, generate a new wave of disintermediation in the sector and potentially establish a new decentralised banking/insurance ecosystem in parallel to and in competition with the existing financial system in the long run. As DeFi/blockchain may significantly reduce transaction costs in insurance, it will likely expand insurance services to the un(der)served population, and therefore narrow protection gaps and promote financial inclusion. Box 2 outlines opportunities for improving claims and underwriting processes in insurance using DeFi/blockchain technolgoies (and smart contracts in particular).

27 Wang et al. 2017.
28 NICOA 2016; Mohan 2021.
29 Zanjani 2002; Jia et al. 2023.
30 Skogh 1989.
31 Schwarcz and Daniel 2013.
32 Abdikerimova and Feng 2022; Fang et al. 2023.
33 Opencover 2023.
34 OECD 2022.

Box 2: How can DeFi/blockchain technologies benefit claims and underwriting?

Smart contracts offer potential opportunities for claims automation via straight-through processing whereby, under certain conditions defined in the smart contract, claims payments are automatically fulfilled. All data used to support the claim is immutable, trusted and verified through consensus on the blockchain. This could include off-chain data such as medical records, or other health data such as biometrics or genomics. Specific blockchain implementations known as oracles enable this blending of off-chain data with transactional on-chain data, most notably ChainLink.

In traditional blockchains (e.g. Bitcoin), the double-spend problem was solved in a decentralised fashion without an intermediary (i.e. a bank). This is analogous to making the same claim twice in an insurance context. Solving the problem in this way ensured trust by reducing occurrences of fraud, waste and abuse.

Underwriting risk can be distributed among multiple parties with varying risk tolerances in the form of multi-party 'legal smart contracts', enabling increased access to coverage. This has the potential to displace large intermediaries as dominant risk underwriters. Similar to how blockchain (Bitcoin) enables transactions between the unbanked, it can offer coverage to the world's uninsured population.

Contributed by a DeFi/blockchain insurance expert (anonymous)

Pessimists believe that the volatility and failures of cryptos and DeFi/blockchain insurance initiatives undermine investor confidence.[35] Retail investors and coverage buyers – and likely many institutional ones – lack robust knowledge about DeFi insurance, in particular its protocols, governance and claims management mechanisms. Investors and coverage buyers are not protected by insurance regulation either: there is no solvency regulation for DeFi 'insurers'. And there are no insurance guarantee funds. It is therefore likely that after a boom – if not a bubble – in crypto asset inflation, investors and coverage buyers will realise the potential risks of the DeFi insurance system and will continue to rely on the conventional insurance business model.

2.3 Insuring DeFi/blockchain exposures

DeFi and blockchain technologies and their applications may also introduce new risks, related to protocols, wallets and metaverses and for smart contract creators, smart contract users, custodians, protocol contributors, white hats and blockchain designers. Demand for insurance is high among these 'pure players'.

Corresponding new types of insurance coverage would include wallet insurance, custodian insurance, smart contract insurance and errors and omissions (E&O) insurance for blockchain companies. This coverage may or may not use blockchain technology, i.e. it could involve traditional insurance products that cover the new risk exposures of DeFi/blockchain technologies. In this sense, the applications of DeFi/blockchain technologies could generate new business opportunities for insurance companies. Demand for DeFi/blockchain risk coverage could be more tangible and mature compared to using DeFi/blockchain technologies to improve insurance supply, and thus also draw the attention of incumbent re/insurers.

35 Brookings Institution 2022.

3 The DeFi/blockchain insurance market: Cases and empirics

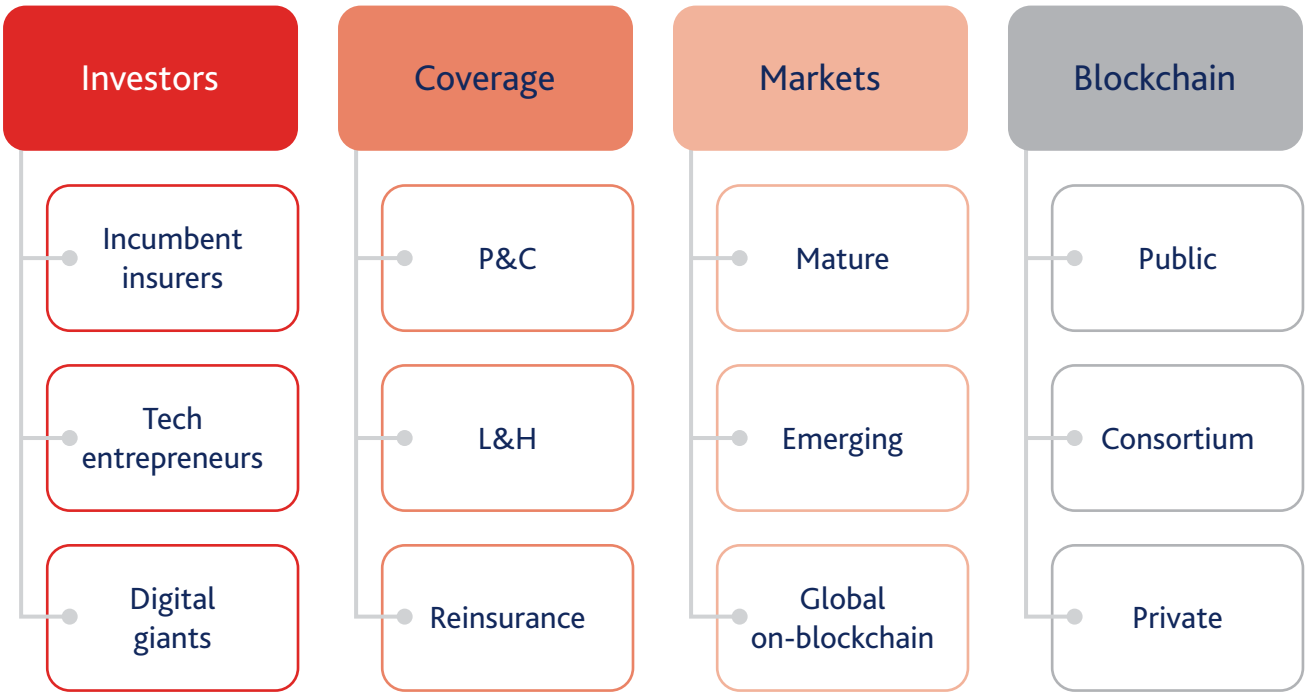
DeFi/blockchain insurance market: Cases and empirics

Whether and to what extent DeFi/blockchain promotes the development of insurance markets and inclusive insurance remains unclear due to a lack of case studies and empirical evidence.

3.1 Overview

Figure 5 provides an overview of the DeFi/blockchain insurance marketplace. DeFi/blockchain insurance **investors** mainly include incumbent insurers, tech entrepreneurs and digital giants.[36] In terms of **coverage**, DeFi/blockchain insurance provides property & casualty (P&C) insurance, life & health insurance and reinsurance. It has been developed in both mature and emerging **markets** and, importantly, some applications purely serve the global online market. Regarding **blockchain** technology, DeFi/blockchain insurance has been developed based on public, consortium and private blockchains.

FIGURE 5: DEFI/BLOCKCHAIN INSURANCE MARKETPLACE



Source: The Geneva Association

This section investigates three representative business cases of DeFi/blockchain insurance, which capture various characteristics of the diverse marketplace. B3i aimed to improve efficiency and was invested in by incumbent international re/insurers. During its life span, it provided reinsurance coverage, mainly operated in mature markets and was developed on a consortium blockchain. Nexus Mutual, a tokenised, decentralised, peer-to-peer insurance business model, is a tech

36 Schmit 2022.

enterprise independent of incumbent insurance players. It provides crypto-related risk coverage (P&C), serves the global online and on-blockchain market[37] and runs on a public blockchain. ZQAlink explores new insurance opportunities. Its investors comprise digital giants and incumbent insurers, and it provides new credit insurance coverage (P&C) in an emerging market on a consortium blockchain.

3.2 Nexus Mutual: A DeFi insurance alternative for a new business model

Nexus Mutual is a DeFi insurance (alternative) protocol/platform,[38] where DeFi users purchase coverage against potential losses related to crypto assets in a digital account. It aims to share risks among individuals in a decentralised manner, i.e. without the need for a centralised insurance company. Nexus Mutual is built on Ethereum, a public blockchain 2.0. By the end of 2022, Nexus Mutual held about two thirds of the global market for on-blockchain coverage.[39]

Nexus Mutual provides three types of coverage:[40]

- **Protocol cover** to protect assets in the event of a protocol and smart contract hack or failure. Claims should be paid when users of the protocol suffer material financial losses due to failures in either the protocol code, economic design or governance set-up.
- **Custody cover** to absorb losses in the event of an attack on a custodian platform. A claim is valid if the custodian gets hacked and the insured loses more than 10% of their funds, or withdrawals from the custodian are halted for more than 90 days.
- **Yield token cover** to protect against the market devaluation of a yield token if it loses its peg to the underlying assets.[41] If the insured's yield-bearing token depegs in value by more than 10%, they can claim up to 90% of their loss by swapping their yield-bearing token for a claim payment.

Instead of using publicly tradable cryptos (e.g. ETH, the cryptocurrency on the Ethereum), Nexus Mutual creates its own token, NXM, and uses it for premium and claims payments, as well as a voting basis for underwriting and claim decisions. Nexus Mutual is owned by its members – those who invested in NXM – similar to conventional mutual insurers owned by policyholders. Members of Nexus Mutual can:

- Buy cover to protect their digital assets as a policyholder.
- Underwrite coverage policies as risk assessors.
- Review the validity of claims as claims assessors.

