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Editors

Cross-Disciplinary Impacts on Insurance Law

ESG Concerns, Financial and Technological Innovation

Springer

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Preface

Cross-Disciplinary Impacts on Insurance Law

ESG Concerns, Financial and Technological Innovation

What do you get when you mix insurance academics and professionals from different countries and cultures and add to this disruption such as new environmental, social and governance concerns, financial and technological innovation? When you combine insurance academics and professionals from diverse countries and cultures, infuse this blend with disruptive forces such as emerging environmental, social, and governance concerns, and the dynamism of financial and technological innovation, what emerges is a collective effort to identify and characterized the new, acceptable norm in twenty-first-century insurance.

Unlike their predecessors, the twenty-first-century insurers have a growing impact on cross-sector service provision by making available to their clients a wealth of expert knowledge and experience in Big Data analytics. Although the series has a predominant legal focus, in this volume, we wanted to explore the wider-angle viewpoint, strongly encouraging submissions of multi- or inter-disciplinary research, as reflected by the different scientific backgrounds of the two co-editors. We also wanted to extend our reach to diversify the volume of authors' profiles, inviting academics in various career stages, including students and sector practitioners, to submit their manuscript proposals.

When considering the wider-angle viewpoint beyond insurance, it is important to look at how insurance fits into the broader financial services industry and how it intersects with other areas of the economy. For example, the insurance industry is closely tied to the healthcare industry, as health insurance is one of the most important and widely purchased insurance products. Additionally, the insurance industry is also connected to the investment industry, as insurance companies often invest the premiums they collect in order to generate returns.

Open Secrets.org (2012–2022) Abortion policy/anti-abortion PACs contributions to candidates. https://www.opensecrets.org/political-action-committees-pacs/industry-detail/Q14/2020. Last visited June 19, 2022
Pearson R (2017) Insuring the industrial revolution: fire insurance in Great Britain 1700-1850. Routledge
Pew Research Center (2022) About six-in-ten Americans say abortion should be legal in all or most cases. https://www.pewresearch.org/fact-tank/2022/06/13/about-six-in-ten-americans-say-abortion-should-be-legal-in-all-or-most-cases-2/. Last visited June 19, 2022
Reinhart C, Rogoff K (2009) This time is different: eight centuries of financial folly. Princeton University Press
Ritzer G (2011) Classical sociological theory. McGraw Hill
Rubin HW (2013) Dictionary of insurance terms. Barron's Business Guides
Saez E, Zucman G (2020) Trends in U.S. income and wealth inequality: revising after the revisionists. National Bureau of Economic Research
Scott M (2021) "What's Wrong With the American Tax System," Investopedia. https://www.investopedia.com/articles/personal-finance/082415/whats-wrong-american-tax-system.asp. Last visited June 19, 2022
Shrider EA, Kollar M, Chen F, Semega J (2021) U.S. Census Bureau, Current Population Reports, Income and Poverty in the United States: 2020. U.S. Government Publishing Office, Washington, DC, pp 60–273
Stiglitz JE (2013) The price of inequality: how today's divided society endangers our future. W.W. Norton & Company
Sumner W, Keller A (1927) Science of society. Yale University Press
Thomas J (2012) In: Heiss H (ed) Insurance contract law between business law and consumer protection. Dike Zurich, USA
United Policyholders Survey Results (2022) 2017 north bay fires survey results. https://uphelp.org/media/surveys/. Last visited June 19, 2022
United States Department of the Treasury (2022) Assistance for small businesses. https://home.treasury.gov/policy-issues/coronavirus/assistance-for-small-businesses. Last visited June 20, 2022
United States Small Business Administration (2022) Loan programs. https://www.sba.gov/funding-programs/loans/covid-19-relief-options. Last visited June 20, 2020
University of Pennsylvania Carey Law School (2022) COVID coverage litigation tracker. https://cclt.law.upenn.edu/. Last visited May 13, 2022
Vandewalker I (2020) "Since Citizens United, A Decade of Super PACs," The Brennan Center for Justice. https://www.brennancenter.org/our-work/analysis-opinion/citizens-united-decade-super-pacs. Last visited June 19, 2022
Wasow B, Hill R (1986) The insurance industry in economic development. New York University Press

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The Role of Insurance in Dealing with Disasters: The Case of Agricultural Insurance

Sara Landini and Kyriaki Noussia

Abstract One of the big challenges in the last years is the coverage of costs arising from catastrophic events. Due to climate change disasters are becoming more frequent and the classic tools of risk management and risk transfer are not enough. The increase in natural disasters, also due to climate change, requires a consideration on the means of transferring systemic risks characterized by low frequency and high harmfulness. In this case funding and prevention are two keywords. Until now the instrument, in addition to public compensation schemes, was the insurance contract together with reinsurance. In addition, thanks to new technologies, instruments beyond the classic insurance contract are offered on the market. This chapter will consider the catastrophic risk within the agricultural sector and discuss the management—also in terms of prevention—of catastrophe risk, its insurance coverage, index-based insurance, the use of cat-bonds. The chapter analyzes the state of the art in agricultural risk insurance according to the CAP Common Agricultural Policy in the European Union; it considers the possible causes of the insufficient diffusion of insurance coverage as a tool for the resilience of agricultural enterprises and proposes tools to reduce costs, simplify management and shift the attention of farmers to insurance.

Keywords Agricultural insurance · Insurance · Natural disasters · Catastrophe risk · Climate change · Cat-bonds · Calamities

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1 Premise

Climate change poses new challenges for businesses. One of the most affected sectors is the agricultural one with heavy repercussions in terms of health and social protection, food security and food safety.

One of the tools that could allow the resilience of agricultural enterprises hit by catastrophic events is the insurance contract, which however in postmodern reality is undergoing important changes in its structure and which has to compete with alternative instruments having a hedging function.

