



Dynamics of Digital Sentiment: Information Propagation in Social Media and Financial Markets, and Approaches to Social Fragmentation

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A Two-Part Special Issue

This issue consists of two special features. Special Feature I is titled “Dynamics of Digital Sentiment: Information Propagation in Social Media and Financial Markets, and Approaches to Social Fragmentation.” Special Feature II is titled “The Study Group on the Creation of Next-Generation Financial Infrastructure: Recommendations by Working Groups A and C and Related Roundtable Discussions.”

The Aim of Special Feature I

In contemporary society, the formation of public opinion on social media and sentiment surrounding markets and the economy function as powerful forces that influence and shape individual decision-making, economic and financial activity, and policy decisions. This digital sentiment often impedes constructive debate and, through echo chambers and filter bubbles, becomes a driver of serious social fragmentation.

Examples abound even when we look only at public policy. They span fiscal policies, including the consumption tax; social-security systems such as health care and pensions; monetary policy, including central-bank independence; electricity and energy policy, including nuclear power; public-health policy, including COVID-19 vaccines; and immigration policy. There are also many cases involving personal values, such as the use of separate surnames by married couples, same-sex marriage, and measures to address the declining birthrate. The influence on national and local elections is likewise profound. Foreign disinformation and misinformation operations became widely recognized through the 2016 Brexit referendum in the United Kingdom and the U.S. presidential election in the same year. In recent years, these operations have become still more serious with advances in AI technologies. The development of advertising and recommendation technologies has also given rise to filter bubbles: despite the convenience these technologies provide, it has become increasingly difficult for us to decide for ourselves what information we encounter. Even a brief look at these examples reveals that this theme is a vital and wide-ranging issue for contemporary society.

Yet while individual posts and videos are easy to observe, the sentiment of the digital information space as a whole is difficult to grasp. Like traditional public opinion, it is a kind of “atmosphere”—a broadly shared but often unspoken mood. The term “social media opinion” captures this well. Tracing how this atmosphere shifts—the processes and mechanisms behind those changes—is even more difficult. At the same time, the comprehensive availability of data is one of the advantages of the digital information space. Together with recent advances in natural-language processing technologies and analytical methods, this has made it possible to visualize this atmosphere and to conduct analyses and experiments on its shifts.

A leading example is computational social science. This interdisciplinary field seeks to explain, on the basis of data, a society formed through complex human interactions. It is a new academic field that has emerged at the intersection of the social sciences—including sociology, economics, political science, psychology, and linguistics—with computer science, network science, statistical physics, and data science. Traditional social sciences dealing with opinion surveys, opinion formation, and social consensus have relied primarily on questionnaires as their means of investigation and analysis. By contrast, computational social science is characterized by its use of large-scale, high-resolution electronic traces of human behavior—known as digital traces—such as social-media posting records, search histories on search engines and e-commerce sites, mobile-phone location data, electronic-payment data, and sensor data. The technical background to the field’s development lies in the fact that it has become possible to observe, on an immense scale, not merely “what people answered,” as in questionnaire surveys, but “what they actually did,” including what they wrote online. In Japan, too, research in this field has accumulated in recent years, and an academic society has been established. Professor Fujio Toriumi of the Graduate School of Engineering at the University of Tokyo, who kindly offered advice for this feature and contributed an article to it, is one of the researchers who have led computational social science in Japan.

The first half of this feature presents three empirical studies that analyze the mechanisms by which the “atmosphere” in the digital information space is formed and widely propagated. Specifically, they are:

1. a paper that analyzes the fragmented structure of public opinion concerning COVID-19 vaccines and changes in individual opinions, using a massive volume of more than 100 million tweets and retweets on X, formerly Twitter;
2. a paper that examines, through a survey conducted among approximately 5,000 respondents using examples of misinformation that had actually circulated in Japan, how media and information literacy affects judgments about whether misinformation is true or false, as well as sharing behavior; and

3. a paper that focuses on the price movements and investor returns of “meme stocks”—stocks whose prices surge as a result of attention on social media and the collective enthusiasm of individual investors—and attempts a quantitative analysis using an artificial market simulation that incorporates information diffusion over a network.