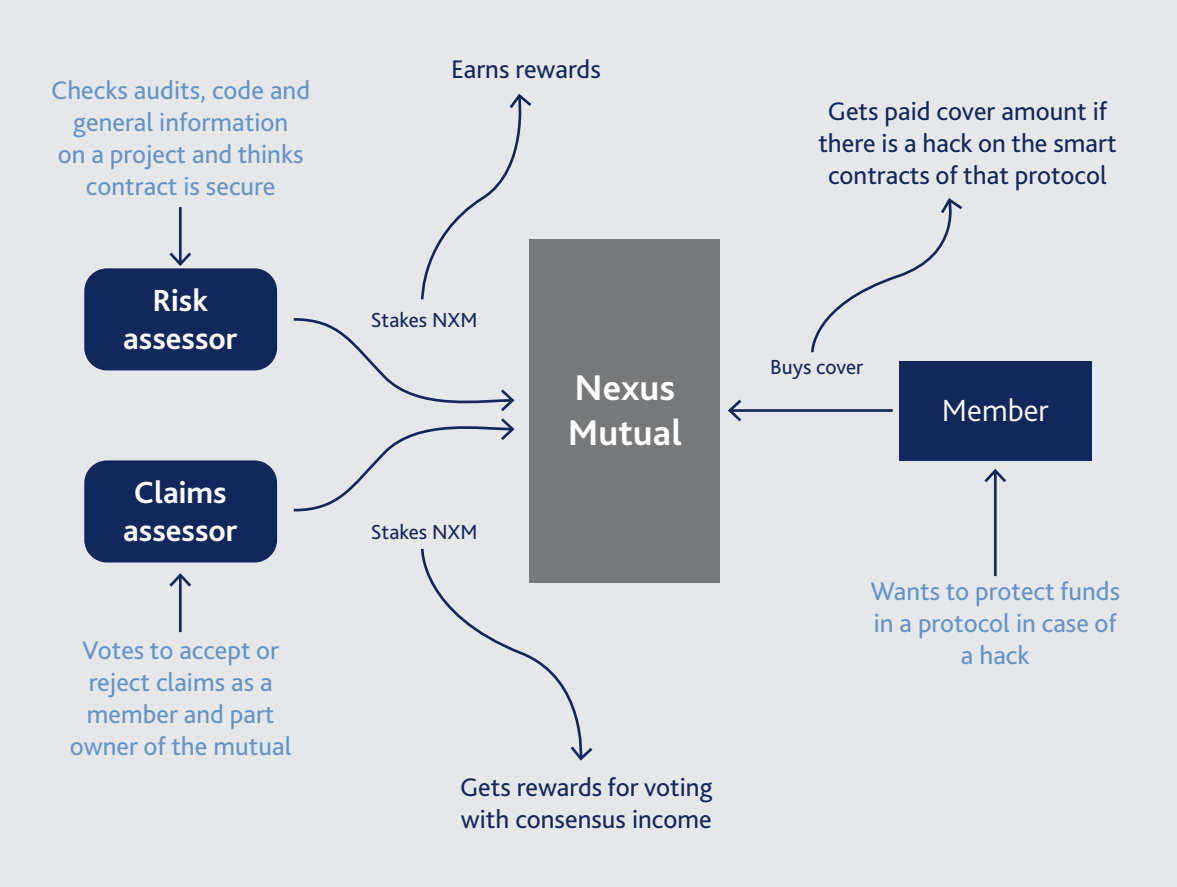
Figure 6 illustrates the business model of Nexus Mutual. Nexus Mutual is halfway on its strategic journey to becoming fully decentralised. For the time being, it is a semi-decentralised platform that connects risk takers to exchange risks. The centralised element of Nexus Mutual is product development. Pricing, underwriting and claims management are, in essence, semi-decentralised, where specialists make the decisions and passive policyholders delegate responsibility to them (under a fully decentralised model policyholders would jointly make the decisions by a voting mechanism). Insurance governance is also semi-decentralised, where a centralised advisory board is given the power to set the maximum exposure to a risk and to punish fraudulent claims assessors. The financing process is decentralised. This semi-decentralised model matches current business needs.

The advantages of Nexus Mutual's DeFi insurance business model are:

- **Competitiveness in on-blockchain insurance**, a niche area where blockchain technology has an advantage, e.g. crypto-related coverage and cyber risk coverage.
- **Efficiency gains.** Nexus Mutual estimates that it could reduce non-commission friction costs, e.g. administrative and other non-commission operating expenses, by 72% compared to a traditional insurance company.
- **Transparency.** Blockchain improves transparency around the product and claims management and investment processes, with real-time reporting of capital position and risk exposure.
- **Flexibility.** As a startup, Nexus Mutual focuses on the DeFi insurance model and, compared to incumbent insurers, enjoys flexibility in technology deployment and product innovation.

37 The on-blockchain market refers to coverage for risks on the blockchain, including, for example, losses from a hack or the devaluation of cryptocurrencies. See OECD 2020.
38 Nexus Mutual and similar coverage providers do not consider themselves 'insurance' but an 'insurance alternative', different from conventional, centralised insurance.
39 Nexus Mutual 2021.
40 Nexus Mutual 2023.
41 A yield token is a version of a stablecoin that exists solely within a DeFi protocol, enabling users to engage in collateralised and self-custodial (or non-custodial) yield-generating activities. OpenCover (n.d.)

FIGURE 6: BUSINESS MODEL OF NEXUS MUTUAL



Source: Nexus Mutual[42]

The disadvantages of such a DeFi insurance model may include:

- **Knowledge barriers.** Policyholders and investors need good knowledge about the tokenised system and cryptos to actively participate in the programme. Additional knowledge about crypto-related risks and claims assessment is necessary for active participation in underwriting and claims management. The documents and other operating data published by Nexus Mutual require advanced knowledge on DeFi protocol design, insurance operations, crypto risk and finance, which potentially weakens its transparency and the ability to build trust.

- **Concentration risk.** The covered exposures are relatively concentrated. Some protocols account for a large share of the total capital. Therefore, reinsurance might be necessary to improve the resilience and sustainability of the programme. Moreover, the covered risks could be highly correlated given the homogeneity of the coverage and potential contagion of the entire crypto market. In the future, the sustainability of claims ratios resulting from the risk portfolio will likely be one of the fundamental success factors; in this regard, adding more business lines to achieve diversification may ease concerns. As Nexus Mutual holds all funds on-blockchain, its invested assets are limited to cryptos, which are exposed to the systemic risk of the crypto ecosystem. A sizeable loss, worth around USD 3 million, representing 1.6% of Nexus' assets, was incurred in December 2022 following the collapse of FTX. Investment options, however, should be increasing regularly, e.g. diversification into non-crypto assets. In support, a risk management function and meaningful stress testing protocols should be introduced to examine the risks of diversification and liquidity.

- **Small scale.** Nexus Mutual's business has been small since it was founded. As of 31 December 2022, Nexus Mutual had USD 4.4 million in annualised premiums in force to cover risks worth USD 172 million. It has had 153 claims since its incorporation and held USD 174 million in capital as of 31 December 2022. As stated by founder Hugh Karp, growth in the active cover amount (the amount of risk being shared among members) is

42 Petrie 2020.

believed to be Nexus Mutual's fundamental success factor. The key hurdle to achieving larger scale is distribution. Currently, all of Nexus Mutual's covers are accessed from the core website rather than through wider distribution channels, e.g. points of sale, bundled products and brokers/agents.

At least at this stage, there is limited evidence to suggest that Nexus Mutual would have the competitive edge in insuring conventional risks or replacing traditional insurers. The underwriting and pricing of traditional insurance are complex and require meticulous calculations by a team of specialised underwriters and actuaries. The next version of Nexus Mutual's underwriting model ('V2') will move in this direction, with specialists making decisions and passive holders delegating responsibility to them. The next step may involve the switch towards an automated administrative system combined with a capital pool, similar to 'reinsurance-as-a-service'. It remains to be seen whether Nexus Mutual and similar tokenised insurance businesses can genuinely disrupt traditional insurance business models.

Current semi-decentralised insurance models may not replace traditional insurers in insuring conventional risks.

3.3 B3i: Blockchain re/insurance for efficiency

B3i ('The Blockchain Insurance Industry Initiative') was the lighthouse blockchain initiative in insurance supported by major re/insurance industry investors until 2022. B3i was a collaboration between incumbent re/insurers to explore the potential of using blockchain technologies with the vision of improving efficiency, i.e. to develop, at least in the initial stage, an end-to-end solution on blockchain for more efficient reinsurance transactions, enabling faster access to reinsurance with less operational risks.[43]

B3i was founded in October 2016 as an insurance industry consortium, originally consisting of five re/insurers: Aegon, Allianz, Munich Re, Swiss Re and Zurich. In 2018, B3i formed a company named B3i Services in Zurich, which was supported by 21 re/insurer investors in 2020. In July 2022, however, B3i announced its insolvency after failing to raise new capital of USD 20 million. During its existence, B3i raised a total of USD 22.7 million over three rounds of funding.[44]

The main projects developed under B3i were:[45]

1) **B3i Re.** Creating reinsurance smart contracts on the blockchain platform was a key area of focus for B3i from the very beginning. It aimed to simplify the information flow and reduce the reconciliation processes among parties, including agents, brokers and re/insurers, and improve fraud prevention. The solution enabled electronic placement and administration of reinsurance treaties, from structuring the submission to negotiating, binding, endorsing and technical accounting. In April 2022, the first and only legally bound CAT XL reinsurance contract on the blockchain was placed by Allianz and Swiss Re.[46]

2) **Reinsurance solution for nuclear pools.** In 2021, B3i was appointed to develop a blockchain-based application to manage the interpool risk and governance processes of six nuclear pools in Europe. The solution was designed to accelerate financial closing, with a shared database to improve risk analysis and audit performance.

