



CENTER FOR INSURANCE
POLICY AND RESEARCH



NATIONAL ASSOCIATION OF
INSURANCE COMMISSIONERS

2022, ARTICLE 4

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in a World of Complexity**

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JIR40
JOURNAL OF
INSURANCE
REGULATION 1982–2022

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ABSTRACT

The U.S. system of state-based insurance regulation has existed for over 150 years, and its state-based foundation is an anomaly in financial services regulation. The resilience of state-based regulation is due to its decentralized structure, which prioritizes experimentation, coupled with the collaboration fostered through the NAIC, which creates the foundations for efficient intervention when necessary. This balance is well-suited to regulating insurance markets, which are best described as complex adaptive systems.

1. This article is based on a keynote address at the NAIC Center for Insurance Policy and Research (CIPR) program, "Emerging from a Crisis - Building a Construct for Lessons Learned for State Insurance Regulation," Dec. 14, 2021.

1. Introduction

The U.S. system of state-based insurance regulation has existed for over 150 years. As a state-based system, it is an anomaly in an environment of increasing regulation by the U.S. federal government. Federal regulatory involvement in insurance regulation has increased in recent years, particularly in the context of health insurance regulation, but the system remains one that is fundamentally state-centric.

It is unlikely that the system would have remained this way for so long without some advantages to its structure. This paper, based on a keynote address delivered at a symposium celebrating the 150th anniversary of the NAIC, argues that insurance markets exhibit the characteristics of complex adaptive systems, and the structure of state-centered oversight, with states working in collaboration through the NAIC, is well-suited to regulating complex markets. The state-based system is characterized by continuing experimentation and exploration, and changes are incremental rather than revolutionary. These characteristics best meet the dynamic features of complex markets.

2. Some History

The record of the NAIC, previously the National Conference of Insurance Commissioners (NCIC), offers a rich history. State insurance regulators can be seen responding to the issues of the day, but over the years, themes begin to emerge. These themes reflect the industry's role in society and the challenges of adapting to an evolving risk environment that accompanies technological, societal, and economic change.

Throughout history, one can see state insurance regulators responding to the impact of financial crises on the industry. The financial crisis of 2008–2009 had parallels not only in the Great Depression but in other financial crises in the late 1800s and early 1900s. The debates in these cases were eerily similar. One could pick up the conversations from the NAIC proceedings on these prior crises and drop them right into the debate of 2008–2009. State insurance regulators discussed the nature of the liquidity risk and how to value assets where market prices had dropped precipitously. The state insurance regulators took action to alleviate the short-term stress insurers were under—i.e., regulatory forbearance—by simply changing the way the assets were valued. It is not the first time it has happened, and it was not the last, as it happened again in the most recent crisis.

Later in the 1930s, state insurance regulators can be seen struggling with how to think about the growth in annuity and single premium policies written by life insurers, the low interest rate environment, and how reserving requirements should evolve in response; and there were frequent references to the difference between banking and insurance. These are all issues state insurance regulators are familiar with today, and the lessons learned from history help inform current responses.

In the property/casualty (P/C) industry, an early regulatory challenge was the risk of conflagration. The conflagration hazard was a result of rapid industrialization and urbanization in the 1800s, which created concentrations of property values exposed to fires, and major fires often caused insurance company failures. The NAIC Proceedings show state insurance regulators discussing the rate increases that followed major

fires in Baltimore and San Francisco in 1904 and 1906. Again, one can take those discussions about tackling availability and affordability issues and drop them right into today's discussions about earthquake, flood, hurricane, wildfire, and other risks.

Throughout history, state insurance regulators have partnered with others to promote risk mitigation (e.g., that was the main solution to the conflagration problems) and experimented with programs to help consumers adversely affected by risk-based pricing.

There are many more examples, but the bottom line is that the historical record provides a fascinating look at the issues of the day; what the industry was dealing with; and by implication, what state insurance regulators were dealing with. There are common themes, but the specific problems vary over time. The issues reflected broader trends in the country and world; i.e., economically, societally, and technologically. Regulatory actions were incremental and adaptive, not revolutionary, with the policy choices benefiting from the diverse perspectives of different states and the robust debates that ensued.

3. Insurance Markets as Complex Adaptive Markets

Over the past few decades, a new approach to understanding markets has emerged in academic circles, one that treats markets as complex adaptive systems.² In a nutshell, the traditional way of looking at regulation focused on the process of correcting market imperfections. In theory, policymakers were supposed to look at the features of the market that deviated from a perfectly competitive system or, at a minimum, workably competitive system, and focus their attention on those deviations. By bringing the market closer to perfect competition, the system could achieve equilibrium, maximizing the benefits that are distributed across the market.³ In this case, a top-down regulatory system that corrects market imperfections might appear most efficient.