In the digital information space, the needless sharpening of opposing views and a breakdown in communication bring about social fragmentation. Many social issues, by their nature, involve trade-offs. Indeed, it is precisely the existence of such trade-offs that makes them social issues. The benefits of public services versus the tax burden, exchange rates and prices versus accommodative monetary and fiscal policy, and securing inexpensive and stable electricity versus safety and environmental protection—the examples are many. Addressing such issues requires calm and careful debate, as well as science-based quantitative examination. Appropriate social choices within the constraints imposed by trade-offs, and efforts to improve the trade-offs themselves, emerge through such debate and dialogue. Yet the fragmentation of public opinion and the communication breakdown brought about by the digital information space hinder such debate and dialogue.

The second half of this feature presents two papers that examine what solutions and responses can be considered in light of the situation described above. Specifically, they are:

4. a paper that, within an opinion-formation model on a social network, examines the effect of suppressing excessive conflict—not by changing individuals’ opinions themselves, but by intervening slightly in the way those opinions reach others—using multiple real-world network datasets, including data from bulletin-board-style social media; and
5. a paper that defines “informational health” as the creation of conditions that allow individuals to access diverse information and autonomously select and adjust their information environment. Building on this definition, it proposes measures such as literacy education about the information space, visualization of meta-information about that information, and the introduction of an “Information Dock”—an informational analogue to the comprehensive health checkup (a Japanese “ningen dock”)—designed to diagnose individuals’ tendencies in information intake. Ultimately, the paper calls for mitigating social fragmentation and realizing a healthier space for public discourse.

The studies underlying the first four papers in Special Feature I were all published in English in international academic journals. In addition, the concept of “informational health” advanced in the fifth paper has been developed into a book and has appeared in various media. In line with the aim of this feature, these works were curated with the following four purposes in mind.

The first purpose is to gather excellent recent research on Japan from two perspectives—analyzing the current situation and exploring approaches to solutions—and to bring these studies together in a single feature.

The second purpose is to highlight and introduce specialized academic research to a wider readership. Studies published in English-language academic journals have relatively few opportunities to reach policymakers, business communities, and the media. Even when Japanese researchers conduct excellent research using Japanese data and addressing Japan-specific issues, such work does not always become widely known to the general public. The contributors kindly prepared their contributions in as accessible a manner as possible, while still conveying the substance of their analyses, and added supplementary explanations so that non-specialists could also understand the content. The “atmosphere” of the digital information space can be analyzed using the latest techniques. Introducing this point to a wider audience is the second purpose of this feature.

The third purpose is to promote information sharing across the boundaries of academic and business domains. The principal readership of this Review consists of practitioners in finance and economics, policymakers, academics, and the media. The theme of this feature has cross-cutting significance. Moreover, because the data and analytical techniques involved are interdisciplinary and new, the topic tends to be overlooked when viewed from the perspective of individual fields. In financial economics, there are adjacent areas such as behavioral economics and behavioral finance, experimental economics, artificial market simulation, and the measurement of market sentiment. Yet there appears to be relatively little work that directly addresses the subjects taken up in this feature. Bridging different business and specialist domains is the third purpose.

The fourth purpose is application to business and policy practice. It goes without saying that the formation of public opinion in the digital information space is important for the design and implementation of policy, electoral strategy, and responses to disinformation campaigns. If public opinion on social media is recast as digital sentiment, it also connects with the perspectives of marketing and market analysis. The attention economy, which is driven by competition for people’s attention and time, does not readily lead to a better society. Moreover, it gives rise to various pathologies, including the extraction of attention for advertising purposes, the overuse of engagement driven by emotions such as anger and anxiety, the overuse of short-term stimuli, attacks that exploit vulnerabilities in human cognition, and the erosion of autonomy and reflection. Yet if these pathologies can be reversed, the same dynamics may instead open the way to a better society and economy. The digital information space holds the potential for transformation toward positive socioeconomic models: an empathy economy that shares sources of value and turns them into positive-sum outcomes

rather than competing for them in zero-sum terms; a well-being economy that aims to enable people to live well; an intention economy that emphasizes consumer intent; and a trust economy that harnesses the value of trust.