The second part of the chapter deals with the issue of agricultural risk and its evolution within the European continent and the centrality of the insurance instrument in the translation of the costs of adverse events. The third part of the chapter analyzes the different insurance layers: reinsurance, mutual funds, premium insurance coverage with particular attention to subsidized coverage with public funds. We therefore note the reduced number of insurance coverage due in particular to the costs and the difficulty for insurers to cope with adverse events that are increasingly the size of a catastrophic event since even frequent events are becoming more and more catastrophic. Precisely for this reason parametric policies can simplify and reduce the costs of contract execution. The fourth part of the chapter is dedicated to these. The fifth part of the chapter reflects on possible levers that move the interest of agricultural enterprises to insurance such as access to credit. Finally, the sixth part of the chapter is dedicated to alternative instruments to insurance coverage such as cat bonds and to parametric policies where the pay out is connected exclusively to a trigger and which end up losing a hedging function and having only a gambling function.

2 Catastrophic Risk in Agriculture

Catastrophic events in agriculture are one of the major causes of over-indebtedness of agricultural entrepreneurs as emerged from the report "Risk Management and Agricultural Insurance Schemes in Europe" (2009) of Joint research center of EU Commission.[1]

The current increase in catastrophic events linked to climate change and the reduction of public resources to deal with the major damages, leads to reflections on the possibility of finding private sources of funding and systems to prevent or reduce damage, in particular damage to production.

Funding and prevention are the two primary needs in case of environmental catastrophic events. An efficient answer to such instances could be found in insurance contracts. The insurers will indemnify the insured party in case of losses. At the same time, in order to avoid moral hazard and in order to reduce the risk, the insurer

[1]Tangermann (2011), p. 13.

will impose by contract to the insured party rules of conduct ordered to reduce or avoid losses. In this term the insurance contracts play a relevant role both in funding and in prevention. However, a drop of insurance demands emerges in the agricultural sector.

The insurance coverages are inadequate with respect to the farmers' needs, and unsustainable in term of cost of coverages.[2] The causes of high premiums are basically: adverse selection problems—only those who are more exposed to risks are interested in concluding an insurance contract—and high cost for losses assessment. Even in case of state subsidies for the payment of premium the bureaucracy represents strong constraints to the development of insurance coverages. Insurance should aim to implement the contractual coverages of damage in case of environmental catastrophes by identifying contractual templates that represent an answer to the above-mentioned problems. The second European climate change program launched in October 2005 (ECCP II) [3] focused on options also for the adaptation to the effects of climate change, Moreover, the risk management aspects are perfectly in line with the Sendai Framework for Disaster Risk Reduction 2015–2030,[4] which is the successor to the Hyogo Framework for Action (HFA) 2005–2015. [5] The Sendai framework presents innovations over previous works, with particular emphasis on disaster risk management compared to disaster management. This change is perfectly in line with the innovative perspective proposed. The Priority 1 of Sendai Framework for Disaster Risk Reduction 2015–2030 "Understand the risk of disaster", includes policies and practices for disaster risk management, including the aim to promote the incorporation of knowledge on disaster risks, including disaster prevention, mitigation. Moreover, the action plan on the Sendai Framework for Disaster Risk Reduction 2015–2030[6] is also addressed so as to promote the use of mechanisms for disaster risk financing, risk transfer and insurance, risk-sharing, and retention. The intention is to propose possible strategies that allow sustainable and adequate funding and prevention actions against catastrophic environmental events. An efficient answer to such instances can be found in insurance contracts: the insurer agrees to indemnify the insured person trying to avoid moral hazard and encouraging

[2]Glauber (2004), pp. 1179–1195; Musser and Patrick (2002); The CAP towards 2020: Meeting the food, natural resources and territorial challenges of the future. EC Communication (COM (2010) 672); Commissione Europea (2011).

[3]European Commission, Climate change: start of the second European Climate Change Programme, https://ec.europa.eu/commission/presscorner/detail/en/IP_05_1330 (last visited Jan 30, 2020).

[4]UNDRR, Sendai Framework for Disaster Risk Reduction 2015-2030, https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030 (last visited Jan 30, 2020).

[5]UNDRR, Hyogo Framework for Action 2005-2015, https://www.undrr.org/publication/hyogo-framework-action-2005-2015-building-resilience-nations-and-communities-1 (last visited Jan 30, 2020).

[6]*See* Key Area 3 - Promoting EU risk informed investments; UNDRR, Sendai Framework for Disaster Risk Reduction 2015-2030, https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030 (last visited Jan 30, 2020).

conduct that can counteract the effects of a harmful event. In addition to insurance contracts, amongst the risk transfer mechanisms, it is necessary to consider the mechanism of the creation of dedicated funds financed by the subjects exposed to risk and sometimes by public interventions. These funds often operate as last resort insurance. The importance of private sector in risk disasters management is taken into account, particularly in the work of UNISDR—United Nations Office for Disaster Risk Reduction—"Disaster Risk Reduction PPP (Private Sector Partnership) Post 2015 Framework - Private Sector Blueprint Five Private Sector Visions for a Resilient Future". In 2017 the European Commission adopted the EU Adaptation Strategy[7] which aims to make Europe more climate resilient. This has also been amended in 2021. The European Commission adopted its new EU strategy on adaptation to climate change on 24 February 2021. The new strategy sets out how the European Union can adapt to the unavoidable impacts of climate change and become climate resilient by 2050. The Strategy has four principle objectives: to make adaptation smarter, swifter and more systemic, and to step up international action on adaptation to climate change.[8] The Commission encourages all Member States to adopt comprehensive adaptation strategies and provides funding to help them build up their adaptation capacities and act. Moreover, the European Commission has developed a Green Infrastructure Strategy aiming to ensure the protection, restoration, creation and enhancement of green infrastructure.[9] The Commission in recent communication on the Multiannual Financial Framework (MFF) mentioned a more common agricultural policy (CAP) will have to support the transition to a fully sustainable agricultural sector development of dynamic rural areas, ensuring healthy, safe and high quality food for over 500 million consumers.[10] On 1 June 2018, the European Commission presented the legislative proposals on the future of the CAP for the period after 2020.[11]

The cost of coverages against environmental catastrophic events represents the main constraint to their diffusion. The causes of high premiums are: i) adverse selection problems (only the most vulnerable subjects are interested to be insured), the diversity of catastrophic events and the difficulty of identifying homogeneous

[7]European Commission, EU Adaptation Strategy, 2017, https://ec.europa.eu/clima/eu-action/adaptation-climate-change/eu-adaptation-strategy_en (last visited 26 July 2022).