However, in a complex adaptive system, equilibrium is fleeting. Markets are made up of many heterogeneous—i.e., diverse—companies and individuals. They do not have perfect knowledge, but they observe, learn, and react. They watch what others in the system are doing, they form expectations about the implications and the future, and they decide what actions to take. They keep watching and learning, and their decisions and interactions evolve over time, each company and person acting based on their own motivations and understanding. They compete, and they cooperate. They are separate actors, but their actions affect the system, and they affect how others in the system react. Organizations in this system do not just evolve. They co-evolve, or, to quote one scholar, they “constantly circle and chase one another in an infinitely complex dance of coevolution” (Waldrop, 1992). In other words, the system is constantly changing.

It is said that complex systems live at the edge of chaos; i.e., not quite chaotic, but not quite a stable equilibrium either. In a truly complex system, exact patterns are not

2. See Mauboussin (2002). A great introduction to complexity theory for a general audience can be found in M. Mitchell Waldrop's book, "Complexity: The Emerging Science at the Edge of Order and Chaos." The Great Courses offers a video course by Scott Page, a leading scholar in the field, titled Understanding Complexity.

3. See Skipper and Klein (2000). "[I]n instances where market imperfections are significant, government intervention might be needed to protect consumers and promote workable competition. In insurance, the justification for regulatory intervention stems primarily from the existence of information problems and principal-agent conflicts, and occasionally from excessive market power."

repeatable, but there are themes that are recognizable (Waldrop, 1992). That seems a reasonably good description of insurance markets.

Now let us complicate this even more and recognize that state insurance regulators are also part of this complex system. The actions they take affect the actions of the others in the system and vice versa. They are actors in this “infinitely complex dance of coevolution,” trying to respond to a constantly changing landscape. As with the other actors, they must choose their actions in the context of limited information, with the markets constantly changing; then, problems and responses coevolve.⁴

4. Emergence and Self-Organized Criticality

An important characteristic of complex systems is known as emergence. Emergence refers to macro system characteristics that emerge from the collective behaviors of the individual actors. Think of traffic jams emerging from the behavior of individual drivers. Emergence is not achieved consciously. It is a result of the combination of the behaviors of individual actors. Given the complexity of the system, what emerges is unpredictable.

In some cases, the system becomes prone to a large event, a special kind of emergence called “self-organized criticality.” The classic example of self-organized criticality is a pile of sand that seems to be stable. At some point, just one more grain of sand will cause the pile to cascade downward; i.e., a massive movement from a small change. This system was in self-organized criticality. It had organized itself and looked stable, but it was on the edge of chaos, and what seemed like a relatively small change generated catastrophic effects.

This aspect of complex systems has been a subject of some focus in the banking world since the global financial crisis, particularly in the context of understanding systemic risk. Did the interconnections in the banking system create a level of self-organized criticality, such that when there was a shock in the subprime market, catastrophe ensued (Battiston, et al., 2016)?

One of the ways scholars study complex systems is through agent-based modeling. With agent-based modeling, researchers simulate the behaviors of individual actors under a set of assumptions about how they behave and then observe what emerges from the simulations. In a 2018 article, professors at the Cass Business School and the University of Oxford did just that for the United Kingdom (UK) property insurance industry, modeling simple rules of behavior and interaction (Owadallya, et al., 2018). The result was the emergence of underwriting cycles. Simple rules of behavior and interaction, with no external shocks to the system, and underwriting cycles emerged naturally. What was the authors’ conclusion? Heterogeneity and interaction must be understood at a micro level if cycles are to be managed and prevented in the industry.⁵

4. This can be complicated even further by recognizing that the system may organize itself into a variety of sub-systems that are networked, which can further generate other systems, thus creating a complex adaptive system of systems or an *emergent nested system* (Walloth, 2016).

5. Considerable attention has been devoted by scholars to the phenomenon of insurance underwriting cycles, in part because the regularity with which they seemed to occur was unexpected in perfectly competitive markets, and there is little agreement on their causes. A thorough review of the academic literature is found in Harrington, et al. (2013). See also Weiss (2007).

5. Implications of Complex Systems for Regulation

What does this mean for regulation or how these systems should be governed? Much has been written in the past decade on how to govern complex systems, and these design principles can be translated into some recommendations for the structure of insurance regulation.

Where the vision of competitive markets assumes a stable landscape and an ideal objective, complex markets operate in a “dancing landscape.” According to Scott Page, a leading scholar in complexity theory, “When the landscape dances, the ideal becomes even less relevant ... Rather than pursue an ever moving target, we should devote our efforts to developing diverse ways of discovering near improvements” (Page, 2018).