Marketing, moreover, is important not only for business but also for public authorities. The reality of complex social institutions and the financial and economic system—including the existence of trade-offs—is not easy to understand. It is entirely understandable that some people prefer not to face trade-offs squarely. Viewed more favorably, this simply reflects their hope that, even in a zero-growth and shrinking economy, opportunities to improve those trade-offs still exist somewhere for experts to seek out. Three issues, including the verification of whether such possibilities exist, have become critical for public authorities: (1) understanding socioeconomic structures and various uncertainties; (2) shaping appropriate societal perceptions of them; and (3) forming democratic social consensus through these efforts. Japan's Quantitative and Qualitative Monetary Easing sought to influence expectations and succeeded in affecting financial markets, but it did not prove effective in influencing price- and wage-setting behavior. Actual changes in prices and wages began only later, as a result of exogenous shocks and supply constraints. Influencing such behavior may have been impossible from the outset, although a more effective approach might also have existed. The science of sentiment—including the mechanisms through which sentiment translates into behavior—therefore remains an important strategic field for policy.

The Aim of Special Feature II

Turning to the second special feature, the SBI Financial and Economic Research Institute established the "Study Group on the Creation of Next-Generation Financial Infrastructure" at the end of 2023. In July 2024, the Study Group published its First Recommendations, "Guidelines for Considering the Creation of Next-Generation Financial Infrastructure," followed in March 2025 by its Second Recommendations, "A Blueprint for Next-Generation Financial Infrastructure." It subsequently established the following three Working Groups to discuss more specific issues in greater depth, building on the "Blueprint." Working Groups A and C, with additional members joining their deliberations, published First Recommendations in May and March of this year, respectively. Special Feature II includes the two recommendations and presents highlights of the roundtable discussions held by Study Group members after their publication.

● Working Group A: Standardization of Financial Infrastructure

With the immediate task of designing standardization and interoperability, the group published its First Recommendations in May 2026, "Strategic Guidelines on the Standardization

and Interoperability of Next-Generation Financial Infrastructure: Toward Implementation of a Sustainable ‘Trust Cycle’” (available only in Japanese).

- **Working Group B: New Mechanisms for Settlement Systems**

Its immediate task is the design of settlement systems.

- **Working Group C: Future Vision of Financial Industry Structure**

With the immediate task of designing scope-of-business regulations, the group published its First Recommendations in March 2026, “Proposal for a Framework on Scope-of-Business Regulations in the Financial Industry.”

It is worth restating here the aim behind this Study Group. Innovations in information technology are bringing about not only structural changes in financial businesses and the infrastructure that supports them, but also the expansion of the financial industry toward its periphery—that is, into non-financial domains—as well as the reverse movement, with non-financial domains expanding into finance. This may well be an inevitable consequence of the very nature of digital information: data itself has become a source of value and can be combined and utilized across fields. With the emergence of financial APIs, blockchain, big data, decentralized finance (DeFi) and cryptoassets, AI agents, and data-integration platforms centered on ontologies that give meaning to and connect a broad range of information related to corporate activity, the source of added value is shifting toward data. In this environment, the providers of financial services are being restructured, and fierce competition has begun over the creation and distribution of added value. Increasingly, the principal competitors of financial institutions are no longer other financial institutions.

Even so, the current financial infrastructure—built on the premise of industry-specific regulations for banks, securities firms, and insurance companies, as well as the two-tier settlement system, and encompassing a broad range of elements such as laws and regulations, IT systems, accounting rules, and governance—has not kept pace with this rapid change. The mindset of responding through incremental, reactive adjustments within existing frameworks has reached its limits and is increasingly becoming a constraint in the global competitive environment.