[8]https://ec.europa.eu/clima/eu-action/adaptation-climate-change/eu-adaptation-strategy_en (last visited Jan 30, 2020).

[9]European Commission, EU strategy on Green Infrastructure, https://ec.europa.eu/environment/nature/ecosystems/strategy/index_en.htm (last visited Jan 30, 2020).

[10]COM (2018) 322 final – Regulation QFP.

[11]Proposal for a Regulation of the European Parliament and of the Council establishing rules on support for strategic plans to be drawn up by Member States under the Common agricultural policy (CAP Strategic Plans) and financed by the European Agricultural Guarantee Fund (EAGF) and by the European Agricultural Fund for Rural Development (EAFRD) and repealing Regulation (EU) No 1305/2013 of the European Parliament and of the Council and Regulation (EU) No 1307/2013 of the European Parliament and of the Council (COM/2018/392 final - 2018/0216 (COD).

classes of insured persons sharing the same insured risks; ii) the cost of coverages for catastrophic event is linked not only to the nature of the covered risk, but also to the costs of the operation. The assessment of losses in case of natural catastrophic events is extremely expensive in term of settlement costs, so the premiums for their coverage are necessarily high. With reference to settlement costs, it is possible to consider in particular:

(I) cost for the technical assessment of the declared damage (existence and consistency of the damage):

- equipment costs;
- survey costs (staff expenses, personal expenses);
- consultancy costs.

(II) for assessing the possible adoption of prevention techniques
(III) for assessing the existence of possible causes of exclusions (e.g. verification whether an intervention has taken place prior to the technical assessment, such as harvesting the product or replacing the crop prior to the technical assessment), of any possible co-causes (causes in addition to the catastrophic events like technical causes due to the negligence of the insured).
(IV) for assessing long-term damage.

In addition to the costs for damage assessment, also the costs for the adoption of prevention measure are important. In the case of agricultural insurance, the costs of prevention include regular field visits to check the production trend and any agronomic advice to be given to the insured. In any case such costs are significantly counterbalanced by the risk reduction.

3 The Different Layers of Risk Coverage

With regards to the agricultural sector presently we have different levels of insurance coverage with pyramid structure:

A first layers is represented by public reinsurers.

An example could be represented by Flood Re, which offers reinsurance coverage for flood risk respect both to homeowners and to production.[12]

In order to pay for the claims that will arise from policies passed to Flood Re there is a central fund which will comprise of two elements:

[12]https://www.floodre.co.uk (last visited 26 July 2022).

- Premiums on flood risks passed to Flood Re by insurers.[13]
- Levy: the annual levy is paid by all insurers authorized to operate in the sector of home insurance in the UK.[14]

A second level is formed by private reinsurers.

In Italian agricultural sector special reinsurance Plans adopted by the Ministry of Food and Forestry Policies provide for reinsurance intervention arrangements "to support the competitiveness of agricultural enterprises by reducing the consequences of atmospheric adversities through the facilitated agricultural reinsurance business contracted by insurance companies".[15]

The main feature introduced since the Agricultural Plan of 2013 includes:

- the expansion of reinsurance policy types, including all experimental and innovative policies compatible with Community law, avoiding constraints on pre-defined contractual types. All the reinsurance techniques available on international markets can be used, widening the supply and competition of insurance products, resulting in lower reinsurance costs.
- Provision of the possibility of non-proportional "stop loss" reinsurance, in order to increase the reinsurance leverage.

A third level is formed by private insurance contracts.

With regards to the present situation in Italian Agricultural Sector, that level represents a strategic point of view. However, it needs to be said that Italy was one of the first countries in Europe dealing systematically with the management of the risks in agriculture with the establishment of the National Solidarity Fund (hereinafter FSN) according to Act. N.364 of May 25, 1970, an instrument that institutionalized the principle of solidarity for businesses that suffer damage caused by variables outside their control.

Public spending on FSN interventions over the first thirty years has been absorbed by more than 70% by compensatory interventions and active defense plans.[16] Since the nineties, there has been a trend reversal: expenditures for the aforementioned interventions have been reduced, except for a few isolated exceptions; the insurance volumes and their public facilities have recorded a steady but gradual growth, to the profound reform of the FSN enshrined by Legislative Decree (D. lgs.) 102/2004, adopted in implementation of Act no. 38 of 7 March 2003, entitled "Financial interventions in support of agricultural enterprises".[17] In addition to systematically ordering the previous legislation, this legislation has updated the national discipline of agricultural risk management, especially, in order to adapt it to the new

[13] https://www.floodre.co.uk (last visited 26 July 2022).

[14] https://www.floodre.co.uk (last visited 26 July 2022).

[15] Ministero Delle Politiche Agricole e Forestali. Decreto 7 Febbraio 2003.

[16] https://bio-protocol.org/exchange/minidetail?type=30&id=9182077 (last visited July 26, 2022).

[17] Ministero Delle Politiche Agricole e Forestali. Decreto 7 Febbraio 2003.

Community guidelines and to modernize the risk management tools available to agricultural enterprises.[18]

The common European Agricultural policy needs to be modernized according to the new challenges posed by climate change and by the fluctuation in agricultural products pricing.[19] Moreover, it must be simplified for do it with a minimum level of administrative burden and must be made more compatible with the other EU policies to maximize their contribution to the ten priorities of the Commission and Sustainable Development Goals (SDGs).