3) **B3i Fluidity.** This was an insurance platform that provided services and components used to build and distribute applications. External applications integrated into the platform included Ritablock, a technical accounting solution that integrates with existing mainstream reinsurance accounting platforms to automate reconciliation processes, and Claimshare, which aimed to enhance insurers' fraud detection systems by sharing and processing claims and other types of data confidentially.

B3i also expanded into maritime reinsurance and climate risk modelling. In early 2022, a collaboration was announced with RiskStream, another blockchain initiative, to explore a use case application that automates parametric homeowners' insurance. Most of these projects were believed to be in an initial stage.

Though B3i's bankruptcy came as a surprise to the insurance industry, it should not have been entirely unforseen considering the normal cycle of innovation. The bankruptcy indicated that the business case was not sufficiently profitable or scalable to continue at that point in time.

43 Swiss Re 2017.
44 Howard 2022; Sheehan 2022.
45 For more information, see: https://www.linkedin.com/company/b3i-tech
46 IAIS 2022.

Factors that may have contributed to B3i's failure include:

- **Lack of a blockchain ecosystem in the insurance industry.** For full end-to-end efficiency, insurance companies would need to first create smart contracts and move much of the business operation on-chain before a blockchain-based reinsurance contract could be generated.

- **Technology bias and unclear goals.** B3i's goal was to use blockchain to make reinsurance transactions more efficient. In theory, blockchain technology can be used to make such efficiency gains. In practice, however, more emphasis was placed on the technology than the underlying problems to be solved. B3i would have had a higher chance of success if it were targeted on one specific pain point of traditional reinsurance, e.g. real-time information exchange, similar to SWIFT for international banking transactions. However, B3i's attempts to solve too many problems at once, from information and communication to accounting and billing, were overly ambitious. In other words, B3i had a chance to 'win small' but ended up 'losing big'.[47]

- **Complex consortium governance.** The consortium setup of B3i proved challenging for agreeing on collective actions and aligning motivation across multiple organisations. The way the initiative was managed is believed to have played a role in its failure. The consortium also failed in its purpose to raise sufficient external venture capital funding, which led directly to B3i's failure.

- **Timing.** The demand for blockchain reinsurance was not sufficiently strong and the supply of blockchain reinsurance solutions too experimental. Both demand and supply must reach a certain level of maturity before scaling up.

- **Legacy system integration.** This requires strong commitment from re/insurers to agree on a standard interface and IT structure, and to continue participating in data sharing. Deficiencies in this area are a common but critical problem for many insurtech applications.

FidentiaX is another blockchain-based insurtech startup that failed earlier than B3i. Similar to B3i, FidentiaX heavily relied on the onboarding of incumbent insurance companies to make their insurance marketplace work, instead of making a more self-contained product. The incumbents were reluctant to change their tech and the FidentiaX project failed due to lack of confidence from investors.[48]

3.4 AnnChain (ZQAlink): Blockchain insurance for new business opportunities

Set up in 2013, ZhongAn was China's first online insurance company, founded by digital giants and incumbent insurers including PingAn, Tencent and Alibaba. In 2016, ZhongAn founded ZhongAn Technology, a wholly-owned subsidiary specialised in designing and implementing technology solutions. ZhongAn Technology incubated AnnChain, an enterprise blockchain, and its application ZQAlink, a tech provider specialised in financial information security. The latter focuses on providing integrated supply chain finance solutions on the AnnChain platform, combining its experience in supply chain business use cases, FinTech and insurance.[49] As ZQAlink and ZA Tech are tech firms, they are not subject to insurance regulation. Instead of direct underwriting, they partner with licenced insurance companies to issue insurance policies.

E-credit insurance

Traditionally, supply chain finance and credit insurance suffered from a lack of supply chain visibility, laborious and inefficient processing of manual paperwork, regulatory and compliance-related barriers, and risk of fraud. Blockchain technology enhances existing processes through information sharing, digitalising previously paper-based documentation, increasing authenticity in trade and improving Know-Your-Customer (KYC) checks.

E-credit insurance built on AnnChain and provided by ZQAlink is a platform that manages credit and guarantee insurance for insurance companies. E-credit insurance targets small and medium-sized banks, which are willing to provide supply chain finance to firms but are reluctant to offer uncollateralised loans without lengthy and reliable credit records. ZQAlink captures the full business transaction details of the borrowers on the blockchain and shares this blockchain-based credit record with insurance companies. Based on the immutable records on the blockchain, insurance companies underwrite e-credit insurance covering the borrowers' credit risk, enabling banks to issue credit loans. The estimated market size of potential coverage offered (i.e. outstanding loan amounts) is up to CNY 5–10 billion.[50]

Regulation also requires insurance companies to establish an end-to-end system covering the entire credit insurance value chain, including anti-fraud, credit risk assessment, credit risk tracking, and other substantive audit and monitoring functions. ZQAlink draws from ZhongAn's risk management expertise to meet those requirements.

47 There are different opinions on the technology bias. One insider believes that this is a key point and that scope creep ultimately caused B3i's failure. Another insider, however, believes that technology bias was relatively less important compared to complex consortium governance.

48 Braun et al. 2020.

49 For more information, see: https://www.zqalink.com/?lailu=www.itdka.cn#/home

50 A key issue under debate is whether the DeFi lending-credit insurance process should allow off-chain assets; see Xu and Vadgama (2022) for further discussion.

Insurance commission financing

ZQAlink designed a platform for ZhongAn where upstream suppliers (insurance brokers and agents) could easily access loans based on their commission receivables. The platform is connected with ZhongAn's internal business system to obtain insurance orders and receivable data from suppliers. Brokers and agents on the platform are able to initiate financing online based on their receivables. After automated risk control reviews, the platform can directly connect to partnering banks, which can review and grant loans online automatically.

AnnChain and the blockchain service provided by ZQAlink may improve information transparency among participants across the supply chain and thus improve both the access to finance and the operating efficiency of upstream and downstream enterprises. The larger-scale application of this service faces challenges, however, such as lack of standardisation in using blockchain in supply chain finance, and, even more importantly, reluctance to share proprietary information. Insurance companies, for example, may have concerns about sharing business orders and receivable data with ZQAlink as a third-party service provider.

3.5 Summary of case studies

Table 1 summarises the three case studies described above to give a snapshot of the DeFi/blockchain insurance market in 2022.

TABLE 1: SUMMARY OF DEFI/BLOCKCHAIN INSURANCE CASES

	Nexus Mutual	B3i	AnnChain (ZQAlink)
Goals	Provide an alternative model to insurance, covering risks related to crypto assets and protocols	Improve the operational efficiency of the traditional reinsurance business	Explore new business opportunities in supply chain finance
Investors	Tech entrepreneurs	Incumbent international re/insurers	Digital giants and incumbent insurers
Coverage	P&C	Reinsurance	P&C
Market	Global on-blockchain	Mature	Emerging
Blockchain	Public	Consortium	Consortium
Clients	Individuals or entities who seek protection for their crypto assets	Wholesale: Re/insurance companies	Businesses with demand for supply chain finance
Advantages	Blockchain's suitability for crypto-related coverage Transparency, with real-time reporting of capital position and risk exposures	Simplifies the information flow and reconciliation processes among parties Addresses the pain points of reinsurance transactions	Addresses the pain points embedded in the supply chain finance process
Challenges	Knowledge barriers to entry High concentration risk Scalability Investment is subject to systemic risks	Uncertainty of profitability and scalability Lack of focus Complex governance Difficult to integrate insurers' legacy systems	Lack of standardisation in using blockchain in supply chain finance Scalability

Source: The Geneva Association

Nexus Mutual, the market leader in public, blockchain-based DeFi insurance, offers mixed prospects. On the one hand, its business model achieves the goal of semi-decentralised operation, has effectively provided more than 8,000 insurance coverages for crypto-related risks, has paid over 150 claims, has maintained its solvency and continuously attracts capital investment.[51] On the other hand, it remains very small compared to conventional insurance operations due to distribution challenges, struggles to expand into off-chain lines of business and suffers from the ripple effects of major crypto failures.

51 Nexus Mutual is registered as a discretionary mutual in the U.K. and follows the rules of the Association of Financial Mutuals. According to U.K. law, Nexus Mutual is allowed to provide services worldwide, is not considered an insurance company and is thus not subject to U.K. insurance regulation. Some jurisdictions may have additional compliance/regulatory requirements for Nexus Mutual, see PANews 2020.

Blockchain solutions such as the Nexus Mutual proposition are moving more towards augmented, decentralised business models, with the inclusion of 'risk assessor' and 'claims assessor' roles. While fully automated solutions are alluring, there are limitations to growth and scalability, as evidenced by Nexus Mutual's challenges with distribution through a single channel (their website). The inclusion of specialised underwriters and actuaries in their new underwriting model 'V2' is intended to overcome this challenge; however, to truly disrupt the traditional insurance business model, DeFi insurance players may consider further automation of these underwriting functions in the future.

