

The 2008 Mortgage Crisis as a Failure of Analogical Reasoning^{*}

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Abstract

This paper examines the negative consequences of analogical reasoning in the context of facilitating the diffusion of innovation. My thesis is that the substitution of empirical observations about the innovation's performance with analogic inference based on characteristics of established phenomena to which an innovation is compared in the diffusion process can blind decision-makers to the disastrous consequences of the innovation adoption.

Drawing on scholarship in the areas of organizational learning, diffusion of innovation and sociology of disasters, this paper explores the role played by the 'mortgage-backed securities as bonds' analogy in the diffusion of mortgage-backed securities (MBS) between 1968 and 2008 in the U.S., as well as the subsequent contraction of the market in which more than three million families lost their homes.

Using a combination of archival sources and interviews with a cross-section of mortgage-industry participants, I construct an analytical history of how the MBS market developed. This history enables me to examine the connection between the analogical reasoning used in the diffusion part of the innovation-adoption process and the post-diffusion outcomes of the innovation's adoption.

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Analogical reasoning is a powerful tool that can facilitate the transfer of knowledge between unrelated domains (Gavetti, Levinthal & Rivkin [39, 2005]), thus, enabling diffusion of innovation (Hargadon & Douglas [55, 2001]). This paper seeks to shed light on an area that has received little attention in the organizational scholarship to date—namely, the negative consequences that analogical reasoning and, more specifically, innovations diffused with the help of analogical reasoning can have for the society at large.

In this undertaking, I draw on the existing research on analogical reasoning, diffusion of innovation, the sociology of disasters and the related management literature on crises to build a bridge between micro processes and macro outcomes.

My research context is the rise and fall of the market for mortgage-backed securities (MBS) in the United States between 1968 and 2008. The research design is a process study aimed at understanding the processes followed by decision-makers in adopting MBS. My goal is to study the role played by the ‘mortgage-backed securities as bonds’ analogy in the process by which MBS diffused. I also consider the role of analogy’s implicit assumptions in the consequences of MBS diffusion—namely, foreclosure proceedings against more than three million families in the U.S (Armour [7, 2009]).

My analysis is at the level of the system—a grouping that includes the industry’s participants, regulators, customers, and suppliers. As Allison’s ground-breaking work on the Cuban Missile Crisis suggests, different levels of analysis in studying decision-making processes can lead to drastically different conclusions about the outcome and how this outcome can be influenced (Allison [4, 1971]).

This paper makes four contributions. First, it provides evidence that brings into question the existing literature’s implicit assumption that reasoning by analogy, once invoked, necessarily im-

proves decision-making, and to begin the process of drawing boundary conditions around the usefulness of analogical reasoning as a decision-making tool.

Second, it provides a rich counter-example to the diffusion-of-innovation literature's implicit assumption that only good ideas diffuse, opening the door for building theory on diffusion of bad ideas and diffusion of ideas with negative consequences.

Third, this paper builds a bridge between the literatures on diffusion of innovation and sociology of disasters by tracing a pathway between the diffusion of an innovation and its disastrous outcomes for the society at large. In doing so, the paper offers proof by example that analytical approaches of sociology of disasters, such as longitudinal research design and attention to system structure, can provide meaningful insights into research on innovation.

The fourth contribution is the use of an innovative methodology that combines the methods of historical analysis, qualitative case research, and formal logic. In this paper, I set up an analytical framework that stacks the deck against the hypothesis that analogical reasoning can bring about a deterioration in the quality of decision-making and then construct an in-depth inductive case study that offers a proof by example.

In addition to its theoretical value, this work has important implications for both public policy and managerial decision-making. In deciding whether to invest in innovations, both governments and firms must be aware of the fact that potential innovations may backfire, leading to disastrous consequences for both the individual organizations and the society at large. The same cautionary note may apply to the use of analogical reasoning in making managerial and policy decisions. In addition to teaching future leaders to reason by analogy, business and policy schools may need to teach their students how to resist the overreliance on analogical reasoning—potentially, a very different task.

1 Micro Processes

1.1 Analogical Reasoning as a Tool

Cognitive psychologists have credited analogical reasoning with facilitating the human capacity for problem solving (Gick & Holyoak [49, 1980]), abstract thinking (Gentner [44, 2003], Spearman [116, 1923]), and scientific discovery (Hadamard [54, 1945], Hesse [56, 1966], Dunbar [21, 1995], [22, 1999]). In the management literature, reasoning by analogy has been linked to questions of making sense of novel and complex landscapes (Gavetti, Levinthal & Rivkin [39, 2005]); accurately perceiving the environment (Gary & Wood [38, 2011]); reducing perceived environmental uncertainty (Schwenk, [108, 1984]); and recognizing entrepreneurial opportunity (Felin & Zenger [34, 2009], Santos & Eisenhardt [105, 2009], Cornelissen & Clarke [17, 2010]).

The endorsement of analogical reasoning as a cognitive tool has implications beyond the theoretical discourse in organizational learning. The power of analogy as a learning tool underpins the case method, and this makes learning by analogy a major part of the business school curriculum. At the method's core is the idea that students can benefit from learning how to extract the lessons from a single case, find comparable cases, and extrapolate their learning from one situation to another. In effect, business schools that use the case method teach their students to reason by analogy.