In the work program for 2017, the Commission has carried out a broad consultation on the simplification and modernization of the CAP. For the year 2021–2022 a transition regulation is in force. The regulation 2020/21 includes a strong contribution to European Green Deal. The new CAP was formally adopted on 2 December 2021. After extensive negotiations between the European Parliament, the Council of the EU and the European Commission, agreement was reached on CAP reform and. The new CAP is due to be implemented from 1 January 2023.[20]

Nevertheless, the subsidized agricultural insurance market manifested in Italy in the last three years, evident signs of suffering. ISMEA (Institute of Services for the Agricultural Food Market) in its 2018 report, underlined that in 2017, the insured

[18] Ministero Delle Politiche Agricole e Forestali. Decreto 7 Febbraio 2003; In particular, we have to consider Regulation (EU) No. 1306/2013 of the European Parliament and of the Council on the financing, management and monitoring of the common agricultural policy and repealing Council Regulations (EEC) No. 352/78, (EC) No. 165/94, (EC) No. 2799/98, (EC) No. 814/2000, (EC) No. 1290/2005 and (EC) No. 485/2008.This Regulation lays down the rules on the financing of expenditure under the Common Agricultural Policy (CAP), including expenditure on rural development. Furthermore, it sets forth provisions on the (i) farm advisory system, (ii) the management and control systems to be put in place by the Member States, (iii) the cross-compliance system and (iv) clearance of accounts. This system may also cover the promotion of conversions of farms and the diversification of their economic activity, risk management and the introduction of appropriate preventive actions to address natural disasters, catastrophic events and animal and plant diseases, as well as the information related to climate change mitigation and adaptation, biodiversity and protection of water, as set out in Annex I to this Regulation. Another fundamental EU regulation is Regulation (EU) No. 1308/2013 of the European Parliament and of the Council establishing a common organization of the markets in agricultural products and repealing Council Regulations (EEC) No. 922/72, (EEC) No. 234/79, (EC) No. 1037/2001 and (EC) No. 1234/2007. This Regulation establishes a common organization of the markets for agricultural products, namely all the products listed in Annex I to the Treaties with the exception of the fishery and aquaculture products as defined in European Union legislative acts on the common organization of the markets in fishery and aquaculture products. Agricultural products covered by these provisions include cereals, rice, sugar, seed, olive oils and table olives, fruits and vegetables, wine, tobacco, and milk. According to this Regulation preventive instruments such as harvest insurance, mutual funds and green harvesting should be eligible for support under the wine support programs so as to encourage a responsible approach to crisis situations.

[19] https://agriculture.ec.europa.eu/common-agricultural-policy/cap-overview/cap-glance_en (last visited July 26, 2022).

[20] https://agriculture.ec.europa.eu/common-agricultural-policy/cap-overview/cap-glance_en (last visited July 26, 2022).

values relating to crops stood at 4981 million euros, the lowest figure since 2010.[21] Compared to 2016, a decrease of 5.8% is observed, after the decline of 5.4% recorded in 2016.[22] The entire amount of premiums was slightly less than 337 million euros, with a 4.5% decrease on an annual basis, while the average level of tariffs was 6.8%.[23]

The ISMEA 2021 report[24] shows that the number of insured companies is still too low, around 76,000 units against almost 705,000 agricultural holdings benefiting from CAP payments. The persistent territorial concentration and limitation of the insured base, in conjunction with the unfavorable trend in claims rates for agricultural sector, finds the inevitable reflection in the progressive increase in the rates applied by insurance companies, with national average rates that in the 2020 campaign they reached the record value of 9.06%.

The same conclusions can be reached regarding other EU countries.[25]

In UK firms provide farm or crop insurance. Agricultural insurance is purchased by agricultural producers to protect against either the loss of their crops due to natural disasters, such as hail, drought and floods, or the loss of revenue due to farm-specific risks. According to the Report of CRED (Center on Epidemiology of Disasters), the total reported economic losses in the United Kingdom caused by weather- and climate-related calamities during 2020 amounted about to US$33.5 billion (£23.7 billion), as a result average economic losses caused by weather- and climate-related extremes in the United Kingdom per annum were US$1.6 billion (£1.1 billion) between 2000 and 2020 inclusive. The CRED also reported that there were 3750 fatalities caused by weather- and climate-related extremes in the United Kingdom between 2000 and 2020 inclusive. The most common weather- and climate-related extremes that affect the United Kingdom are storms, flooding, extreme temperatures, droughts, and to a far lesser extent, earthquakes, wildfires, and land movement. Insurance industry revenue in this sector is forecast to grow. New product development through technological innovation and better financial returns from insurers' investments are expected. However, as demonstrated in the past five-year period, revenue is subject to sudden changes in financial markets. The level of public subsidies that the agricultural sector receives over the next five-year period will significantly affect industry demand.[26]

In EU, the CAP, as in the Report of the EU Commission COM (2018) 322 final,[27] must be modernized to respond to these challenges, it must be simplified for do it with a minimum level of administrative burden and must be made more compatible with the other EU policies to maximize their contribution to the ten priorities of the Commission and, the last level is risk retention for the amount of the deductible. Insurance contracts usually provide for a deduction leaving a part of the risk to the insured person who will arrange it. The provision of deductible amount is a means to avoid moral hazard of the insured party and to improve the use of precautionary measures by the insured party. In fact, the part of risk deducted from the coverage will be retained by the insured party who needs to manage it. There may be two types of deductibles. It is possible that the insurer covers the full amount of claims of an entity greater than a certain amount and the insured maintains the risk of harmful events within that limit. It is possible that the policyholder is committed to always supporting part of the risk within the limits indicated.

It is also important to consider the importance of Catastrophe (CAT) bonds in this field. A (CAT) bond is a high-yield debt instrument that meant to raise money in case of a catastrophe such as a hurricane or earthquake. It is usually insurance-linked. In fact, it has a special condition that states if the issuer, such as the insurance or reinsurance company, suffers a loss from a particular predefined catastrophe, then its obligation to pay interest and/or repay the principal is either deferred or completely forgiven.[28]

4 Index-Based Insurance: Are They Insurance Contracts?

With regards to the contractual coverages of disasters different solutions have been proposed in agricultural sector. Index-based insurance is a type of insurance where the amount of compensation is predetermined on the basis of the achievement of certain target indexes like climate or weather indexes.[29] The advantages of this mechanism are well known: reduction of settlement costs; greater chance of predetermining losses and therefore better reinsurance capabilities; correction of adverse selection problems; all insured are subject to the same terms, conditions, and winnings, which virtually eliminates the problem of adverse selection for insurers. These contracts require qualifying actions to determine whether they are insurance contracts or derivative contracts for the purposes of the applicable law.[30]

[21] Report on risk management in agriculture, Rome, 2018. https://www.ismeamercati.it/flex/cm/pages/ServeAttachment.php/L/IT/D/6%252Ff%252Fa%252FD.e19e6e1c4492e2a7d686/P/BLOB%3AID%3D9191/E/pdf?mode=inline, pp. 47, 81 (last visited July 26, 2022).