In a complex system, diversity of perspectives is critical. Given the breadth of information to analyze, it is easy to confuse signal with noise. A lack of diversity leads to groupthink, which is catastrophic in a world of complexity. A large body of research shows decisions are better with diverse perspectives at the table. Diversity leads to robustness and promotes innovation. Page (2011) describes diversity as the engine of innovation, a characteristic that leads to robustness in the system.

According to Kreienkamp and Pegram (2020), complex problems call for an “adaptive approach,” one that prioritizes effectiveness in the long run over short-term efficiency. In this approach, one should explore several tentative paths, learning incrementally, pruning the ones that do not work, and pursuing those that do. Kreienkamp and Pegram (2020) state, “Redundancy, diversity, and overlap of functions is actually desirable in complex environments, promoting experimentation and innovation. Importantly, they also enhance system resilience by ensuring that sudden failure of any part can be compensated by others.” Because actions in a complex system trigger further changes, the system demands continuous evaluation and adaptation.

Duit and Galaz (2008) analyze alternative governance structures in terms of their relative strengths along dimensions of exploration and exploitation. In a complex system, exploration—i.e., learning and understanding what is happening—and exploitation—i.e., taking action and exploiting what you have learned—are critically important, more so than when the environment is stable. The optimal balance between exploration and exploitation tends to shift toward exploration in a world of complexity. On the other hand, it is obvious that exploration is not enough. At some point, actions must be taken, and those features that promote a culture of exploration may be the very ones that make exploitation more difficult or severely inefficient. Collective action problems must be resolved or at least controlled. A robust governance system is one with a high level of both exploration and adaptation.

Duit and Galaz (2008) consider a network-based governance system; i.e., one that relies more on informal networks than on hierarchical control. While a network-based system may be suboptimal during times of stability and predictability because of some inherent inefficiencies, it performs better than a centralized system as change becomes faster and more uncertain. This is because it is far better at exploration.

However, the ultimate strength of the network system depends on its capacity to address the collective action problem that arises when quick, large-scale action is needed. The ability of a network-based system to address the collective action problem

depends on a variety of factors, which essentially come down to the level of trust, facilitated by repeated interactions among the actors; the limited number of network participants; and the existence of shared understandings, routines, and conventions.

6. Assessing the U.S. State-Based Insurance Regulatory System

Let us consider the current U.S. system of state-based regulation in the context of these features.

6.1 Diversity and Exploration

Exploration is a strength of the U.S. state-based system. Diversity is an inherent characteristic, with different states having different cultures and market challenges. Our system is characterized by tension. The historical record is filled with debate. Sometimes it seems more like a heated argument. In some cases, particularly where there is an insolvency, states may even sue each other.⁶

This diversity, coupled with the absence of centralized control, feeds into a strength in exploration; i.e., the “laboratory of the states.” The historical record of insurance regulation is replete with examples of state exploration. As states try to understand their markets and devise solutions, there is a natural level of experimentation across the states.

Historically, regulatory solutions have tended to emerge from individual states. They are then more widely adopted, often after they are highlighted and discussed at the NAIC. The Standard Fire Policy (SFP), different forms of rate regulation, oversight of changes in control, how to manage insurer insolvencies, and guaranty funds are just a few examples. More recent examples include Insurance Regulatory Information System (IRIS) ratios, which were originally developed by Ken Smith, Deputy Director in Illinois, and a risk-focused exams framework, which was developed by the Ohio Department of Insurance (DOI). Iowa imposed a suitability standard for life and annuity insurance sales in the late 1990s and led the charge to adopt the standard at the NAIC.

While there are exceptions, NAIC policies tend to germinate from what the states have tried. Continuous learning and adaptation are key features of the system. Lessons learned across the states are shared in the Commissioners’ Roundtable and other meetings through the development of white papers and informal conversations among the state insurance regulators.

The counterpart to this diversity and decentralization is the system’s collective action problem, with a potential risk of reduced coordination, knowledge fragmentation, and inefficiency. While systems are needed that promote diversity and exploration, systems are also needed that help to constrain it. Exploitation—i.e., the ability to act on what you have learned—requires some manageable level of diversity. There must be mechanisms that constrain the level of diversity from exploding to unmanageable levels.

6. The most recent, but certainly not the first example, involves multistate litigation in the context of the rehabilitation plan for the Senior Health Insurance Company of Pennsylvania (SHIP). Several state insurance commissioners sued Pennsylvania Commissioner Jessica K. Altman, seeking an injunction of the plan’s features that allowed for premium increases in their states.