1.2 To Study or Not to Study: a Scholarly Impasse

In organizational learning as a field, little is known about the consequences of using a flawed or faulty analogy. Anecdotal evidence from political science and military strategy—e.g. (May and

Neustadt [85, 1986])—suggests that the use of the wrong analogy can lead to the making of bad decisions. However, other anecdotal evidence from the same domain, as in the Holub's ([58, 1977]) poetic account of a military brigade stranded in the Alps, popularized by Weick (e.g., Weick [132, 1995]), suggests that reasoning by analogy—even an erroneous one—is better than having access to no analogy at all.

Even among psychologists who have studied erroneous analogies, there is disagreement over the consequences of the errors and whether an analogy can ever lead the decision-maker astray. Some authors in this line of research have argued that heuristic processing of analogies can have dangerous consequences—e.g., Gilovich [51, 1981]. Others have suggested that the similarity heuristic (one source of erroneous analogies), while imperfect, can be a useful decision-making tool because the similarity of the surface features that the similarity heuristic works with are constrained by the structural features of the objects being compared (Medin & Ortony [81, 1989]).¹

Existing field research has suggested that U.S. foreign-policy decision-making is shaped by the spectres of either WWII or Vietnam (Spellman & Holyoak [117, 1992], Petraeus [92, 1987]), and these comparisons may be triggered by information irrelevant to the decision-making situation at hand (Gilovich [51, 1981]). If these findings hold, the question of what makes analogy apt rather than dangerous seems well worth investigating.²

¹According to the latter line of reasoning, an analogy, even if it is based on irrelevant information, can improve a decision-maker's performance. This argument also finds some support in simulation research (Gavetti, Levinthal & Rivkin [39, 2005]).

²This is especially true if erroneous analogies have a tendency to persist in people's minds at both individual (Kempton [66, 1986]) and organizational levels (Tripsas and Gavetti [123, 2000]).

1.3 A Case for Studying the Downside of Analogical Reasoning

Understanding the negative consequences of analogical reasoning is valuable from both theoretical and empirical perspectives. From a theoretical perspective, if an analogy is a powerful tool, it should be powerful in yielding both good and bad outcomes. As with dynamite, which can be put to both constructive and destructive uses, there is no theoretical reason to believe that analogical reasoning's power at facilitating learning does not backfire.

Scholars of analogical reasoning have noted the potential for such reasoning to yield negative outcomes. For example, Loewenstein et al. write: "But analogy is a two-edged sword: Any new learning powerful enough to yield correct solutions in appropriate contexts could potentially lead to incorrect solutions if misapplied" (Loewenstein, Thompson & Gentner [76, 1999]).

Similarly, Holyoak and Thagard suggest that "identifying appropriate mapping is crucial in allowing useful transfer of knowledge" ([61, 1989]). This leaves open the question of what happens when the mapping is inappropriate. One possibility is that the transfer of knowledge proceeds regardless of the quality of the knowledge. Thus, the same tool that is good at disseminating useful knowledge may be just as good at disseminating less useful or, perhaps, even hazardous information.

From an empirical perspective, analogical reasoning may act as a substitute for more reliable decision-making processes such as systematic data collection and evaluation, and, thus, an understanding of the costs and benefits of analogical reasoning is essential for both scholars and decision-makers. One attribute of analogical reasoning that makes it a powerful cognitive tool is that analogies may serve as substitutes for a rich body of knowledge in decision-making (Day & Gentner [18, 2007]).

Such substitution enables the decision-makers to sidestep a deeper analysis to avoid (what could be seen as) reinventing the wheel. As a result of this substitution, decision-makers may rely on their knowledge about the source of the analogy (the object with which they are already familiar) instead of investing in developing new knowledge about the target (the unfamiliar object they are trying to learn about).

Relying on information about the source of the analogy at the expense of developing new knowledge about the target can yield undesirable outcomes (Schwenk [108, 1984]). Cognitive psychologists have documented cases of analogical substitution occurring without the decision-maker's awareness (Day & Gentner [18, 2007]) and even against the decision-maker's previously held attitudes (Perrott, Gentner & Bodenhausen [89, 2005])—two scenarios that may make undesirable outcomes especially likely.

Taken together, these papers suggest that the use of a bad analogy may result in both the arrival at and the diffusion of the incorrect solution to the problem. Furthermore, the decision-maker may not be sufficiently aware of the cognitive processes involved to stop and question the decision these processes generate. This automaticity is particularly suspect because experimental research suggests that seemingly extraneous features may affect the outcomes of analogical reasoning. For instance, individuals' judgment of the similarity of two items may depend on which is listed as the target and which is listed as the source of the analogy (Tversky & Gati [128, 1978], Mussweiler & Gentner [84, 2007]).³

³A body of research suggests that altering decision-makers' instructions can enhance analogic transfer (Gick & Holyoak [50, 1983]; Catrambone & Holyoak [14, 1989]; Loewenstein et al. [76, 1999]). More research is needed on what instructions would enhance the decision-maker's capacity to resist the adoption of faulty analogies. Other, perhaps yet to be developed, tools are necessary to focus the decision-maker's attention on the source of the analogy and what the possible implications of using a flawed analogy might be.