[22] Report on risk management in agriculture, Rome, 2018. https://www.ismeamercati.it/flex/cm/pages/ServeAttachment.php/L/IT/D/6%252Ff%252Fa%252FD.e19e6e1c4492e2a7d686/P/BLOB%3AID%3D9191/E/pdf?mode=inline, pp. 47, 81 (last visited July 26, 2022).

[23] Cafiero et al. (2007); Glauber (2004), pp. 1179–1195; Musser and Patrick (2002); D'auria et al. (2011), p. 27; Capitanio and Cioffi (2011). The CAP towards 2020: Meeting the food, natural resources and territorial challenges of the future. EC Communication (COM (2010) 672); Commissione Europea (2011).

[24] ISMEA Report on risk management in agriculture, Rome, 2021.

[25] *See* Brunette (2019) (last visited Jan 30, 2020).

[26] Agricultural Insurance in the UK - Market Research Report, 2020.

[27] COM/2018/322 final - 2018/0132.

[28] *See* par. 5.

[29] Skees and Collier (2010).

[30] Stout (1996), pp. 38, 39; Stout (1995), p. 53; Stripple (1998).

From a legal point of view, there are also issues of qualification of the contract for the authorization of the national public insurance market in relation to EU directives in this field and, most recently, considering the Directive 138/2009/EC as Solvency II.[31] The limit of this tool is that it does not allow any damages prevention measures to be evaluated. It is said that these policies reduce the moral hazard as the "pay-out" is based on an independent basis and on an exogenous weather parameter, independent of the insured's behavior. This aspect does not detract from the "winning" certainty that can represent a disincentive from the adoption of damage prevention measures.[32] Secondly, based on losses directly related to the calamitous event which are more easily verifiable and quantifiable. It is important to take into account the loss of profit (income in case of natural persons) or loss of revenue. Both need to be structured through careful legal drafting techniques so that the contract also contains conditions for the prevention and containment of damage[33] and it covers the risk of a catastrophic event, not of a risk of patrimonial losses independent from a catastrophic event. This distinction is important for both public authorizations, where cover is provided by an insurance company, and for access to public subsidies—like in the case of agricultural risk coverage. The limits to this solution are that it does not eliminate adverse selection phenomenon as the covered event will be a certain type of catastrophic event. Thus, only subjects most exposed to that risk will be interested in that kind of insurance coverage. It is evident that both solutions, i.e., index-based insurance and insurance for loss of profit, fail to reach the objective of adequate, in term of responds to farmers' needs, and sustainable coverage, in terms of costs. Particular blockchain applications may occur in the claims settlement phase in the case of indexed policies that allow you to correlate the amount of the indemnity to certain indices. The basic concept of parametric solutions is that, instead of indemnifying for the actual loss incurred, parametric insurance covers the probability of a predefined event happening, and pays out according to a predefined scheme. In the agricultural sector, index-based insurance is spreading and is generally parameterized to meteorological indices. It is doubtful whether these contracts can be considered insurance contracts, as the indemnification is based on index. They could be considered derivatives because they don't respect the indemnification principle, that is a defining characteristic of insurance. It is our opinion that these contracts are insurance contracts because they are based on the compensation of a loss where the determination of the loss is calculated thanks to the use of algorithms that can help in reducing human errors and also frauds in the process of losses assessment.

[31] Doff (2007); Eling et al. (2007), sf.69.

[32] Landini (2013), pp. 228 ff.

[33] *See* conditions for compensation arising from the adoption of prudential conduct by the claiming party.

5 Levers to Insurance

Moreover, it is important to find levers to pull farmers toward the conclusion of agricultural insurance. Both solutions essentially aim to cover losses but do not consider the need for business continuity and support in managing the over-indebtedness crisis than the catastrophic event. This issue is very sensitive in European Commission policy. The EU adopted in June 2019 the Restructuring and Second Chance Directive 2019/1023[34] that would allow viable business in distress to be rescued and honest but bankrupt individuals to be given a second chance. According to the goals of the proposal of the directive it is the need for more targeted rules which are necessary to make restructuring frameworks more efficient; it is also the rules on company managers' duty of care when nearing insolvency which also play an important role in developing a culture of business rescue instead of liquidation, as they encourage early restructuring, prevent misconduct and avoidable losses for creditors. Equally important are rules on early warning tools. One of the problems in case of indebtedness, is that the enterprise, especially SMEs, have not resources to pay professionals able to manage the crises in advance. It is important, in addition to coverages for losses caused by calamities, to have insurance contracts providing for legal and commercial assistance in managing the crisis when certain levels of debts are reached and to manage the crisis in advance providing for monitoring of the patrimonial situation of the insured enterprise. This kind of insurance service could be distributed together with agricultural coverages in case of calamities to enhance the interest of farmers toward insurance coverages and considering the usual correlation between losses in case of calamities and indebtedness. Agricultural insurance could also represent an instrument to facilitate access to credit. Thus, another lever could be the provision of better conditions in loan contracts in the case of insurance coverage against natural catastrophe having an impact on the agricultural production. The borrower may enjoy better economic conditions if his business is protected against natural disasters. The presence of such insurance coverage would help to reduce credit risk and help access to credit. With regard to this solution, attention should be paid to the risk of possible agreements between banks and insurance companies that could impose insurance contracts that are neither adequate nor sustainable. It should be said that the problem is solved in the guidelines adopted by EIOPA (European Insurance Authority) and by national authorities.[35]

[34] Rasekh and Rosha (2021).