The reality is that states come together to hash through the issues, but they come with different backgrounds and perspectives. There is a tension between compromise and collaboration versus sticking to your guns. Given the decentralized structure and the constantly changing markets, uniformity is unachievable, and differences create friction and added costs. Some limiting mechanism is necessary.

In the U.S. system of state-based regulation, the NAIC acts as the primary mechanism for constraining diversity, while the ever-present threat of federal regulation and preemption acts as a second force.

The role of the NAIC in constraining regulatory diversity is clear from the historical record. From the beginning, there have been efforts to improve coordination and build connections across the states. A number of committees were appointed in 1871 to tackle issues, including the Committee on Blanks and a Committee on Investments. In the 1895 *Proceedings*, commissioners can be seen discussing various ways of improving coordination, and the ancestors of many of the NAIC's current initiatives can be seen there, including coordinated exams, the Financial Analysis (E) Working Group, Receivership Financial Analysis (E) Working Group, and the Valuation Analysis (E) Working Group for principle-based reserving (PBR).⁷ Progress has been made over the years, although not as quickly or broadly as some in the industry would like.

Model laws may not be uniformly adopted by all 50 states, but they undoubtedly influence the ways in which states approach an issue. For example, not all states have joined the Interstate Insurance Product Regulation Commission (Compact), but it has gone far to constrain, albeit not eliminate, diversity in this area. Of course, if the system gets too far out of balance, the U.S. Congress (Congress) or other external forces will exert their own pressure.

The NAIC's Accreditation Program drives a level of uniformity in solvency regulation across the states, including statutory accounting as the primary foundation of regulatory accounting, risk-based capital (RBC), holding company and reinsurance regulation, a common manual for insurers' financial examinations, and much more.⁸

In short, the NAIC serves as the primary mechanism for developing shared understandings, routines, and conventions. This is accomplished through frequent meetings and collective problem solving through a robust structure of committees, task forces, and working groups. Frequent interactions and joint problem-solving generate a level of familiarity and strong working relationships among state insurance regulators in multiple states. These relationships create the foundation necessary for quick action in the case of a crisis (e.g., following the 9/11 terrorist incidents, during the 2008-2009 global financial crisis, and many earlier times).

States experiment with solutions, and the NAIC exists to support cross-fertilization among the states. When the time comes to exploit what has been learned, the NAIC

7. The 1895 *Proceedings* make for fascinating reading. Illinois Superintendent Bradford K. Durfee, in his presidential address before the 1895 convention, made a variety of suggestions for leveraging committees of the NCIC to reduce duplication across the states. These included: 1) creating a committee to oversee the reserve valuation process so reserves approved in one state would be accepted by others; 2) referring annual statements to a committee for analysis, verification, and valuation of assets; and 3) conducting joint examinations of large companies. Despite that promising initial rhetoric, the discussion became heated over the two-day meeting, and the challenges of collective action in the state system are apparent. The NAIC-CIPR Research Library recently made the NAIC's historical proceedings available online. They can be found at <https://library.naic.org>.

8. For more information on the NAIC's Accreditation Program, see <https://content.naic.org/cipr-topics/accreditation>

exists to promote efficient exploitation. To summarize, the system benefits from diversity, but not too much, and the NAIC is the incubator that both fosters learning across the system while keeping the diversity of the system in check. The system tends toward diversity and must work hard to keep it in balance.⁹

The NAIC functions best as a collaboration and coordination mechanism, but centralized expertise at the NAIC is not a substitute for state expertise. The NAIC can be a player, but resiliency demands the diverse expertise the states can provide. This bears repeating; a resilient regulatory system demands that the states remain the primary source of expertise in the system and able to respond with agility.

That means the states must have the resources, the human capital, so they can engage both independently and through the NAIC in those activities that support discovery and experimentation, sharing what is learned, and robust and timely decision-making and action. There is a tendency in recent years to build centers of expertise at the NAIC. That is not bad, but it is not a substitute for expertise at the states.

6.2 Connections and Emergence

State insurance regulators also need to keep their eyes on the lookout for self-organized criticality; i.e., a structure that looks stable but can implode as a relatively small shock propagates through the system. The shock could happen because of connections (e.g., through concentrated reinsurance arrangements) or it could happen because of a lack of diversity in risk taking across the industry. This suggests the need for a detailed understanding of the connections and concentrations across the market obtained through detailed micro-level data.¹⁰

History demonstrates that this has long been a concern of U.S. state insurance regulators; i.e., a focus not just on the micro but on the macro view, and not just on individual firms but on the connections and interactions. It is not an accident that early on, the NAIC created mechanisms to monitor the investment portfolios of insurance companies and paid attention to the concentration in holdings of railroad bonds not just at a single company but across the industry. Note the detail on reinsurance transactions that is required in financial statements, giving state insurance regulators a look into connections and potential concentrations. Ever-increasing amounts of data are collected by state insurance regulators in insurer quarterly and annual statements.