Contributed by a DeFi/blockchain insurance expert (anonymous)

B3i's insolvency suggests that re/insurers are not yet ready for the mass deployment of blockchain-based transactions. B3i was designed to address pain points in the reinsurance business, including information sharing, communication, accounting and claims management but, as discussed above, failed as a result of pursuing too many (unclear) goals and adopting a complex consortium governance structure. Many insurance companies continue to believe in the potential of blockchain technology, such as smart contracts in parametric insurance. However, balancing the costs and benefits and making these projects progressively profitable and scalable remains challenging.

Insurers continue to believe in the potential of DeFi and blockchain technologies, but balancing the costs and benefits, and improving profitability and scalability remains challenging.

With AnnChain (ZQAlink), insurers and digital giants are aiming to open up new insurance business opportunities using blockchain technology. It successfully identified credit insurance demand in a blockchain-enabled supply chain finance business model and anticipates high growth in the coming years. However, it remains to be seen whether this blockchain-enabled credit insurance model can be replicated across other lines of business.

As evidenced by the failure of B3i, consortium blockchains do not seem to provide material benefits over existing technologies for incumbent insurance companies. The use of public blockchains may be a more promising approach given their benefits, such as a credibly-neutral settlement layer, transparency and interoperability.

Another lesson learned from the case studies is that DeFi/blockchain insurance should be problem driven rather than technology driven and focus on efficiency problems or exploring new business opportunities in the insurance industry. Future DeFi/blockchain insurance solutions for new business opportunities should reduce knowledge barriers, e.g. digital literacy, to achieve the intended benefits of transparency and gaining economies of scale.

Looking holistically at the DeFi/blockchain insurance initiatives undertaken by insurtechs, big tech and incumbent re/insurers, common features that contribute to their success include setting realistic goals, avoiding scope creep, effective governance and addressing specific pain points of existing business practice. Common challenges include scalability and short-term profitability. DeFi/blockchain initiatives 'fail' without quick return on investments, which are important for attracting continuous investment.

3.6 Empirical evidence: Impact of DeFi/blockchain insurance

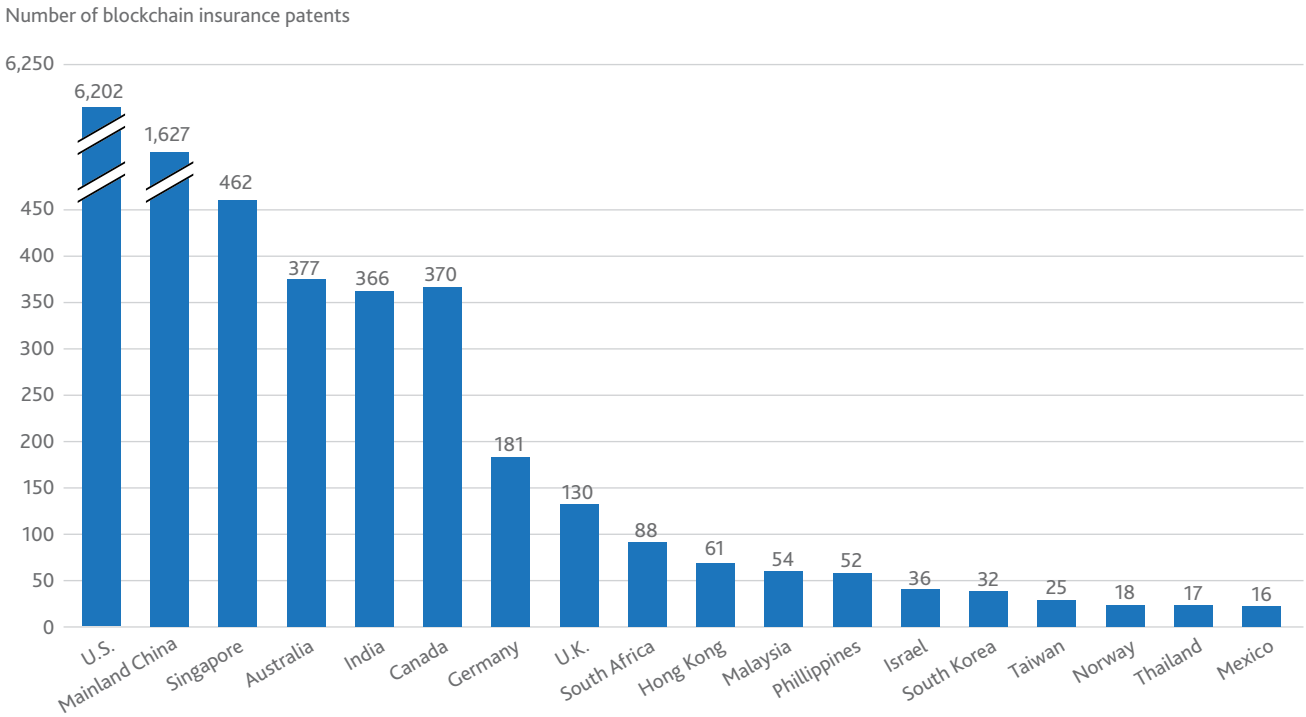
The existing literature documents a positive and causal impact of cryptocurrency value (measured by bitcoin price) on financial inclusion (measured by the number of depositors per 1,000 adults).[52] Research also argues that blockchain-based micropayment systems and international capital transfer systems may potentially improve financial inclusion and alleviate poverty.[53] However, whether and to what extent DeFi/blockchain promotes the development of insurance markets and inclusive insurance in particular remains unclear due to a lack of empirical evidence.

This report fills the gap by empirically analysing the relationship between 1) the growth and maturity of an insurance market and the degree of DeFi/blockchain insurance development and 2) the level of financial inclusion in insurance and the degree of DeFi/blockchain insurance development. We approximate the level of DeFi/blockchain insurance development in a market by the number of blockchain insurance patents obtained (using 170 patent databases from around the world). The measures of insurance market development and financial inclusion in insurance are obtained from Swiss Re and the International Monetary Fund (IMF),[54] respectively. The market-year-level sample contains data from 18 markets over 10 years (2012–2021). Figure 7 shows the distribution of blockchain insurance patents over the 18 markets.

52 Vincent and Evans 2019.
53 Khan et al. 2019; Norta et al. 2019.
54 Swiss Re Sigma explorer: https://www.sigma-explorer.com; IMF Macroeconomic & Financial Data: https://data.imf.org/.

The results of the market-year panel regression analysis show that DeFi insurance and its underlying blockchain technology are mainly developed in large and/or competitive non-life insurance markets.[55] DeFi/blockchain insurance has not yet had a significant impact on the life insurance sector or on financial inclusion in insurance. It has also not yet led to major growth in the insurance industry (see the table in the Appendix for detailed results of the regressions).

FIGURE 7: BLOCKCHAIN TECHNOLOGY DEVELOPMENT BY MARKET, 2012–2021



Source: Patsnap Analytics[56]

Given the mixed results from the case studies and empirical evidence, the fundamental question is whether DeFi/blockchain insurance will disrupt the existing insurance market, or result in the creation of a new market. In the short term, as the crypto market grows and given its volatile nature, demand for insurance covering risks arising from cryptos is expected to persist. DeFi/blockchain technology is not yet powerful enough to become a game changer in more important segments of insurance, which would require re/insurers to shift their existing business practices to DeFi/blockchain insurance. In the medium term, DeFi/blockchain insurance is likely to remain focused on events where specialist claims assessment and/or privacy considerations are less of an issue, e.g. parametric cover, natural catastrophes and crypto-specific risks.

55 We do not intend to make a causal inference here. Causality could play out in different directions. It could be that large, more competitive markets drive DeFi/blockchain insurance development, the reverse causality, or both.

56 The number of blockchain insurance patents are obtained from 170 patent databases. The data cover 18 markets. Database available at: https://analytics.zhihuiya.com/status/