2 From Micro Processes to Macro Outcomes

2.1 Analogic Reasoning and Diffusion of Innovation

Another reason to study the negative consequences of analogical reasoning is the important role it plays in the diffusion of innovation. When the likelihood and consequences of innovation adoption are hard to foresee (Rogers [97, 1962], Rogers & Shoemaker [98, 1983]), analogical reasoning can facilitate both opportunity recognition (Felin & Zenger [34, 2009], Santos & Eisenhardt [105, 2009], Cornelissen & Clarke [17, 2010]) and perceived uncertainty reduction (e.g., Schwenk, [108, 1984]).

Analogical substitution is one mechanism by which analogical reasoning reduces perceived uncertainty. In the absence of a clear understanding of an innovation's long-term consequences, the diffusion of innovation proceeds by analogy (Hargadon & Douglas [55, 2001], Etzion & Ferraro [24, 2010]). The innovator asserts an analogy on some important features between the innovation and an established phenomenon and uses analogical inference to sway the public's acceptance of the innovation (Rindova & Petkova [96, 2007]).

The selection of a target to which the innovation is compared in the diffusion phase of the innovation-adoption process can be a strategic exercise. For instance, the Long Island Lighting Company (LILCO), the utility company that built the Shoreham nuclear power plant in Long Island, in trying to convince the public to accept nuclear power, argued that evacuating Long Island after a nuclear accident would be a process analogous to managing a rush-hour commute (Clarke [16, 1999]). Note that strategic selection of an analogy does not guarantee the analogy's acceptance. The analogy of post-nuclear accident evacuation to rush-hour traffic failed to sway the public opinion in the innovation's favor, possibly because Long Island residents' impressions of

the speed and orderliness of the rush-hour commute differed from those of LILCO management.

While, in some cases, inventors may select an analogy to fit the innovation, in others, they may change the innovation to fit the analogy. For example, in trying to get the public to switch from gas to electricity, Edison argued that electricity was analogous to gas. To make the analogy between electricity and gas more convincing, Edison transferred lamp shades from gas lamps (where the shades served as a safety device meant to protect the public from noxious gases) to electric lamps (where, in absence of gas, the safety device was no longer needed) (Hargadon & Douglas [55, 2001]).

2.2 Innovations and Disasters

As the LILCO nuclear power plant example suggests, innovations that diffuse with the help of analogical reasoning may have important consequences for public safety. Those consequences can range from benign, as in the case of Edison's lamp shades, to disastrous. To date, organizational scholarship has produced almost no research about the processes by which innovations can bring about disasters. And yet, there is no reason to believe that all new ideas produce good outcomes.

The absence of research on innovations that produce disasters is due to both theoretical and practical considerations. The theoretical assumption undergirding much innovation research is that in order to diffuse, an innovation has to be a good idea (Abrahamson [2, 1991]). Moreover, it is further claimed that once an innovation has diffused, it must have been a good idea in the first place.

The problem with these assumptions is that they fail to account for and inhibit theory-building about the diffusion of destructive innovations. Indeed, a well-documented pro-innovation bias

exists in sociology, management, and entrepreneurship research (see Rogers [97, 1962], Baumol [10, 1990], and Abrahamson [2, 1991]), respectively).

Another, more practical, reason is that much innovation research stops at the diffusion phase of the innovation-adoption process and does not go on to look at the consequences of such adoption. With notable exceptions (Hargadon & Douglas [55, 2001], Zbaracki [137, 1998]), innovation researchers do not use longitudinal design to look at performance of innovations over time (Rogers & Shoemaker [98, 1983]).

From the perspective of detecting negative consequences of innovation, this choice of research design is problematic. If consequences of innovations need time to manifest themselves, the evaluation of such consequences requires a longitudinal design. Indeed, longitudinal studies are especially important for detecting disasters. Sociologists studying disasters have long known that disasters do not happen overnight; they need gestation periods to accumulate resources and energy in order to become disasters (Turner [125, 1978], Turner & Pidgeon [126, 1997]). Thus, a predominance of cross-sectional or short-term research designs prevents innovation researchers from observing the connection between innovations and disasters.

2.3 Sociology of Disasters and Analogic Reasoning

The research on the sociology of disasters suggests that during the gestation phases—the periods leading up to disasters—disasters are frequently preceded by warning signs or signals that decision makers miss or ignore (Turner [125, 1978], Vaughan [129, 1996], Turner & Pidgeon [126, 1997]). An interesting question in the sociology of disasters (and in the management literature on crises) is what makes individuals and organizations either miss or ignore these signals.

Several different hypotheses have been proposed to explain missed signals. One such model suggests that decision makers miss these cues due to a lack of decision-makers' attention to the signals (Rerup, [95, 2009]); others maintain that the perception of the crisis or disaster hinges on a comparison of the current state to the desired state (Billings, Milburn & Schaalman [11, 1980]), and accurate information about both states necessary to make this assessment may not be available to the decision-makers.

Analogical reasoning may play a role in both mechanisms. One possibility is that the use of analogies may trigger a “wholesale transfer of evidence” between two unrelated domains (Clarke [16, 1999]). Such a transfer could result in analogic substitution, which would draw attention away from what's already known about the target object and to the inferences projected from the analogy's source onto the target.

Thus, instead of learning more about the innovation and how it differs from the source of the analogy, the decision-makers would marginalize the processing of such information. In this scenario, the substitution could blind the decision-makers to the difference between the current state and what they infer to be the current state based on the analogy in question.