U.S. state insurance regulators have always been data-driven, not a surprise given that the industry is data-driven. This will undoubtedly continue to increase in importance. The NAIC's *State Ahead* strategic plan included features related to more data collection and better leveraging data across different domains.¹¹ There are many opportunities. How can the system leverage artificial intelligence (AI) and machine learning (ML) to better understand how the market is changing and what risks are emerging, both on the financial and market side, to better focus regulatory attention?

9. Grace and Phillips (2007) find some evidence that states with smaller domestic insurance markets rely to some extent on the regulation of states with larger domestic insurance markets. This suggests that although the state-based system is highly decentralized, informal networks, cooperation, and reliance among state insurance regulators reduce the level of duplication.

10. Haldane (2015), then Chief Economist for the Bank of England, gave a speech on the implications of complexity theory for the regulatory architecture. In it, he pointed to the importance of obtaining a better macro perspective of the market through more detailed micro-level data.

11. For more information on the NAIC's *State Ahead* strategic plan, see https://content.naic.org/state_ahead.htm.

As mentioned earlier, state insurance regulators are not just monitoring and regulating this complex system. They are themselves a part of the system and should be conscious of the role they play. Regulatory requirements that drive a consistent view of risk and more uniform behaviors across the industry—i.e., reduce diversity—can also create a self-organized criticality. A shock can hit the entire system. Uniformity breeds fragility. Recall that diversity promotes a robust market, and it is healthy for the regulatory system to bear that in mind.¹²

Axelrod and Cohen (2001), in their book “Harnessing Complexity: Organizational Implications of Scientific Frontier,” suggest some design principles to address the problem of self-organized criticality, all aimed at reducing the interconnections that allow stress to propagate through the system. They note that all methods work at some cost in lost opportunities for efficiency. Page (2009) summarizes the lesson as, “Don’t be so obsessed with small efficiency gains that you push a system toward a critical state . . . If the system is interdependent, you want to build in some slack.”¹³

This advice has implications for what state insurance regulators might look for as they monitor the industry (e.g., an excessive focus on capital efficiency at a company). There are also implications for how to design a regulatory system. Do not be too obsessed with the efficiencies of having a uniform system. Do not create regulatory structures, like highly constrained capital systems or highly detailed rules, that drive uniform industry behaviors and approaches to risk; allow for some slack.

In short, the design of a high-functioning regulatory system for insurance should consider the market’s characteristics and the industry’s role in addressing the ever-changing risk. Constant evolution is an intrinsic characteristic of these markets. The system is always evolving and adapting. By implication, the regulated entities are also constantly adapting. State insurance regulators will always be one step behind these changes, and there is no set of rules or regulations that will change this. What emerges from a complex system is unpredictable, and no system of capital regulation or anything else will change that. Humility is demanded, and most importantly, state insurance regulators must continue to explore, learn, adjust, and adapt, as they have been doing successfully for 150 years.

7. Conclusion

The insurance industry is a complex adaptive system, constantly changing. The optimal regulatory structure leans more toward exploration than exploitation; embraces diversity, but not too much diversity; keeps an eye on the connections and interactions; watches for how the big picture emerges; is on the lookout for self-organized criticality; and is humble.

12. Axelrod and Cohen (2001) state, “It is ironic that in our efforts to stabilize systems against independent or correlated failures, we often transform them into more tightly coupled systems . . .”, thus increasing rather than decreasing the risk of catastrophic failure (pp. 138). As state insurance regulators pursue the creation of a global international capital standard, this bears keeping in mind. See <https://www.iaisweb.org/activities-topics/standard-setting/insurance-capital-standard/>.

13. Professor Page in Lecture 12, “Harnessing Complexity,” uses the example of risks associated with supply chain optimization to illustrate how an obsession with small efficiency gains can push a system to a critical state.

The structure of the U.S. state-based system contains many strengths. Through the years, state insurance regulators have worked to find a balance that maintains those strengths while limiting the inherent inefficiencies.

Since 1871, when 30 jurisdictions ranging from New York to California and Maine to Louisiana, met in New York City, the NAIC and its predecessor, the NCIC, have played an important role in striking that balance. The task of regulating insurance markets will always be challenging, but the structure of the U.S. state-based system seems well-suited to this incredibly dynamic, ever-changing, complex industry.

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