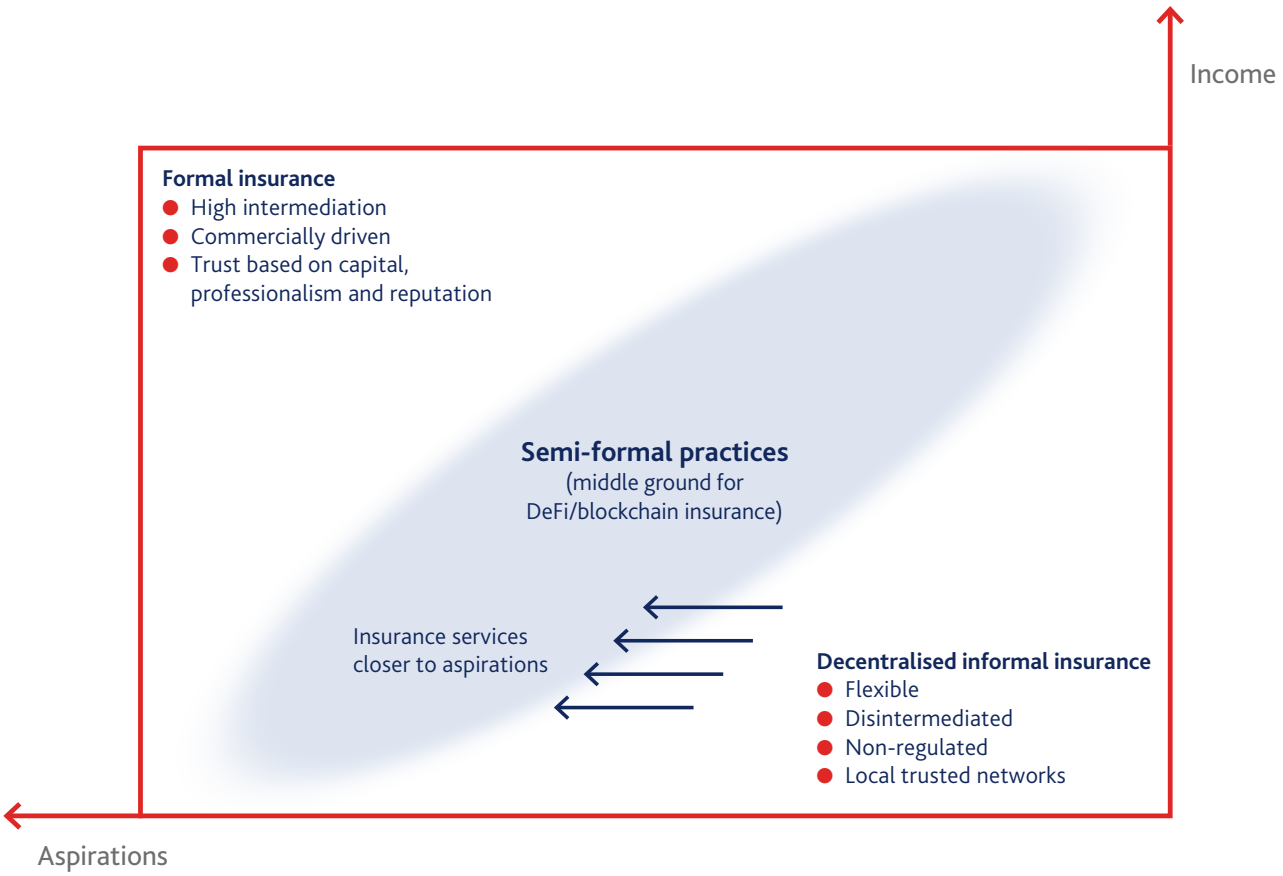
4 DeFi/blockchain for more inclusive insurance

DeFi/blockchain for more inclusive insurance

DeFi/blockchain insurance could narrow protection gaps and promote financial inclusion by expanding insurance services to the un(der)served.

This section examines various DeFi/blockchain-based inclusive insurance solutions as well as the opportunities and challenges associated with improving the accessibility, affordability and attractiveness of insurance coverage. It illuminates the potential contributions of DeFi/blockchain to addressing protection gaps via revolutionary approaches to payments, distribution and trust. It remains to be seen, however, when the socio-economic conditions will be ready to deliver this promise in underdeveloped or developing regions.

FIGURE 8: HOW DEFI/BLOCKCHAIN POTENTIALLY PROMOTES FINANCIAL INCLUSION IN INSURANCE



Source: Larios-Hernandez[57]

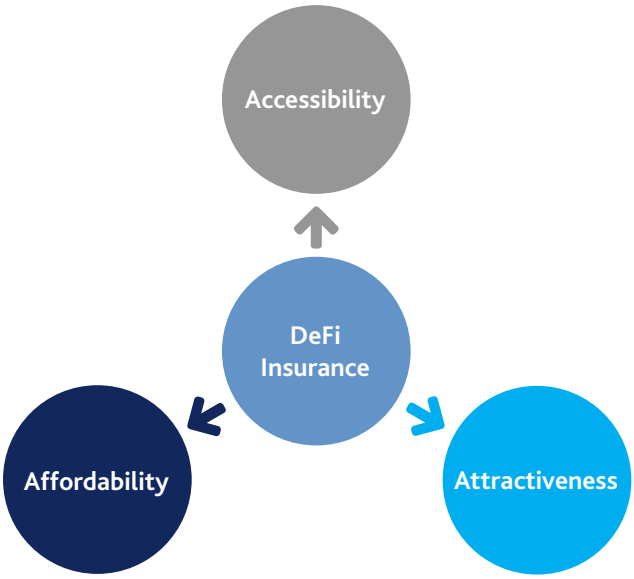
57 Larios-Hernandez 2017.

As Figure 8 illustrates, DeFi/blockchain insurance may potentially narrow the insurance protection gap for low-income populations through semi-formal microinsurance programmes.[58] Conventional informal insurance used by un(der)insured people includes family protection and various community-based, mutual risk-sharing programmes. They are decentralised, flexible, disintermediated, non-regulated and rely on local, trusted networks. By contrast, the modern, centralised, formal insurance model is highly intermediated, commercially driven and establishes trust based on capital, professionalism and reputation. The lower people's income, the more they tend to choose informal insurance for risk management. The arrows in Figure 8 show that the DeFi/blockchain-based, semi-formal insurance model matches well with the existing habits and practices of un(der)insured individuals. It is governed by participating peers or socially oriented organisations.[59] Therefore, DeFi/blockchain technology would increase the sophistication of informal insurance and therefore contribute to financial inclusion.

The DeFi/blockchain insurance model matches well with the habits and practices of un(der)insured individuals and could contribute to financial inclusion.

DeFi/blockchain enables peer-to-peer insurance solutions that meet the demands of un(der)served socio-economic groups. Such groups in the context of insurance usually include those that are geographically remote, or have low incomes or poor financial literacy. Their protection gaps include agricultural risk, health/maternal risk and longevity risk. DeFi insurance enables such individuals to form a risk pool without the approval or interference of insurance intermediaries. Insurance services can be provided completely online, from underwriting to claims, greatly improving the **accessibility** of insurance to individuals living in remote areas. A DeFi/blockchain system may also reduce the operational costs associated with insurance, thus improving the **affordability** of inclusive insurance for low-income populations. Finally, purchasing a DeFi/blockchain insurance product via smartphone applications or mobile phone networks can be as simple as buying other goods online, which improves the customer experience and **attractiveness** of insurance coverage for individuals with poor financial literacy. Figure 9 illustrates the 'Triple-A Impact' of DeFi/blockchain insurance on financial inclusion.

FIGURE 9: THE 'TRIPLE-A IMPACT': HOW DEFI/BLOCKCHAIN IMPROVES FINANCIAL INCLUSION IN INSURANCE



Source: The Geneva Association

Taking rural India as an example, it is believed that blockchain technology has the potential to connect people to local and global supply chains by: 1) delivering financial products and services digitally to their doorsteps, 2) cutting down the costs of engaging in financial transactions and 3) providing more suitable products.[60] Therefore, it could solve the problems of geographical access, high costs and inappropriate or inadequate financial services.

Cryptos are particularly useful for inclusive insurance targeted at the unbanked population (i.e. individuals without a bank account). Business practice in Africa and Latin America shows that insurance products with premiums paid via prepaid cell phones are growing quickly.[61] In 2017, two thirds of unbanked adults globally owned a mobile phone.[62] It is thus reasonable to expect that insurance services can be expanded to cover the unbanked population with digital wallets accessible via their mobile phone networks. Premium and claims payments can be made in any digital currency that the insurer and policyholder are willing to accept, including different types of cryptos and central-bank-issued digital currency. The digital wallet or prepaid cell phone account play the role of a bank account, which circumvents the

58 The efficiency and transparency gains of DeFi/blockchain insurance may also improve financial inclusion beyond microinsurance. For example, blockchain-based health insurance reduces the information asymmetry between hospitals, patients/policyholders and insurers, which improves the affordability and availability of health insurance for middle and middle-lower classes in developed countries. See Larios-Hernandez 2017.
59 Larios-Hernandez 2017.
60 Schuetz and Venkatesh 2020.
61 MAPFRE 2020.
62 EIOPA 2021.

barrier of bank access and improves the accessibility of risk transfer and insurance coverage for the unbanked population. Cryptos therefore enable insurers' direct contribution to financial inclusion, independent of the availability of a banking system.

It is unclear whether DeFi/blockchain technology will facilitate inclusive insurance due to its early stage of development and the immaturity of the technology.

The features of smart contracts are expected to improve the trust between un(der)served individuals and DeFi/blockchain operators/developers. One important application of smart contracts is parametric insurance, which mitigates moral hazard and improves the availability of insurance in rural areas. Besides, smart contracts are believed to have a major positive impact on fraud detection and process automation, which will reduce insurers' operational costs and thus improve the affordability of insurance products.[63] Last but not least, smart contracts enable instantaneous and automatic execution of claims payments (possibly using cryptos on a DeFi/blockchain network), which improves the customer experience.[64]

The consensus among regulators and re/insurers is that digital technology/insurtech should play a critical role in improving the inclusivity of insurance.[65] The International Association of Insurance Supervisors (IAIS) defines the term 'digital inclusive insurance' as insurance that utilises digital mechanisms to improve outreach and delivery,[66] the core elements for increasing accessibility of insurance services to un(der)served populations. However, in practice, it remains unclear whether DeFi/blockchain will facilitate inclusive insurance – and if yes, how and to what extent. This is partly because DeFi/blockchain insurance is still at a very early stage of development compared to other insurtech applications such as big data, artificial intelligence and the Internet of Things, and partly because blockchain technology remains immature, making its development hard to predict.