In the study of technical disasters, it has been observed that the structure of the system matters in determining whether its elements come together over time to produce disasters (Perrow, [90, 1984]). One can imagine that the structure of the social system, such as the level of industry fragmentation (Jacobides [63, 2005]), also matters with respect to how much attention any one participant of the system—be it a competitor firm, supplier, customer, or regulator—can pay to the innovations being introduced. It is possible that analogic blindness is enhanced by system fragmentation.

3 Analytical strategy

In going from the theoretical foundations to the research design, my strategy is to build on the relevant strengths of the various literatures I draw on. I derive the definition of a bad analogy from the existing literature on analogical reasoning and then use the historical analysis and ethnographic techniques from studies of disasters (Kieser [68, 1994]).

In selecting the level of analysis for this paper, I abstract from the level of the organization (the typical level of analysis in the sociology of disasters (e.g., Perrow [90, 1984], Vaughan [129, 1996]) to the level of the system—a level that includes all industry participants, customers, suppliers, and regulators. In making this choice, I build on the same logic that the sociology of disasters uses to abstract from the level of the individual to the level of the organization.

Scholars in the sociology of disasters argue that a particular disaster, such as the Union Carbide chemical leak in Bhopal, could not have been avoided if a different set of employees was present at the plant on the night of the event. Similarly, in my research, I suggest that the mortgage crisis was caused by the interaction of multiple organizations and that the substitution of organization A for organization B in the lead-up to the crisis would not have averted the crisis.

Finally, in my methods, I also draw on the tools of formal logic. I start by setting up an analytical framework that highlights the best case for analogical reasoning to succeed. I then offer proof by example that even under the best of circumstances, analogical reasoning can induce analogic blindness, starting a chain of events that ends with disastrous consequences for the system as a whole.

3.1 Defining a Bad Analogy

There is no definition of a bad analogy in the current literature; however, we do have a candidate for the definition of a good analogy: “A good analogy both reveals common structure between two situations and suggests further inferences” (Gentner & Colhoun [46, 2010]). Thus, by mirroring this definition, I can propose a potential definition of a bad analogy: a bad analogy provides the decision-maker with two situations that are erroneously perceived to share structural features, such that further inferences based on this analogy are also flawed.

The cognitive psychologists⁴ studying analogical reasoning have identified two sources of flawed analogies:⁵

1. Heuristic rather than systematic processing of analogies.
2. Reliance on surface rather than structural features when building an analogical comparison of the source and the target.

While the two sources of error may overlap empirically, the theoretical distinction is still useful. Scholars who primarily study heuristics and look at heuristic processing of analogies⁶ make reference to the distinction between surface and structural features in the analogies they study. However, cognitive psychologists who primarily study analogies and focus on the distinction between surface and structural features do not specify whether they are looking at heuristic or systematic processing of analogies.

⁴While some organization scholars have looked at negative consequences of analogical reasoning directly, (e.g., Tripsas and Gavetti [123, 2000]), most have closely followed the literature in cognitive psychology (e.g., Tsoukas [124, 1991], Levinthal & Rerup [72, 2006], Zollo & Reuer [138, 2010]), Grégoire, Barr & Shepherd [53, 2010]).

⁵See Figure 1 in the Appendix for a summary of the existing research.

⁶These researchers label the phenomenon they study as “similarity heuristic” and view it as a subset of the representativeness heuristic (Schwenk, [108, 1984], Kahneman & Frederick [64, 2002], Locken et al. [77, 2008], Read & Grushka-Cockayne [94, 2011]).

3.2 Analytical Framework

If we think of the type of processing people engage in (systematic vs. heuristic) and the features of the analogy they focus on (surface vs. structural) as two distinct vectors, existing research, as Figure 1 on page 49 indicates, has shown limits of analogical reasoning in three out of four scenarios:

1. In drawing the analogy, individuals rely on heuristic rather than systematic processing.
2. In drawing the analogy, individuals focus on the surface rather than structural similarities between the two objects.
3. The reliance on heuristic processing leads individuals to focus on the surface rather than structural similarities between the two objects.

Thus, there is one scenario in which the use of analogical reasoning is expected to be the most effective in improving decision-making: when applying systematic processing to structural features of the source and the target, a scenario captured in the upper right-hand quadrant of Figure 1 on page 49. The remainder of this paper will document a failure of analogical reasoning in precisely that scenario: when performed by individuals who are engaged in systematic processing of information and focused on comparing structural rather than surface features.

3.3 Standard of Proof

In setting out to develop a proof by example, it is important to clearly describe the standard that such an example would have to meet and to ensure that the proof is internally consistent (Velleman [130, 2006]). In this section, I will outline the standard of proof, define the terms of the outline, and describe the data I use in building the analytical history.

Based on the analytical framework developed from the existing literature on analogical reasoning, I set out to prove that, under the best of circumstances, analogical reasoning can lead to suboptimal outcomes. Therefore, the proof by example will need to show that while engaging in systematic processing of the analogy and considering the structural features of the analogical comparisons, decision-makers arrive at a negative outcome that goes against their expectations.

3.4 Defining the Terms

Structural features Scholars studying analogies based on surface rather than structural features draw the distinction between surface and structural similarity based on the features' relevance to a successful search for a solution and, consequently, dependent on the analyst's goals (Holyoak [59, 1985], p. 81).⁷ In this paper, I define structural features as the features the decision-makers express concern about in considering whether or not to adopt an innovation.⁸

Systematic processing In the research on analogical reasoning, there exists no clear definition of systematic processing of analogies. However, in the related literature on persuasion, cognitive psychologists work with the following definition:

According to a systematic view, recipients exert considerable cognitive effort in performing this task. They actively attempt to comprehend and evaluate the message's arguments as well as to assess their validity in relation to the message's conclusion.