[35] Mortgage life and other credit protection insurance, when adequately developed and targeted, can be beneficial for consumers, offering policyholders and their estates protection in the event that they become unable to pay a loan. Despite the benefits, national competent authorities have reported issues and risks related to these types of insurance products that may lead to consumer detriment, as reported in EIOPA's 2019 Consumer Trends Report. These risks include unmitigated conflicts of interests, aggressive sales techniques, and high commissions. In UK payment protection insurance is of particular interest regarding bankruptcy of the debtor. Payment Protection Insurance (PPI) is an insurance contract generally taken out at the time of a loan or credit card. The law states that this

6 Cat Bonds and Disasters: The Case for Agricultural Insurance

International experiences using alternative catastrophe risk management arrangements have shown that in both the public sector sponsored schemes (e.g., for hurricanes) or the private sector initiatives (e.g., investment bank sales of catastrophe insurance), innovations have allowed better risk control for the insureds and for small insurers who usually direct risks to the market. Catastrophe risk poses a unique challenge to the insurance industry. Catastrophic risks in primary markets tend to be spread temporally more than spatially. The pricing of catastrophe reinsurance is based on the notion of spreading risk over time. The securitization of catastrophe risk, happens via catastrophe bonds which pay investors high yields, but are subject to default on all or part of principal and interest if a catastrophic event occurs during the life of the bond; contingent surplus notes which essentially install and instigate rights which allow the insured party to issue debt to pre-specified buyers in the event of a catastrophic event; exchange traded catastrophe options, catastrophe equity puts, catastrophe swaps and weather derivatives.[36] The emergence of catastrophe (CAT) bonds as a new method of catastrophic risk management, unites the disaster law's approach to compensation and risk-spreading with other branches of finance and portfolio management.[37]

CAT Bonds were first developed in the U.S. market after two major catastrophic events: starting from hurricane Andrew in 1992 and the Northridge earthquake in 1994, and following with the events of 1992 and 1994, insurance providers became increasingly averse to insurance policies covering certain events in specific areas and additionally the premiums rose quickly. [38] CAT bonds were therefore devised to transfer insurance risk borne by insurance and reinsurance companies to the financial markets. CAT bonds are essentially securities used, also by insurance companies, to transfer the risks borne as a result of issuing insurance policies to the financial markets.[39] Insurers see the CAT Bonds as a way to diversify their reinsurance capabilities and strengthen the access to capital markets; CAT Bonds are used in

contract is an asset in the bankruptcy, as is the right to complain if it was mis-sold. Where a PPI contract signed before the date of the bankruptcy, the right to claim compensation belongs to the bankruptcy trustee. For more information, see https://www.gov.uk/guidance/ppi-after-bankruptcy.

[36]Pollner (2001). Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=632627.

[37]Chen (2012). Available at https://doi.org/10.2139/ssrn.2141591.

[38]Polacek, A., Catastrophe bonds: A primer and retrospective, https://doi.org/10.21033/cfl-2018-405.

[39]Polacek, A., Catastrophe bonds: A primer and retrospective, https://doi.org/10.21033/cfl-2018-405, What is a Catastrophe bond? - Artemis - resource library Artemis.bm - the Catastrophe bond, insurance linked securities & investment, reinsurance capital, alternative risk transfer and weather risk management site, https://www.artemis.bm/library/what-is-a-Catastrophe-bond/ (last visited Jan 30, 2020); Edesess, M., Catastrophe bonds: an important new financial instrument, https://risk.edhec.edu/publications/Catastrophe-bonds-important-new-financial-instrument (last visited Jan 30, 2020).

order to complement the reinsurance options available. There are substantial differences reinsurance products and CAT Bonds. Traditional reinsurance contracts offer reinstatement provisions, which reset coverage when the reinsurance limit is exceeded. No such provision is generally found in a CAT bond structure. Reinsurance also tended to be annual contracts, whereas CAT bond coverage typically covers events that may occur over a 3-to-4-year period. Furthermore, contracts of insurance and reinsurance are subjected to the principle of utmost good faith. The doctrine of utmost good faith and *uberrima fides* existing in English law is somehow attenuated in other European countries, like Italy,[40] but execution of the contract in good faith is still a fundamental principle of the Italian legal system, which establishes the standard of conduct that a reinsured must satisfy, in order to reap the benefits of its reinsurance agreement, either in the placement/underwriting of business, or in the subsequent stage of the submission of claims to the reinsurer. On the contrary, CAT Bonds market is purely transactional: no good faith issue may be conceivable, and this is a relevant factor in increasing certainty. It may be critical in fact for an insurer selling this risk to be able to claim full credit on its financial statements for all risk transfers, including CAT Bonds. Since CAT Bonds are fully collateralized with the bond proceeds protected by a reinsurance trust for the benefit of the ceding insurer, provided that the documentation is properly and accurately drafted, the ceding insurer should rely on a relatively smooth and quick collection of reinsurance.

6.1 Agricultural, Cat Bond and Parametric Insurance

Agriculture is a risky business and farmers face risks making their incomes volatile as confronted with losses due to bad weather or crop diseases or with the risk of catastrophic losses, all of which pose serious financial problems. Given the above, and the long experience living with risk, farmers have developed several well-honed strategies such as spreading their bets by growing a mix of crops and crop varieties. Also, communities provide another layer of protection against risk via community funds, credit groups, and kin-support networks. However, with the uncertainty entailed, farmers are withheld from specializing in their most profitable alternatives, essentially trading off higher income to reduce risk exposure. Agriculture insurance is provided by the private for-profit sector, governments (public), and other, mostly non-profits (mutual groups, NGOs, etc.). Private agricultural insurance is focused on insuring farm business losses. Index-based insurance serves the need to overcome the problems of traditional forms of crop insurance. And even if it also provides cover against specific perils, yet contracts are written against events defined and recorded at regional levels rather than at individual farm levels. Index-based

[40]For instance, the consequences of misrepresentation and non-disclosure of material facts set out under articles 1892 and 1893 c.c. are somewhat less severe than those existing in English law.

products broaden the scope for insuring against named perils, widening the number of assured farmers who can be served by the same index contract. Public agricultural insurance has tried to fill the gap left by the private sector, especially for meeting the insurance needs of the many smallholders who cannot afford to pay the full costs of insurance.[41] Parametric (at times 'index') risk insurance is insurance that pays out benefits on the basis of a predetermined index (e.g., rainfall level, wind speed, Richter scale) for loss resulting from weather and catastrophic events, using a model to calculate the payout of the insurance policy and to closely mirror the actual damage on the ground; thus enabling a much more rapid payment as no loss adjusters are required after the event to assess the actual damage.[42] Index-based insurance include resilience bonds/parametric resilience insurance, i.e., financial instruments whose cash flows depend on the occurrence of contractually settled catastrophic events and part of the economic value of the investment is devoted to finance resilience actions.[43] Fully parametric agriculture insurance is an efficient and scalable solution for agriculture risks that cannot often be accommodated via traditional insurance schemes.