63 CB Insights 2022.
64 Popovic et al. 2020.
65 IAIS 2018; MAPFRE 2020; Swiss Re 2020.
66 IAIS 2018.

5 Hurdles and risks

Hurdles and risks

Realising the potential benefits of DeFi/blockchain insurance comes with regulatory, business and technical hurdles and risks.

Realising the potential benefits of DeFi/blockchain insurance comes with regulatory, business and technical hurdles and risks (see Box 3 and Figure 10).[67] This section summarises these challenges.

Legal and regulatory uncertainties

The varying treatment of smart contracts and lack of consensus on their equivalence to traditional insurance contracts create legal uncertainties and hinder the widespread adoption of smart-contract-based insurance. There is also uncertainty around which jurisdiction's laws would apply in the context of global blockchain-enabled DeFi insurance solutions, specifically when disputes arise regarding smart contract fulfilment. Consensus is even lacking between insurance practitioners, technicians and legal experts on these issues.

> *"DeFi/blockchain insurance differs significantly from traditional forms of insurance. The regulatory challenge in this space is huge and, to a large extent, still unexplored."*
>
> **Expert involved in the B3i initiative**

The regulatory dimension includes crypto regulation, data-privacy risk, tax compliance and money laundering risk. Some expert interviewees consulted for this research consider regulation as the most important hurdle and risk for DeFi/blockchain insurance.

Given its experimental nature, detailed and specific regulation on technology use can be a double-edged sword: on the one hand, it may help prevent events like the demise of TerraUSD or FTX; on the other hand, it may discourage the development of DeFi/blockchain insurance. Fundamentally, regulators should carefully balance the regulation and promotion of DeFi/blockchain insurance. It will be necessary for regulators to conceptually accept and practically engage in this.[68]

DeFi/blockchain inclusive insurance should also be regulated to address some of the concerns around decentralised informal insurance. DeFi/blockchain insurance is expected to perform better than the decentralised informal insurance network by charging fair rates, improving trust and avoiding nefarious acts.

FIGURE 10: BUSINESS AND TECHNICAL HURDLES AND RISKS IN DEFI/BLOCKCHAIN INSURANCE

Business	Technical
• Immature ecosystem • Insufficient digital literacy • Talent shortage in both technical and insurance expertise • Systemic risk • Inadequate governance • Insolvency risk • Scalability • Cryptos ≠ DeFi/ blockchain insurance	• Integration with existing IT systems • Data privacy concerns • Cyber and other security risks • Disadvantages of blockchain technology • Inmaturity of DeFi protocol design

Source: Schuetz and Venkatesh, IIS, and Saeed and Arshed[69]

67 Schuetz and Venkatesh 2020; IIS 2021; Saeed and Arshed 2022.
68 See Box 2 for a detailed discussion on DeFi/blockchain insurance regulation.
69 Ibid.

Box 3: Regulatory considerations for DeFi/blockchain insurance

The IAIS[70] highlights the following concerns around specific dimensions of DeFi/blockchain risks. a) Operational risk, including the immutability of blockchain, IT risk, governance challenges and concentration risk regarding dependencies on external application suppliers. b) Data privacy, data protection compliance risk and potential tension with the right to be forgotten and the immutability characteristic of blockchain technology. c) Cyber risk: the distributed nature of blockchain technology could provide additional points of entry for hackers, calling for strong cyber governance. d) Unclear regulatory approach: should protection covers on DeFi/blockchain space be considered 'insurance' and how should they be regulated?

The Financial Stability Board (FSB)[71] also noted the systemic risk and governance risk of DeFi/blockchain applications. DeFi/blockchain could reach a point where such risks represent a threat to global financial stability due to its scale, structural vulnerabilities and increasing interconnectedness with the traditional financial system. The decentralised governance of DeFi makes it difficult to identify the individual or entities responsible for meeting regulatory obligations. In an extreme decentralised case, there may be no single person or entity that could be held responsible for the functioning of the protocol, although, as of today, DeFi/blockchain insurance has not yet reached that level.

What type of regulation should be in place? A technology-neutral approach would leverage existing regulatory frameworks that apply to the underlying core activities.[72] In practice, this means that the same rules apply to the same types of activities or risks, regardless of the technology used. Switzerland's FINMA, for example, applies the same rules to DeFi/blockchain applications as it does to traditional financial market intermediaries.[73] Rather than developing DeFi/blockchain-specific regulation, the issuance of guidance and regulatory bulletins would support supervisors on how to apply existing regulatory frameworks.

As DeFi/blockchain insurance may eliminate the need for an intermediary, it can be incompatible with some existing regulatory frameworks, particularly those designed for systems with financial intermediaries at their core. Regulators should pay special attention to aspects that are incompatible with existing laws and regulations. Regulatory sandboxes might be used to encourage DeFi/blockchain pilots and to assess potential risks in a safe, controlled environment.

Contributed by Dennis Noordhoek, Director Public Policy and Regulation, The Geneva Association

Business hurdles and risks

- **Immaturity of the ecosystem.** An ecosystem will be required to fully realise the benefits of DeFi/blockchain insurance, similar to that for electric cars, for example, which need a widely available system of charging stations to outperform internal combustion engines. Currently, the ecosystem for DeFi/blockchain insurance (e.g. smart contracts, on-blockchain financial infrastructure) is far from ready. Most existing insurance operations remain off-chain.
- **Complexity and knowledge barriers.** Understanding the intricacies of DeFi/blockchain insurance products can be challenging for customers, limiting their adoption. Large insurers offer products and services that are well understood and marketed specifically to customers based on their needs. However, DeFi and blockchain technologies enable a huge number of potential offerings of varying complexity, which may be challenging for customers to navigate. The claims management mechanism of a DeFi/blockchain insurance system may also be difficult for customers to understand. This knowledge barrier could apply to the supply side, too (e.g. CEOs and senior management of incumbent re/insurers).
- **Talent shortage.** People with a good understanding of both the technical perspective of blockchain and the business perspective of insurance are rare. This scarcity of expertise hampers the development and implementation of effective DeFi/blockchain insurance solutions.
- **Insolvency risk and reinsurance support.** Similar to conventional insurance operations, DeFi/blockchain insurance is exposed to insolvency risk. Given they are based on mutual risk sharing and the potential for systemic risk, reinsurance, particularly CAT risk cover, is critical to the growth and sustainability of DeFi/blockchain insurance programmes.

Immature DeFi/blockchain ecosystems, knowledge barriers and scalability issues present challenges to the development of DeFi/blockchain insurance.

70 IAIS 2022.
71 FSB 2022.
72 OECD 2022.
73 FINMA 2021.

- **Scalability challenges.** Fundamentally, DeFi/blockchain insurance needs to reach a critical mass to realise its promise of efficiency gains and to become commercially viable. For the time being, it may not have enough competitive advantages in conventional insurance lines of business and distribution channels, which limits its scalability potential in the short term.

- **Conceptually separate crytos and other DeFi/ blockchain applications.** Cryptocurrency was the original application of blockchain technology, but DeFi and blockchain technologies have now gone way beyond this. Educating stakeholders as well as the general public to disentangle cryptos and DeFi/ blockchain insurance will be important.

Technical hurdles and risks

- **Integration with existing IT systems** is a general challenge for many insurtech applications. Building brand new systems is often expensive and existing data are hard to integrate. Finding a way to transform existing IT systems so they are 'DeFi/blockchain friendly', or moving existing systems onto the blockchain are major technical hurdles.

- **Data privacy concerns.** When sharing data, in particular health-related medical records, with stakeholders via a public or consortium blockchain, data compliance, trust issues and privacy concerns limit the data transferability between parties.

Technical hurdles include transformation of legacy IT systems, concerns over data privacy and cyber risks.

- **Cyber and other security risks.** Cryptos are exposed to hacks (e.g. theft of private keys) and protocol failures. The same cyber risk also applies to DeFi/blockchain insurance, whether on a public or a consortium blockchain. Properly protecting customer information and transaction records from leaks, loss and theft is a key challenge. A high level of security is expected for mainstream DeFi/blockchain insurance applications, especially those on public blockchains.[74]

- **Disadvantages of blockchain technologies.** Computational power, energy consumption and error modification are the three major disadvantages of blockchain technology.[75] All represent its immaturity, which is expected to improve over time as business applications develop. Improving the interoperability across blockchains also requires technical solutions.

- **Immaturity of DeFi/blockchain protocol design.** The immature design of DeFi/blockchain protocols and defect token pricing mechanisms may lead to the failure of DeFi/blockchain insurance programmes. Similar technical failures have been seen in the crypto field.

Box 4 summarises some of the core considerations for the future of DeFi/Blockchain insurance.

Box 4: Core considerations for the future of DeFi/Blockchain insurance

Systemic risk and market volatility. DeFi insurance solutions are exposed to the volatility of cryptocurrencies, which can impact their stability and reliability. For example, claims payments in Ethereum tokens are not likely to be preferable to customers given the volatility of cryptocurrency markets. Stablecoins may hold promise, however, sentiment needs to improve following the crash of UST (Terra stablecoin). Institutional investor interest (Blackrock) may introduce much needed stability to markets. Some tokenised DeFi insurance solutions are exposed to the volatility of major crypto assets and their own created tokens. Major recent failures in crypto markets will likely slow down the development of DeFi/blockchain insurance due to reduced confidence in the overall crypto system.