In contrast, according to a heuristic view of persuasion, recipients exert comparatively little effort in judging message validity. Rather than processing argumentation, recipi-

⁷Management scholars have pointed out that how exactly one goes about drawing the boundaries between structural and surface similarities is unclear (Barry & Rerup [8, 2006]).

⁸Note that in this analysis, I do not take a stance on whether the decision-makers are right or wrong to concern themselves with the attributes they focus on.

ents may rely on (typically) more accessible information such as the source's identity or other non-content cues in deciding to accept a message's conclusion (Chaiken [15, 1980]).

In keeping with this approach, for the purposes of this paper, I define systematic processing as a type of decision-making requiring the decision-makers to expand cognitive effort.

Negative outcomes The disastrous consequences of analogical reasoning I am interested in studying are not merely what Merton described as “unintended consequences of purposive social action”(Merton [82, 1936]). They are closer to “revenge effects”—precisely the consequences the decision-makers were most hoping to avoid (Tenner & Rall [119, 1996]). Therefore, in my analysis, I define negative outcomes as the outcomes the decision-makers were hoping to avoid. This definition makes for a higher standard of proof since outcomes that run contrary to the decision-makers' intentions are, presumably, harder to come by than the negative outcomes decision-makers had not considered.

3.5 Data Sources

In building an in-depth longitudinal case study of the mortgage-backed securities market in the United States between 1968 and 2008, I relied on a combination of interviews and archival data to trace the development of the market. Between 2008 and 2010, I conducted 21 unstructured interviews with 17 current and former industry participants. In keeping with the system perspective, my goal was to speak to someone involved in each step of the mortgage-backed securities system.⁹ To ensure accuracy in interview transcription, I circulated a draft of my analytical history to the

⁹For a graphical representation, see See Table 1 on page 51.

people I interviewed and incorporated their suggestions in subsequent drafts.

To improve my understanding of the thinking processes of practitioners in the field, I also read ethnographies of financial markets (Abolafia [1, 2001]; Zaloom [136, 2006]; Ho [57]), National Public Radio interviews with mortgage-industry players and consumers, published practitioner accounts (Lewis [75, 1990], Tett [122, 2009], Einhorn & Greenblatt [23, 2008]), and attendance of industry conferences. To counteract the selective memory and survivor biases inherent in interview data, I consulted press archives and multiple editions of trade manuals, including all editions of the *Handbook of Mortgage-Backed Securities* from 1985 onwards (Fabozzi [25, 1985], [26, 1988], [27, 1992], [28, 1995], [29, 2001], [30, 2005], Fabozzi et al. [32, 1998]; [31, 2007]), to trace the evolution of the players' beliefs (Yin [135, 2008], Rötheli, [103, 2009]).

To understand how this MBS market fits into the history of MBS trading in the United States, I have also developed a familiarity with prior American MBS markets, including markets of the 1870s and 1930s (Snowden [110, 1987], [111, 1988], [112, 1996a], [113, 1996b], [114, 2003]; Severson et al., [109, 1966]; Levy [74, forthcoming]; White [134, 2009]; Fishback et al. [36, 2001]).

4 Research Context Overview

The financial crisis of 2008 has already prompted numerous investigations within the academic fields of finance, economics, law, and others. Broadly speaking, the focus of these studies has been on what went wrong. Much less has been said about *why* things went wrong. Without knowing *why*, it will be hard to learn from this financial crisis and to work to prevent another.

In my research, I conceptualize the crisis as a social disaster. I define social disaster as a type

of event that disrupts the social fabric (as foreclosures on more than three million households in U.S. have most certainly done)¹⁰ and points to limits in our knowledge about the world (some of the brightest minds of finance and of the society at large did not see the crisis coming).

In structuring this project, I have made the following design choices:

1. Level of analysis — in my research I look at the decision processes at the level of a whole system, which I define as not just the industry players across the mortgage value chain, but also consumers, and regulators.
2. Study timeline — Turner’s foundational work suggests that disasters do not happen overnight. Potential disasters need time to accumulate resources and energy in order to become disasters (Turner [125, 1978], Turner & Pidgeon [126, 1997]). I trace the roots of the current crisis to the 1960s.
3. Focus on process — because the questions I ask have to do with how the system evolved, my focus is on the process of the evolution, and my analysis methods are historical and discursive. Specifically, relying on a combination of interviews, primary sources, and archival sources, I construct an analytical history of the 40 years immediately preceding the crisis.

The hypothesis that emerges from my research is that the unquestioned use of a faulty *analogy* by the industry players who built the market for mortgage-backed securities in the U.S., by the regulators of this market, and by the U.S. Congress, was a central cause of the market’s eventual collapse and the ensuing broader crisis.