It was against this background that the Institute launched the Study Group, grounded in a normative perspective of articulating a future vision and reasoning backward from it, rather than patching up immediate issues one by one. The aim is to shift from an economic entity-based approach to a financial function-based approach, and to redesign the financial system itself. What lies beyond this is a vision of Japan chosen by users at home and abroad, both as a financial system and as a financial center. The Study Group puts forward its vision of next-

generation financial infrastructure in the form of recommendations not in order to seek a single answer, but to spark broader debate across society. The specific themes taken up in Special Feature II—standardization and scope-of-business regulations—are likewise positioned as part of this larger conception. Both the special feature on digital identity in Vol. 6 of the Review and the feature on currency, settlement, market, and information infrastructure in Vol. 5 were conceived from this same perspective. The Institute will continue such efforts and will keep raising questions for society and the financial industry.

Having outlined the aims of the two special features, the following sections discuss in turn the five papers in Special Feature I and the two Working Group recommendations in Special Feature II.

Sano, Wu, and Takayasu Paper

The Sano, Wu, and Takayasu paper, “Polarization Structure and Opinion-Change Dynamics in Social Media Discourse: The Case of COVID-19 Vaccines in Japan,” is an attempt to visualize, using the methods of computational social science, the “atmosphere” drifting through the digital information space. Drawing on approximately 120 million tweets and retweets concerning COVID-19 vaccines posted on X, formerly Twitter, in Japan, the paper detects communities based on who amplified whose posts and uses machine learning to determine each account’s stance on the vaccine—whether supportive or opposed. Through this approach, the paper depicts the polarization structure of public opinion and opinion change from both macro and micro perspectives. The analysis identifies six communities, including supportive, opposing, news, and political communities, and confirms the presence of echo chambers, in which similar opinions circulate repeatedly and reinforce one another. It further reveals that while an individual’s opinion is influenced by the community they belong to, there is an asymmetry: the influence of the opposing side persists, whereas that of the supporting side diminishes as the momentum of its information dissemination wanes. What the paper shows is the duality of social media mechanisms: the very same mechanisms that generate fragmentation can also serve as channels for widely delivering accurate information. Generative AI carries the risk of further deepening fragmentation, yet it can also serve as a tool for decoding that structure and devising countermeasures.

Yamaguchi Paper

The Yamaguchi paper, “Media and Information Literacy and the ‘Overconfidence Trap’: Designing Misinformation Countermeasures in the Generative AI Era,” examines how literacy affects behavior related to misinformation. It distinguishes between the phase of detecting misinformation and that of refraining from spreading it, and attempts to analyze how higher

or lower levels of literacy influence each. Drawing together a series of survey studies conducted by the author, the paper is based on a survey of approximately 5,000 respondents covering 15 examples of misinformation that actually circulated widely in Japan. Another distinguishing feature of the study is that it separates objectively measured literacy, such as media literacy, information literacy, and critical-thinking skills, from self-reported subjective confidence. The findings confirm what the paper calls a “breakwater effect,” whereby people with higher objective literacy are less likely to spread misinformation. At the same time, the study identifies a paradox—the “overconfidence trap”—whereby people who are overconfident in their ability to think critically are more likely, rather than less likely, to misjudge whether information is true or false and to spread it. Generative AI mass-produces misinformation with expert-like plausibility, further deepening this trap. Looking ahead to such an age, the paper underscores the importance of literacy education that both fosters media and information literacy and cultivates the humility to recognize that “I, too, can be deceived.”

Matsumoto and Izumi Paper

The Matsumoto and Izumi paper, “Artificial Market Simulation Analysis of the Meme Stock Phenomenon: Social Media Information Diffusion and the Profit-Loss Structure of Individual Investors,” examines, through an artificial market simulation, how the dynamics of the digital information space affect financial markets. Its subject is the “meme-stock” phenomenon, in which a stock’s price surges as attention on social media grows, diverging substantially from fundamentals. Drawing on narrative economics advanced by Professor Robert Shiller, the paper represents information propagation among social-media investors by combining a network model with the SIR model, originally developed to describe the spread of infectious diseases, and reproduces this process within an artificial market. This is a key methodological feature of the study. The analysis shows that conventional investors gain overall, whereas investors who rely on social-media information are more likely to incur losses. It further reveals an asymmetric structure in which profits and losses are strongly shaped by investors’ positions within the network, with profits limited to a very small number of investors located at the source of information. The paper quantitatively examines the possibility that, behind collective action driven by a narrative of solidarity, those who received information early may have benefited from a transfer of profits from those who received it late. Based on these findings, it calls for equalizing access to information, strengthening financial literacy education, designing regulation that takes network characteristics into account, and making use of simulation-based policy evaluation.