In June 2021, Generali issued the first ever "Green cat bond" whereby the investment of the collateral in assets with a positive environmental impact and the allocation of the solvency capital was released towards eligible "green assets" and inherently green forms of insurance business. The transaction targets both asset side (green investments) and liability side (insurance policies) making it the very first capital management and reinsurance product. It also provides a new and innovative capital management tool for a sector that will face an escalating frequency and severity due to climate change. The bonds were welcomed and over-subscribed so far.

6.2 *The Need for Parametric Block-Chain Climate Risk Insurance*

Insurers, usually, would calculate premiums via the assessment of past risk as this has been evaluated and has been quantified of claims made in the past. This is a form of ex-post retrospective underwriting works well for well tested through time insurance products which allow resort to records of claims and payments, but not for new products whereby no such records to provide similar data exist, and in such cases usually *in situ* measurements of the risk posed are used as a method for underwriting. This method is costly and, therefore, instead remote sensing was initially thought as a way of alternative risk assessment. However, such data mining is not straightforward. Another method is that of the geographical underwriting of

[41] Hess and Hazell (2018).

[42] Navarro-Martin (2017).

[43] Pagano et al. (2019), pp. 305–332.

risk, as risk of exposure to hazards often varies geographically, which, in turn, means the spatial variation in exposure leaves room for varied insurance rates geographically. However, index-based insurance was considered mostly appropriate for agricultural insurance combined with remote sensing via satellites which allows for cost-effective, reliable, and impartial information and data on agriculture and a continuous flow of information to develop long-term datasets with stable characteristics over time. In the case of agricultural/crop insurance, the application of remote sensing stems from the concern of government to control fraud in agricultural insurances. To date the adoption of the technology in claim-based insurance is not pervasive. However, index-based insurance has a greater potential for uptake by the insurance industry as combined with the method of remote-sensing applied in it, it allows the redesign of insurance business via the development of insurance products in new areas and with new customers; thus, allowing the industry to develop new markets, non-reachable without remote sensing and have agricultural insurances with lower costs.[44] This, together with the adoption and combination of parametric insurance, via the use of blockchain technology, seems to be a solution to lead the way forward towards precise risk calculation and affordable premium for agricultural insurance.

Innovative technologies are rarely implemented, increasing vulnerability. Communities often manage risks via solidarity, cooperation, and trust among rural communities or via diversification. However, this can result in lower income. The creation of a parametric—yet via blockchain—climate risk agriculture insurance can increase agricultural resilience to climate change through offering a more accessible index insurance product via bespoke tailor—made standardized and customized insurance products, along with significant innovations to automate pay-outs and reduce the transaction costs via the use of the technology of blockchain.

The Global Innovation Lab for Climate Change, a lab which identifies, develops, and launches sustainable finance instruments that can drive billions to a low-carbon economy issued such a product for Blockchain Climate Risk Crop Insurance which serves as a standardized, digital index crop insurance platform for smallholder farmers that addresses the impacts of climate change on crop production by making insurance more transparent, efficient, and scalable.[45] The Blockchain Climate Risk Crop Insurance addresses supply and demand barriers by improving insurance with reduced claim cycles and transaction costs, and increased transparency and trust via smart contracts on a blockchain. Instead of lengthy processing of claims, weather data automatically triggers pay-outs, giving farmers the means to react promptly to the weather event. Also, the use of index insurance reduces costs since the system relies on easily verifiable data, thus resulting in a much lower cost of processing claims and probably lower fraud potential. By creating templates for

[44] De Leeuw et al. (2014), pp. 10889–10894.

[45] The Lab, Blockchain Climate Risk Crop Insurance, https://www.climatepolicyinitiative.org/wp-content/uploads/2020/08/Blockchain-Climate-Risk-Crop-Insurance_instrument-analysis.pdf (last visited 30 January, 2022).

blockchain-based insurance products, it allows farmers and end-consumers to use the tools provided to create their own customized insurance product, at a lower cost.

Challenges to the instrument may be: a) persisting low demand due to farmers being unaware of the product's value, or because despite the transaction costs reductions, insurance premiums remain higher than what farmers are willing to pay; b) a basis risk as a result of poor designed products, the distance between the index measurement location and the actual production field, the extension of the area covered and its variability; or c) the perception that the use of blockchain protocols may automatically lead to significant environmental co-impacts at scale.

However, it is innovative as it is addressing the lack of trust in insurance products farmers and it is at the same time enabling higher standardization of insurance products and it is commercially viable under all scenarios from a business perspective, as it has been tested so far, and it is catalytic and actionable. Overall, the instrument offers the possibility to create standardized and customized insurance products, and as it will be available via mobile phones it will allow farmers to react promptly to weather events, increasing resilience of vulnerable crops in remote locations. [46]

7 Conclusions

Climate change requires rethinking the insurance contract in order to bring it closer to the new needs of agricultural businesses and to make coverage sustainable for insurance companies. We need to rethink to make damage compensation and risk mitigation tools complementary. New technologies can help by providing indexed systems for determining damage and monitoring tools for agricultural enterprises that allow a better risk assessment, the identification of tailor-made mitigation systems, continuous monitoring of their implementation, alert systems where implementation is necessary. mitigation tools, a speeding up of liquidation procedures to favor the more rapid recovery of the affected companies.

The meteo-climatic analyzes, based on data from the World Meteorological Organization (WMO), show that in the year 2020 we have had an average temperature anomaly of plus 1.2 Celsius degrees compared to the pre-industrial period. The year 2020 can be placed among the three hottest years of the historical series considered (data from 1981 to 2010), despite the observation of the phenomenon of "La Nina", with its effect of contrasting the increase in temperatures. The areas in which particularly high temperatures were observed, compared to the historical average, include the Arctic belt and Siberia, where anomalies above +5 Celsius degrees were recorded. It is also known that the rise in global temperatures is also

[46] The Lab, Blockchain Climate Risk Crop Insurance, https://www.climatepolicyinitiative.org/wp-content/uploads/2020/08/Blockchain-Climate-Risk-Crop-Insurance_instrument-analysis.pdf (last visited 30 January, 2022).

related to an increase in the frequency of extreme phenomena. The year 2020, in particular, was characterized by a high number of fires, which mostly hit Australia and the USA, as well as flood phenomena and floods, which affected various areas of Asia and Africa. A severe drought hit South America, particularly in the areas between Brazil, Paraguay, and Argentina. Numerous tropical storms were detected 30 of which 13 categorized as hurricanes.