In brief, the analogy in question is that mortgage-backed securities were originally constructed by analogy to bonds—marketed as ‘bond-like’ and increasingly designed to incorporate bond-like

¹⁰For a detailed comparison of how this statistic compares to previous foreclosure episodes in the U.S. history, see Figure 2 on page 50.

features (such as seemingly predictable prepayment patterns)—and, eventually, were treated by the regulators and other market participants as bonds.¹¹

To believe this analogy, one would have to view mortgage-backed securities as exemplifying a new breed of costless financial innovation that provided benefits to, but imposed no costs on, the society at large. The market for new securities provided the end-borrowers with greater availability of mortgage credit and lower mortgage interest rates. At the same time, once mortgage-backed securities were perceived to be sufficiently bond-like, they were assumed to be as safe as, and to need as little regulatory monitoring as, conventional bonds.

This safety assumption played out on two levels: safety from the financial-market regulator's perspective — as in inability to cause a crisis¹² — and safety from the end-borrower's or mortgage-credit consumer's perspective. From the financial regulator's perspective, once the bond analogy was fully accepted, the task of monitoring new securities was effectively passed down from mortgage lending, banking, and securities regulators to private ratings agencies. From a consumer's perspective, prior to the unraveling of the 2008 mortgage crisis, few anticipated that liquidity problems in fixed-income security trading could result in people losing their homes.

¹¹Note that the danger here lies not in assuming that bonds are safer than mortgage-backed securities or stocks, but, rather, in thinking that we can understand and predict the behavior of mortgage-backed securities by understanding and predicting the behavior of bonds.

¹²The perception of bonds being less risky investment vehicles than stocks in the American financial market dates back to the Great Depression. This perception comes, in part, from the fact that one of the causes of the market crash was the leverage in the system. In the 1920s, the leverage (and, thus, the systemic risk) was driven by margin investors who put in pennies while gambling dollars in the stock market. This behavior resulted in the introduction of Regulation T by the Federal Reserve, which mandated that the margin for trading equities and equity-derivatives was at least 50%. (See [Reg. T, 63 FR 2827, Jan. 16, 1998] for more detail.) This mandate served to reduce the opportunities for leverage in equities trading. Several efforts at introducing similar requirements for futures trading fell through. (For an excellent history of regulators' attempts to impose margin rules on commodity futures, see Markham [80, 1991].) This perception was subsequently reinforced by the Hickman studies in the 1950s that analyzed bond credit-worthiness data that went back to 1900 and, thus, failed to capture the 1890 meltdown of railroad bonds.

5 History

In the 1960s, U.S. mortgage lending system participants faced uncertainty about traditional sources—retail deposits and Federal purchases of mortgages. They perceived deposits to be insufficiently stable, and government funding was in doubt as the U.S. Congress signaled its desire to get the Federal government out of the mortgage business. The search for a solution turned into a search for a new source of funding. “Recognizing the serious impediments to investment, housing and lending industry officials pushed for major changes in the mortgage market structure and the types of securities that could be marketed”(Farquhar, [33, 1972]).

The mortgage bankers viewed the bond market as liquid and stable. Bond investors, such as pension funds and insurance companies, had longer term investment horizons than did holders of retail deposits and, consequently, were a promising source of long-term stable finance. Thus, the solution to the mortgage industry’s funding shortage was framed as making mortgages more attractive to bond investors or, in other words, turning mortgages into bonds.

A combination of government and industry officials envisioned a new security that would accomplish this transformation: “The new financing device would aim at capturing larger portion of the investment portfolios of pension and trust funds for housing”(Samuelson, [104, 1969]). The advocates of the innovation were explicit about the new security’s primary purpose: “What the security does is to transform the mortgage into a bond-type instrument”(Nevins [86, 1972]).

An Act of Congress authorized the issuance of mortgage-backed securities (MBS) in 1968 (FNMA Charter Act 1968, Section 304 (d)). The mortgage-backed securities were a sidebar to the Act’s primary purpose: to split the Federal National Mortgage Association (Fannie Mae), the government agency charged with buying mortgages from the mortgage banks, into a newly formed

government agency called the Government National Mortgage Association (Ginnie Mae) and to spin off the remainder of Fannie Mae into a private corporation with a congressional charter.¹³ According to the Charter Act, both Fannie and the newly formed Ginnie Mae were authorized to issue mortgage-backed securities. For the 34 years of its existence, prior to the authorization of the new securities, Fannie Mae raised funds in the bond market.

Before the new securities were launched, the bond traders, who advised Fannie Mae and now also Ginnie Mae, lobbied the agencies to make these securities more bond-like by adding features that addressed a specific type of risk.¹⁴ Traders argued that if investors could not think of MBS as bonds, the government agencies would be stuck with securities that did not have a market. The traders' concerns were echoed by mortgage bankers' trade press. By 1972, the failure of MBS to attract investments from pension funds, insurance companies, and other bond-market investors was viewed as a failing grade for the effort to turn mortgages into bonds. In this grading, prepayment risk represented the core of the problem: "The modified pass-through security is more like a bond than a mortgage, but the holder still has no protection against accelerated payments"(Nevins [86, 1972]).

Mortgage-backed securities differed from conventional bonds along a number of important dimensions.¹⁵ However, for bond traders, with whom the government agencies consulted, these differences boiled down to just one: the risk that investors in MBS could not control the timing and volume of the repayments of the principal. The 'prepayment risk' in MBS had to be addressed because this level of uncertainty about prepayments was not present in the bonds traded on the

¹³The spin-off was widely perceived to be an accounting move by the government to take the mortgage debt off the federal balance sheet in order to mask the scale of Vietnam War spending (Frame & White [37, 2005]).