As a brief comment from the writer of these notes, it is not only meme stocks that are driven by narratives. Nearly all financial markets are influenced, to a greater or lesser degree, by

narratives, and their influence is also profound in many policymaking settings—recall the debates over Japan’s deflation. Disinformation campaigns, moreover, exploit the destructive power of narratives. In this sense, the study strongly underscores the importance of analyzing the digital information space.

Chujyo, Liu, and Toriumi Paper

The Chujyo, Liu, and Toriumi paper, “Reducing Polarization through Opinion Dynamics with Positive and Negative Relationships,” directly addresses the theme of the second half of this feature—approaches to fragmentation. People tend to align with those they trust and oppose those they distrust. To apply this aspect of human relationships to social media, the paper focuses on the voter model. In this model, each person is regarded as a node in a network and updates their opinion with reference to those around them. It is a classic model for studying processes of consensus formation, but under this model polarization is unlikely to arise. The authors therefore adopt a “signed voter model,” in which each edge connecting two people carries either a plus sign (a friendly relationship prone to alignment) or a minus sign (a hostile relationship prone to opposition). Using this model, they examine the effect of an intervention that does not change individuals’ opinions themselves, but slightly adjusts whose opinions reach others and how easily they do so. Specifically, they analyze data from seven real-world communities as signed networks, including data from overseas bulletin-board-style social media such as Reddit and records of counterparty reputation ratings on Bitcoin trading platforms. The results confirm that a structured intervention that takes account of both current opinion states and relationships moves the group steadily toward consensus, whereas a random intervention of the same intensity has almost no effect. The key to mitigating fragmentation, then, is not to increase informational contact indiscriminately, but to direct the intervention. The aim is not to homogenize opinions, but to curb excessive fragmentation under which even sound debate can no longer be sustained. The authors position this intervention as an adjustment of how information reaches people, rather than directly rewriting human relationships, and call for careful attention to ensure that this form of intervention does not lead to misuse or opaque manipulation.

Toriumi Paper

The Toriumi paper, “Informational Health as a Response to Social Division in the Attention Economy,” is the solution-oriented paper that closes the feature by re-examining the structure of the information space itself. Its point of departure is the “attention economy”—a structure in which people’s attention and interest are limited, and in which platforms seeking advertising revenue compete to capture that attention by selecting information on the basis of clickability

rather than accuracy or public interest. The paper explains how this structure narrows exposure to diverse information through filter bubbles and echo chambers, thereby deepening social fragmentation. Here, the author reframes fragmentation not as mere differences of opinion, but as a state in which people come to regard those who hold different positions as incomprehensible and hostile, and the basis for dialogue is lost. “Informational health” is proposed as a response to such a state. This concept does not seek to exclude misinformation uniformly; rather, it aims to create conditions under which individuals can access diverse information and autonomously choose their information environment. As concrete measures, the paper proposes three approaches: literacy education on the mechanisms of the information space; visualization of meta-information, such as the source and bias of information; and the introduction of an “Information Dock”—an informational analogue to the comprehensive health checkup (a Japanese “ningen dock”)—designed to diagnose individuals’ tendencies in information intake. The aim is neither to unify opinions nor to impose particular values, but—while respecting individual autonomy and freedom of expression—to restore a state in which conflict can be managed within society, thereby moving closer to a healthier space for public discourse. Such a shift, however, is not necessarily at odds with market principles. Referring to reports that users who encounter more diverse information have higher retention rates, the paper notes that informational diversity can also be in the long-term interest of platform operators.

Closing Notes on Special Feature I

The five papers move from visualizing the “atmosphere” drifting through the digital information space to identifying concrete pathways to mitigate fragmentation within that space. What runs through all five is the recognition that fragmentation is not an unavoidable fate brought about by new technology, but a phenomenon that can be acted upon by understanding its structure and redesigning its mechanisms. Whether the pathologies of the attention economy can be turned around and transformed into a positive-sum economy grounded in empathy, well-being, and trust remains an open question. The scientific groundwork for answering this question has only just begun to be laid, and its further development is anticipated.