Governance and accountability. Robust governance mechanisms are needed to ensure the transparency and accountability of and trust in DeFi insurance systems. Will a decentralised voting system always make good decisions? Major active players may collude with each other and dominate underwriting, claims and other business decisions in favour of themselves. A voting system may also result in nobody taking responsibility and longer response times. Blockchain is not a silver bullet for bad actors and governance mechanisms will need to be in place to ensure integrity and trust is upheld, at least until more automated ways to mitigate risks are developed.

Need for empirical evidence. Though this report has attempted to provide empirical evidence on the impact of DeFi/ blockchain technologies on the insurance market and financial inclusion, further empirical studies are required to assess the long-term impact and viability of DeFi/blockchain insurance given that existing studies are largely qualitative.

Source: The Geneva Association, with contribution from an anonymous expert

74 Deloitte 2022.
75 Forbes 2022.

6 Conclusions and recommendations

Conclusions and recommendations

A no-regret strategy for insurers would be to continue evaluating the readiness of the DeFi/blockchain ecosystem and cautiously invest in transforming traditional business models.

This report analyses the opportunities and challenges associated with DeFi/blockchain insurance and its potential to improve the efficiency of traditional insurance, enable new business models and make insurance more inclusive. DeFi and blockchain technology is mainly present in large, competitive markets and its applications in insurance remain limited and concentrated in niches of the non-life sector, such as crypto-related risks. The theoretical benefits of DeFi/blockchain insurance have not yet been realised or empirically observed. As shown by the case studies discussed, short-term challenges will remain significant and expectations for DeFi/blockchain insurance in the near future should be lowered. Confidence in investing in decentralised finance has also suffered from recent failures and scandals. Altogether, DeFi/blockchain insurance remains a niche that has so far neither driven major growth of the insurance market nor significantly improved financial inclusion in insurance.

The failure and struggles of DeFi/blockchain insurance initiatives offer the insurance industry and investors an important lesson: in order to realise the expected efficiency gains and business growth, all participating parties need to be in the DeFi/blockchain ecosystem, which may take much longer than anticipated.

What is the outlook for DeFi and blockchain in insurance? Addressing specific pain points of existing insurance practices should be the major focus in the short term. However, technically this will not be easy as blockchain is generally not a technology that can be easily explored to patch existing IT systems. In the longer term, insurers may recognise blockchain as a new ecosystem, i.e. for building and selling insurance products, which could insure both pure on-blockchain risks and off-chain conventional risks. DeFi and blockchain technology may also become a platform on which new business models can be built to formalise the informal risk-sharing system currently used by un(der)insured people (as shown in Figure 8), and therefore narrow the insurance protection gap. In tandem with developing ecosystems, we may see successful DeFi/blockchain business models for inclusive insurance at scale in the coming decades.

To realise the long-term, potential benefits of DeFi/blockchain insurance, we offer the following recommendations for re/insurance incumbents, insurtech startups, and regulators and supervisors.

DeFi/blockchain insurance remains a niche that has not yet driven major growth of the insurance market nor significantly improved financial inclusion in insurance.

Re/insurance incumbents

The rationale for conventional insurers to invest in DeFi/blockchain insurance in the long term is at least two-pronged:

1) The development of DeFi/blockchain insurance is hard to predict and the current players are mostly technology companies operating in insurance. A no-regret strategy for incumbent insurance companies would be to keep cautiously investing in the DeFi/blockchain insurance ecosystem as DeFi insurance has the potential, in the long run, to disintermediate the insurance industry and transform the traditional insurance business model. The first move might be to identify a specific pain point in existing business practice that DeFi/blockchain technology has the potential to address. Coordinating regulatory, business and technological considerations will be a fundamental successful factor for DeFi/blockchain insurance.

2) The banking system has experienced a wave of capital-market-driven disintermediation in recent decades. However, loans continue to be originated. In response to disintermediation, banks have shifted from commercial banking to investment banking services. In a potential future dominated by DeFi/blockchain insurance, risks will still be shared among participants and transferred to third parties. Insurance services will remain in high demand for risk assessment, pricing and claims management. Thus, a new services-based revenue source is likely to emerge for incumbent insurers actively investing in the DeFi/blockchain transformation.

   For incumbent, international re/insurance players, starting with a pilot in a new line of business or a new market would be an appropriate strategy. Partnerships between re/insurance incumbents and blockchain technology firms can mitigate the issue of insufficient digital literacy. Talent who understand both the insurance business and blockchain technology will be critical. An innovative technical and business model will also be needed to overcome the challenge of integrating legacy IT systems.

DeFi/blockchain insurance startups

It is important for startups to identify business opportunities where DeFi/blockchain technology has a competitive advantage. Crypto-related covers and e-credit insurance in supply chain finance are proven examples. Meeting customer demand for simplicity and transparency by reducing the complexity of existing DeFi/blockchain insurance products will be crticial – continuously refining the product to improve user friendliness is likely to be the best way forward, which might be a gradual and long process. Refining the technology and developing sustainable DeFi/blockchain insurance programmes with proper incentives for policyholders and investors will be critical.

Regulators and supervisors

Enhanced data privacy, cybersecurity laws and regulations, and technical advancements are crucial to the success of DeFi/blockchain insurance based on public and consortium blockchains. The legal recognition of smart contracts in general as equivalent to conventional contracts could drive massive growth of blockchain applications, including DeFi/blockchain insurance.

As DeFi/blockchain technologies are at an early stage of adoption in the insurance industry, most jurisdictions are still exploring policy and supervisory responses and have thus not yet developed targeted regulatory frameworks. A technology-neutral approach, with special attention given to aspects that are incompatible with existing laws and regulations, would provide the best balance between innovation, consumer protection and financial stability.

These recommendations underscore the unpredictability of DeFi/blockchain developments. A no-regret strategy for insurance companies would be to continuously evaluate the readiness of the ecosystem and cautiously invest in transforming traditional business models, while keeping propositions and engagement easy for customers. There is also a clear need for regulators to create a legal/regulatory ecosystem for the recognition of smart contracts, ensuring data privacy and cybersecurity protections are made available to insurance contracts.

Appendix

IMPACT OF BLOCKCHAIN INSURANCE PATENTS ON THE INSURANCE MARKET AND ON FINANCIAL INCLUSION IN INSURANCE

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	Ln (Total premiums)	Ln (No. of insurers per 100K people)	Penetration non-life	Density life	Premium growth	Ln (Policies per capita)	Ln (Life policies per 1,000 people)	Ln (Non-life policies per 1,000 people)
Ln (Patent)	**0.022 ***	**0.020 ****	**0.161 ****	**-0.003**	**-0.092**	**0.004**	**0.014**	**0.044**
Population growth	-0.005	-0.009	-0.066	0.031	-5.17 *	-0.274	-0.015	-0.796
Unemployment rate	0.037 **	-0.009	0.002	0.077 ***	-1.782	-0.005	-0.009	-0.010
Inflation	-0.020	-0.022 **	0.036	-0.032	-1.143	0.004	-0.004	0.002
Interest rate	0.038	0.032 *	0.033	0.061 *	-0.393	0.010	0.000	-0.031
GDP growth	-0.002	-0.004	-0.001	0.004	0.143	-0.012	-0.003	-0.028
Market fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.99	1.00	0.87	0.99	0.30	0.99	0.99	0.98
Observations	180	130	180	180	180	54	73	54
No. of markets	18	12	18	18	18	5	7	5

*Notes: The table reports the impact of blockchain-insurance-related patents on indicators of insurance market development and financial inclusion in insurance. Linear market-year panel fixed effects models are estimated. *, ** and *** represent statistical difference from 0 at 90%, 95% and 99% confidence levels, respectively.*

Source: The Geneva Association

References

Abdikerimova, S., and R. Feng. 2022. Peer-to-peer Multi-risk Insurance and Mutual Aid. *European Journal of Operational Research* 299 (2): 735–749.

Allen, F., X. Gu, and J. Jagtiani. 2022. Fintech, Cryptocurrencies, and CBDC: Financial structural transformation in China. *Journal of International Money and Finance* 124: 102625.

Alwis, S., and T.M.K.K. Jinasena. 2022. A Blockchain-Based Decentralized Insurance Platform. In 2022 *International Research Conference on Smart Computing and Systems Engineering (SCSE)*, vol. 5, pp. 137–142. IEEE.

BIS. 2022. *Cryptocurrencies and Decentralized Finance.* https://www.bis.org/publ/work1061.pdf

BIS. 2023 Blueprint for the Future Monetary System: Improving the old, enabling the new. *BIS Annual Economic Report.* https://www.bis.org/publ/arpdf/ar2023e3.htm

Braun, A., L.H. Cohen, J. Xu. 2020. FidentiaX: The tradable insurance marketplace on blockchain. *Harvard Business School Case* 219–116. Harvard Business School Publishing. https://www.hbs.edu/faculty/Pages/item.aspx?num=56189

Braun, A., N. Häusle, and S. Karpischek. 2022. Collusion-proof Decentralized Autonomous Organizations. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3760531

Brookings Institution. 2022. *Debunking the Narratives About Cryptocurrency and Financial Inclusion.* https://www.brookings.edu/research/debunking-the-narratives-about-cryptocurrency-and-financial-inclusion/

CB Insights. 2022. *How Blockchain is Disrupting Insurance.* https://www.cbinsights.com/research/report/blockchain-insurance-disruption/

CB Insights. 2023. *State of Blockchain 2022 Report.* https://www.cbinsights.com/research/report/blockchain-trends-2022/

CMS. 2015. *What Immigrants and Refugees Need to Know About the Affordable Care Act (ACA).* https://marketplace.cms.gov/technical-assistance-resources/immigrants-refugees-need-to-know.pdf

Cousaert, S., N. Vadgama, and J. Xu. 2022. Token-based Insurance Solutions on Blockchain. In *Blockchains and the Token Economy: Theory and Practice*, pp. 237–260. Cham: Springer International Publishing.