¹⁴The information on the industry's lobbying efforts is scarce in the trade publications, but popular accounts and field ethnographies have rich accounts of such efforts (Lewis [75, 1990]).

¹⁵See Table 2 on page 52 for a summary of the differences.

market at the time.

The prepayment risk that worried the bond traders arose from the ability of most consumers in the U.S. to refinance or pay off their mortgage in full at any time without incurring a financial penalty. Traders call this ‘prepayment risk’ because they believe that most consumers refinance (prepay) their loans when interest rates go down, but not when interest rates go up. In keeping with this theory of consumer behavior, the prices of MBS go down both when interest rates go up and when interest rates go down, whereas, holding other things constant, prices of conventional bonds go down only when interest rates go up.

The traders explored several avenues for managing the prepayment risk. One entailed lobbying for the re-introduction of prepayment penalties for consumers (Lewis [75, 1990]). Prepayment penalties were common in the U.S. in the 1870s-1890s, during the first instance of a market for MBS in the United States. After the crisis of 1893 brought that MBS market to a halt, progressive state legislatures in a number of Western states banned prepayment penalties because the fees were viewed as interfering with the consumers’ ability to repay their mortgages (Levy [74, forthcoming]). The loans issued by the Homeowners’ Loan Corporation (HOLC), the federal entity meant to relieve the stress of foreclosures after [the second instantiation of a MBS market in the United States and] the Great Depression, were notable for not having prepayment penalties (Rose [101, 2010]).

In 1970, when Ginnie Mae issued the first MBS on the market, as in prior years, prepayment penalties were regulated at the state level (and by banking regulators), and the traders perceived state-level legislation to be too cumbersome to overturn (Lewis [75, 1990]). In 1982, the Federal Alternative Mortgage Transaction Parity Act sought to preempt state bans on prepayment penalties for the emergent variable-rate mortgages (Fabozzi [30, 2005]). While mortgage issuers introduced

special types of mortgages with prepayment penalties at the traders' behest, they failed to gain a significant share of the prime mortgage market (Green & Wachter [52, 2005]).

Anticipating delays and difficulties in their attempts to alleviate the prepayment risk at the consumer level, the traders focused on building a protection from the prepayment risk into the structure of MBS. Specifically, they envisioned a form of protection that involved making MBS emulate callable bonds, an instrument widely accepted by the bond market.

Broadly speaking, there are two types of conventional bonds: bonds in which the principal amount can be recalled by the borrower and bonds in which the principal cannot be recalled. The principal of callable bonds—a subset of conventional bonds—can be paid by the borrower before the bonds' maturity date (i.e., recalled). Typical (re)call provisions in callable-bond contracts set limits on how much of the bond can be recalled at any given time. A callable bond usually cannot be recalled during the first few years after its issuance. In addition to the 'no-recall' time period, the contract may also set restrictions on the percentage of the principal that can be recalled in any given year.

A major difference between callable and non-callable bonds is that with non-callable bonds, investors need to worry only about the state of the world in which interest rates go up.¹⁶ In that state of the world, investors holding bonds with a lower interest rate (coupon) than the newly prevalent rates miss out on the opportunity to reinvest the money they used to purchase the bond at a new, higher rate.

Once the no-recall period has lapsed, in addition to worrying about the state of the world when

¹⁶Bond investors and mortgage-backed securities investors are both subject to liquidity risk and the possibility that they may find themselves in need of liquidity and unable to tap their investment. This is the same risk faced by depositors who hold money in fixed-term CDs. The liquidity risk along with the interest-rate risk jointly account for the fact that, other things being equal, bonds with longer maturities trade at higher yields (longer-term CDs offer better interest rates) than bonds (CDs) with shorter maturities (terms).

the interest rates go up, investors in callable bonds also need to worry about the state of the world in which interest rates go down. This is because borrowers are likely to want to repay the principal in the lower-interest-rate environment, leaving the bondholders with comparatively less outstanding principal on which to generate interest income and, thus, less valuable bonds.

Since callable bond holders enter into a contract with a single issuer, they are able to negotiate the terms of this prepayment (or call) option. As Table 2 on page 52 suggests, typical callable-bond contracts include limits on when the bonds can be prepaid, what percentage of the principal can be prepaid, and fees associated with the exercise of the call option. As was previously discussed, the efforts of imposing the prepayment penalty on consumers met with limited success, so the question of how the prepayment risk was to be handled and who was going to pay for the prepayment option remained open.

The MBS brought to market between 1970 and 1983 handled the prepayments received from consumers by dividing principal prepayments pro-rata among the investors. That is, if investors A and B each held 50 percent of a pool of 100,000 mortgages, and two percent of these mortgages prepaid every year, after five years, A and B could expect 90,000 mortgages to remain in the pool, with each investor continuing to receive payments from about 45,000 mortgages.

From the inception of MBS, the bond traders argued that splitting up MBS prepayments into tranches would help—if not address, then at least bracket the prepayment risk. In the tranching structure, investors in the first tranche of the security would receive all the prepayments received in the first few years after the issuance of the security; investors in the second tranche would receive all prepayments received in the next few years and so on. In the simplified example, if A held the first tranche of the new MBS and B held the second tranche, after five years of prepayments, A would continue receiving payments from 40,000 mortgagors, while B would continue to be

entitled to cashflows from 50,000 mortgages.