Climate change requires rethinking synergies between the different tools to strengthen the resilience of agricultural businesses: insurance contracts, reinsurance, mutual funds financed by farmers, derivatives. It is also a question of finding new levers that push farmers to take out insurance by finding links between insurance and credit facilities (thanks to the reduction of the risk of insolvency due to catastrophic events), including consultancy services. Therefore, it is necessary to simplify the bureaucracy in subsidized coverage also through the automation of the contract conclusion processes. Block chain and smart contracts technology can also help in creating better tailor-made insurance services and it can rend the assessment of losses faster and cheaper.

Finally, it is a question of rethinking the complementarity between indemnity protection in the event of a disaster provided by insurers and risk prevention and mitigation tools.

References

Agricultural Insurance in the UK - Market Research Report, 2020., www.ibisworld.com

Artemis - resource library artemis.bm - the Catastrophe bond, insurance linked securities & investment, reinsurance capital, alternative risk transfer and weather risk management site. https://www.artemis.bm/library/what-is-a-Catastrophe-bond/

Brunette M (2019) Chocs climatiques pourquoi les agriculteurs francais sont ils si mal assures, July 24, 2019. https://theconversation.com

Cafiero C, Capitanio F, Cioffi A, Coppola A (2007) La gestione del rischio nelle imprese agricole tra strumenti privati e intervento pubblico. Agriregionieuropa 8:1

Capitanio F, Cioffi A (2011) Gestione del rischio in agricoltura ed intervento pubblico. Evoluzione, sostenibilità e prospettive del sistema italiano, in Rivista Economia e Diritto Agroalimentare; Commissione Europea, (2010)

Chen JM, Postmodern Disaster Theory (September 5, 2012). MSU Legal Studies Research Paper No. 11-17. https://doi.org/10.2139/ssrn.2141591

D'Auria R, Capitanio F, Adinolfi F, Di Domenico M, Guido M (2011) La gestione del rischio in agricoltura nella futura politica di sviluppo rurale dell'UE. Agriregionieuropa 27

De Leeuw J, Vrieling A, Shee A, Atzberger C, Hadgu KM, Biradar CM, Keah H, Turvey C (2014) The potential and uptake of remote sensing in insurance: a review. Remote Sens 6:10888–10912. https://doi.org/10.3390/rs61110888

Doff R (2007) Risk management for insurers: risk control, economic capital and solvency II. Risk Books, London

Edesess M. Catastrophe bonds: an important new financial instrument. https://risk.edhec.edu/publications/Catastrophe-bonds-important-new-financial-instrument

Eling M, Schmeiser H, Schmit JT (2007) The solvency II process: overwiew and critical analysis. Risk Manag Insur Rev 10(1):sf.69

European Commission (2010) The CAP towards 2020: Meeting the food, natural resources and territorial challenges of the future, EC Communication (COM (2010) 672
European Commission (2011) Legal proposal for the CAP after 2013
European Commission, Climate change: start of the second European Climate Change Programme. https://ec.europa.eu/commission/presscorner/detail/en/IP_05_1330
European Commission, EU strategy on Green Infrastructure. https://ec.europa.eu/environment/nature/ecosystems/strategy/index_en.htm
European Commission, EU Adaptation Strategy, 2017. https://ec.europa.eu/clima/eu-action/adaptation-climate-change/eu-adaptation-strategy_en
Glauber J (2004) Why subsidized insurance has not eliminated disaster payments? Am J Agric Econ 86(5):1179–1195
Hess U, Hazell P (2018) Innovations and emerging trends in agricultural insurance. GIZ
Landini S (2013) From environmental insurance to environmental derivatives? Eur Energy Environ Law Rev:228 ff
Musser WN, Patrick GF (2002) How much does risk really matters to farmers? In: Just RE, Pope RD (eds) A comprehensive assessment of the role of risk in U.S. agriculture. Kluwer Academic Publishers, Boston/Dordrecht/London
Navarro-Martin M (2017) Parametric insurance, applications in agriculture, climate and disaster risk and pandemics. World Bank
Pagano AJ, Romagnoli F, Vannucci E (2019) Flood risk: financing for resilience using insurance adaptive schemes. Agrochimica:305–332
Polacek A. Catastrophe bonds: a primer and retrospective. https://doi.org/10.21033/cfl-2018-405
Pollner J. Catastrophe risk management: using alternative risk financing and insurance pooling mechanisms (February 2001)
Rasekh A, Rosha A (2021) Restructuring and insolvency in Europe: policy options in the implementation of the EU Directive. International monetary fund, May 2021
Skees JR, Collier B (2010) New approaches for index insurance: ENSO insurance in Peru. In: Kloeppinger-Todd R, Sharma M (eds) 2020 vision for food, agriculture, and the environment, focus 18 innovations in rural and agriculture finance. International Food Policy Research Institute, Washington, DC
Stout I (1995) Betting the bank: how derivatives trading under conditions of uncertainty can increase risks and erode returns in financial markets. J Corp Law 21:53
Stout I (1996) Insurance or gambling? Derivatives trading in a world of risk and uncertainty. Brookings Rev 14:38, 39
Stripple J (1998) Securiting the risk of climate change, in IIASA, IR- 98 098 December, Austria
Tangermann S (2011) Risk management in agriculture, and the future of the EU's common agricultural policy. ICTSD 34:13
The Lab, Blockchain Climate Risk Crop Insurance. https://www.climatepolicyinitiative.org/wp-content/uploads/2020/08/Blockchain-Climate-Risk-Crop-Insurance_instrument-analysis.pdf
UNDRR, Sendai Framework for Disaster Risk Reduction 2015-2030. https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030
UNDRR, Hyogo Framework for Action 2005-2015. https://www.undrr.org/publication/hyogo-framework-action-2005-2015-building-resilience-nations-and-communities-1

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