Cummins, J.D., and P.M. Danzon. 1997. Price, Financial Quality, and Capital Flows in Insurance Markets. *Journal of Financial Intermediation* 6 (1): 3–38.

Deloitte. 2022. *DeFi Deciphered: Navigating disruption within financial services.* https://www2.deloitte.com/content/dam/Deloitte/us/Documents/risk/us-financial-advisory-defi-march-2022.pdf

EIOPA. 2021. *Discussion Paper on Blockchain and Smart Contracts in Insurance.*
https://www.eiopa.europa.eu/system/files/2021-04/eiopa-discussion-paper-on-blockchain-29-04-2021.pdf

Fang, H., X. Qin, W. Wu, and T. Yu. 2023. *Mutual Risk Sharing and Fintech: The Case of Xiang Hu Bao.*
https://www.aeaweb.org/conference/2023/program/paper/RFKByytf.

Feng, R. 2023. *Decentralized Insurance: Technical foundation of business models.* Springer.

Feng, R., M. Liu, and N. Zhang. 2022. *A Unified Theory of Decentralized Insurance.*
https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4013729

Forbes. 2022. *Advantages and Disadvantages of Blockchain Technology.*https://www.forbes.com/sites/forbestechcouncil/2022/10/20/advantages-and-disadvantages-of-blockchain-technology/?sh=659617523453

FSB. 2022. *Regulation, Supervision and Oversight of Crypto-Asset Activities and Markets.*
https://www.fsb.org/wp-content/uploads/P111022-3.pdf

Hirschfield, D., and M. Duric. 2022. *Why Are Smart Contracts the Smart Choice for Financial Services?*
https://www.taylorwessing.com/en/insights-and-events/insights/2022/02/why-are-smart-contracts-the-smart-choice-for-financial-services

Frankenfield, J. What Are Crypto Tokens, and How Do They Work? *Investopedia.* 12 February 2023.
https://www.investopedia.com/terms/c/crypto-token.asp

Goodenough O., and S. Salkind. 2021. *Computable Contracts and Insurance: An introduction.*
https://law.mit.edu/pub/computablecontractsandinsuranceanintroduction/release/1

Harvey, C., A. Ramachandrun, and I. Santoro. 2021. *DeFi and the Future of Finance.* Wiley.

Howard, L.S. Industry's Blockchain Project, B3i, Ceases to Trade After Filing for Insolvency. *Insurance Journal.* 29 July 2022.
https://www.insurancejournal.com/news/international/2022/07/29/677926.htm

IAIS. 2018. *InsurTech – Rising to the regulatory challenge | A summary of IAIS-A2ii-MIN Consultative Forums 2018 for Asia, Africa and Latin America.*
https://www.a2ii.org/en/knowledge-center/insurtech-%E2%80%93-rising-to-the-regulatory-challenge-a-summary-of-iaisa2iimin-consultative-forums-2018-for-asia-africa-and-latin-america

IAIS. 2022. *IAIS Report on FinTech Developments in the Insurance Sector.*
https://www.iaisweb.org/uploads/2022/12/IAIS-Report-on-FinTech-developments-in-the-insurance-sector.pdf

IBM. 2023. *What Are Smart Contracts on Blockchain?* https://www.ibm.com/topics/smart-contracts

IIS. 2021. *Decentralized Finance (DeFi) – Risks and opportunities for the insurance industry.*
https://www.internationalinsurance.org/Insights_decentralized_finance

Khan, N., T. Ahmad, and R. State. 2019. Blockchain-based Micropayment Systems: Economic impact. *Proceedings of the 23rd International Database Applications & Engineering Symposium* 1–3. https://orbilu.uni.lu/handle/10993/39491

Larios-Hernández, G.J. 2017. Blockchain Entrepreneurship Opportunity in the Practices of the Unbanked. *Business Horizons* 60 (6): 865–874.

MAPFRE. 2020. *Inclusive Insurance, a Solution for the Protection of Developing Countries.*
https://www.mapfre.com/en/insights/corporate/inclusive-insurance-solution-protection-countries-roads-development/

Mohan, B. 2021. Managing Flows and Risks in Supply Chains-A Page from Ancient Silk Route. *SCMS Journal of Indian Management* 18 (2): 67–77.

Nexus Mutual. 2021. *NXM White Paper.* https://uploads-ssl.webflow.com/62d8193ce9880895261daf4a/641444d29741e43db9b43394_nmx_white_paperv2_3.pdf

Nexus Mutual. 2023. *Documentation: Cover products.* https://docs.nexusmutual.io/overview/cover-products/

NICOA. 2016. *Origin and Development of Marine Insurance.* https://nicoa.in/wp-content/uploads/2016/04/MarineCargo.pdf

Norta, A., B. Leiding, and A. Lane. 2019. Lowering Financial Inclusion Barriers with a Blockchain-based Capital Transfer System. In *IEEE INFOCOM 2019-IEEE Conference on Computer Communications Workshops (INFOCOM WKSHPS)*, pp. 319–324. IEEE.

OECD. 2020. *The Tokenisation of Assets and Potential Implications for Financial Markets.* https://www.oecd.org/finance/The-Tokenisation-of-Assets-and-Potential-Implications-for-Financial-Markets.pdf

OECD. 2022. *Why Decentralised Finance (DeFi) Matters and the Policy Implications.* https://www.oecd.org/daf/fin/financial-markets/Why-Decentralised-Finance-DeFi-Matters-and-the-Policy-Implications.pdf

Oliver Wyman. 2022. *Time to Engage: Digital assets for the banking c-suite.* https://www.oliverwyman.com/our-expertise/insights/2022/mar/time-to-engage-digital-assets-for-the-banking-c-suite.html

OpenCover. *What is Yield Token Cover?* https://opencover.com/cover/yield-token-cover/

OpenCover. 2023. *The State of DeFi Insurance Alternatives (DeFi Cover) 2023.* https://opencover.com/state-of-crypto-and-defi-insurance-alternatives-cover/

PANews. 2020. *Comparison between Cover and Nexus Mutual: Who wins?* https://xueqiu.com/8290361133/166427102

Petrie, K. Shield Mining is Here! *Medium.* 29 September 2020. https://medium.com/nexus-mutual/shield-mining-is-here-85067a30ab06

Popovic, D., C. Avis, M. Byrne, C. Cheung, M. Donovan, Y. Flynn, C. Fothergill, Z. Hosseinzadeh, Z. Lim, and J. Shah. 2020. Understanding Blockchain for Insurance Use Cases. *British Actuarial Journal* 25: e12.

Saeed, M., and N. Arshed. 2022. Revolutionizing Insurance Sector in India: A case of blockchain adoption challenges. *International Journal of Contemporary Economics and Administrative Sciences* 12 (1): 300–324.

Schmit, J. 2022. Digitalization in Insurance. *Presentation at CICIRM.*

Schuetz, S., and V. Venkatesh. 2020. Blockchain, Adoption, and Financial Inclusion in India: Research opportunities. *International Journal of Information Management* 52: 101936.

Schwarcz, D. 2013. Transparency Opaque: Understanding the lack of transparency in insurance consumer protection. *UCLA Law Review* 61: 394.

Sheehan, M. B3i Fails to Raise New Capital, Enters Insolvency. *Reinsurance News.* 28 July 2022. https://www.reinsurancene.ws/b3i-fails-to-raise-new-capital-enters-insolvency/

Skogh, G. 1989. The Transactions Cost Theory of Insurance: Contracting impediments and costs. *Journal of Risk and Insurance* 726–732.

Stepanova, V., and I. Eriņš. 2021. Review of Decentralized Finance Applications and their Total Value Locked. *TEM Journal* 10 (1): 327.

Swiss Re. 2017. *B3i – Blockchain Insurance Industry Initiative*. https://www.swissre.com/dam/jcr:d560374e-d7ba-4472-a28c-1f53f932303b/2017_09_25_B3i_blockchain_insurance.pdf

Swiss Re. 2020. *Financial Inclusion: An opportunity for insurers as digitalisation accelerates*. https://www.swissre.com/institute/research/sigma-research/Economic-Insights/financial-inclusion-opportunity-digitalisation-accelerates.html

Vincent, O., and O. Evans. 2019. Can Cryptocurrency, Mobile Phones, and Internet Herald Sustainable Financial Sector Development in Emerging Markets? *Journal of Transnational Management* 24 (3): 259–279.

Wang, J., P. Wu, X. Wang, and W. Shou. 2017. The Outlook of Blockchain Technology for Construction Engineering Management. *Frontiers of Engineering Management* 4 (1): 67–75.

Xu, J., and N. Vadgama. 2022. From Banks to DeFi: The evolution of the lending market. *Enabling the Internet of Value* 53–66. https://doi.org/10.1007/978-3-030-78184-2_6

Zanjani, G. 2002. Pricing and Capital Allocation in Catastrophe Insurance. *Journal of Financial Economics* 65 (2): 283–305.

THE GENEVA ASSOCIATION

INSURANCE FOR A BETTER WORLD

The Geneva Association
Talstrasse 70
Zurich, Switzerland

www.genevaassociation.org