Study Group on the Creation of Next-Generation Financial Infrastructure

The following sections introduce the First Recommendations of Working Groups A and C.

Working Group A

The First Recommendations of Working Group A, “Strategic Guidelines on the Standardization and Interoperability of Next-Generation Financial Infrastructure: Toward Implementation of a Sustainable ‘Trust Cycle,’” reposition standardization and interoperability as foundations of trust in next-generation financial infrastructure. Even as the unbundling of financial functions and the integration of TradFi and DeFi advance, customer lock-in within individual ecosystems is instead prioritized, the positive externalities of standardization are not reaped, and connection costs remain persistently high. In response, the recommendations set out three pillars and nine actions. Two core points are highlighted below. The first is a hybrid design combining “strong standardization” with “weak standardization (flexible connectivity).” Rather than aiming only for conventional standardization that unifies everything, the recommendations seek a layer-specific optimal mix: foundational layers such as identity and settlement are standardized strictly, while flexible connectivity—in which AI translates and absorbs differences—is applied at the service-coordination layer. Conventional standardization debates focused solely on the former approach, but this approach also faced limitations arising from the scale of coordination costs and from differences in incentives to standardize among stakeholders. Recent advances in AI technology are bringing about a new approach to these challenges. The second is the construction of a “Trust Cycle” that links identity (establishing who the actor is), data (making value visible and assessable), assets, and settlement (tokenization and enhanced liquidity), and then feeds the track record of asset transfers and settlements back, once again as data, into the creditworthiness associated with the identity. The accumulation of transactions cultivates trust, and that trust, in turn, gives rise to further value creation; the aim is to implement this self-reinforcing cycle as infrastructure. To support these efforts, the recommendations distinguish good standardization from bad, lay out agile public-private governance and a framework for cost allocation, and propose an external strategy for Japan to shift from a follower of international standards to a rule-maker—presenting it as a roadmap structured around short-, medium-, and long-term horizons.

Working Group C

The First Recommendations of Working Group C, “Proposal for a Framework on Scope-of-Business Regulations in the Financial Industry,” argue that the time has come for a fundamental review of scope-of-business regulations, including the prohibition of other businesses that applies to banks and insurance companies. As the integration of commercial activities in the non-financial sector and settlement in the financial sector advances with the spread of AI agents and BaaS, strict scope-of-business regulations remain in place in the name of ensuring soundness and preventing industrial dominance and conflicts of interest. In addition, in the

current system, two criteria—the proportion of voting rights held and the determination of holding-company status—are intricately intertwined, resulting in an asymmetric structure in which, unlike a major shareholder of a bank, an entity that qualifies as a bank holding company is subject to scope-of-business regulations. As a result, general business-corporation groups are forced to adopt asset and capital structures that allow them to avoid triggering the regulations, making agile business development difficult. The recommendations frame the issue as follows. On the sufficient-condition side, the role of ex-ante regulations that “prohibit” other businesses has run its course, with oversight having shifted to sophisticated prudential regulations and ex-post monitoring by third-party organizations. On the necessary-condition side, in an age in which commercial activities and settlement are increasingly integrated, if uniform regulation is left in place, the “risk of both authorities and the private sector preventing business from taking on challenges,” which would impede innovation, would become increasingly apparent. Based on this understanding of the current situation, and with the strict application of prudential regulations as a major prerequisite, the recommendations set out four measures: (1) eliminating scope-of-business regulations prohibiting other businesses for subsidiaries of banks and insurance companies, as well as for subsidiaries of bank and insurance holding companies; (2) requiring general business-corporation groups to strengthen group management and ensure strict governance and compliance; (3) abolishing the voting rights restriction, while strictly applying risk weights; and (4) strengthening ex-post checking systems. Through these measures, the recommendations propose a shift in the regulatory paradigm from ex-ante regulation to ex-post regulation.