Because the tranching was meant to address prepayment-risk concerns, the investors who got the first prepayments (in this case, investor A) would bear the brunt of the prepayment-risk burden. By convention, these most exposed tranches were labeled junior or subordinated to the more senior tranches (in this case, held by investor B) which were protected from prepayment risk for the first few years. The subordination structure was meant to mirror the world of bond and corporate debt issuance, where, in the case of bankruptcy, investors in senior debt instruments are protected from risk, and investors in more junior debt claims bear more risk.

For the senior tranches of the security, the structure emulated the no-recall period of callable bonds. Effectively, investor B in this design would hold the equivalent of a callable bond that could not be recalled for the first five years. Thus, it was argued that investors in the senior tranches invested in a product that was comparable to a callable bond with a 'conventional' period of time until it was callable. This tranching structure was meant to bring MBS closer to a bond.

In 1978, Salomon Brothers, seen as a major force in the development of the MBS market, formed the first department in which bond traders specialized in trading mortgages (Lewis [75, 1990]). In 1977, MBS dealers, formerly bond traders, created Public Securities Association to represent their interests. One result of dealer lobbying was the creation of Freddie Mac, yet another quasi-government agency, created to securitize mortgages originated by Savings and Loans Associations (Frame & White [37, 2005]).

In 1983, Freddie Mac launched the first Collateralized Mortgage Obligation (CMO), a mortgage-backed security that incorporated the tranching MBS structure according to the original vision of the bond traders. This security design provided a measure of prepayment-risk predictability by splitting prepayments among different groups of investors according to investor tastes. This was in

sharp contrast to previous designs, which split the pre-payments pro-rata. Bond traders (now MBS dealers) welcomed the CMO because they could market the new securities as (callable) bond-like.

To further fine-tune an understanding of prepayment risk, in 1985, Public Securities Association launched the Standard Prepayment Model (labeled PSA curve by the industry), a prepayment-rate benchmark used to predict the timing of CMO cashflows (Fabozzi [26, 1988], [29, 2001]). Models designed to predict prepayment used the PSA curve, a running average of historic prepayment rates, to predict future prepayments.

One reason for the dealers' enthusiasm for the CMO had to do with the prudential investment guidelines, a set of rules that constrained the types and credit quality of securities into which institutional investors such as pension funds could put their customers' money.¹⁷ The Employee Retirement Income Security Act (ERISA) of 1974, enforced by the U.S. Department of Labor, and similar fiduciary duty regulations focused institutional investors' attention on, for instance, high-grade corporate bonds, as opposed to the less well-understood government experiments in securitization. Once CMOs were positioned to rating agencies as bonds and given bond ratings, there was little reason for the institutional investor to believe that s/he was dealing with anything other than bonds.

The introduction of CMO and the influx of institutional investors into the MBS market unleashed a wave of innovation in different types of MBS, meant to make prepayment risk easier to analyze and manage. Innovation produced complex security structures with as many as 69 tranches, subordination of prepayment cash flows, and insurance against prepayment risks (Carroll & Lappen [13, 1994]). The structures were accompanied by models that attempted to predict the

¹⁷I am grateful to Larry White for the insight about prudential investment guidelines.

performance¹⁸ of the securities and justify the creation of new ones.¹⁹

Managing prepayment risk was understood as important to predicting and controlling the duration of the securities. (Predictable or contractually specified duration is a feature of conventional bonds.) The mechanisms for controlling the prepayment risk assumed that the decision to prepay a mortgage is independent across borrowers. A correlation in decisions to prepay mortgages was ruled out as implausible. But what if everyone prepays at once?

The MBS with a tranching prepayment structure worked as intended in the early days of the market. However, between 1990 and 1993, the Federal Reserve took the effective federal funds rate from 8.29 percent to 2.96 percent (over a series of interest-rate cuts) and the MBS market was hit with waves of prepayments that effectively wiped out the interest component of existing MBS holdings. “Homeowners refinanced at unheard-of rates. Wall Street’s prepayment models, based on the 1985-’87 experience (when interest rates actually fell more steeply), failed to predict the onslaught of prepayments”(Carroll & Lappen [13, 1994]).

What enabled the homeowners to refinance at rates that were previously ‘unheard-of’? If the institutional logic for the existence of the market for mortgage-backed securities is to be believed, MBS exist to inject liquidity into the previously constrained home-lending market (Fabozzi et al. [29, 2001]). The existence of this liquidity in the early 1990s provided homeowners with opportunities for refinancing²⁰ that were not previously available to them and, in turn, rendered prepayment risk models based on historic data unreliable, if not irrelevant.

When the MBS market was first created, the rationale for its existence was that it would provide

¹⁸Here, performance means the duration of MBS under different interest-rate scenarios, so that interest-rate bets can be made and risks can be hedged.

¹⁹For a detailed comparison of MBS to bonds along the key features involving prepayment risk, see Table 3 on page 53.

²⁰These opportunities consisted of both greater credit availability and greater ease in accessing the credit.

greater liquidity (e.g., improve refinancing opportunities) for homeowners. However, once the market was created, industry participants either forgot this rationale or did not sufficiently believe it to incorporate it into their forecast models. The MBS traders' prepayment-risk models failed to take into account how the existence of a market for MBS might affect end-consumer behavior and, with it, the performance of MBS.

One might have expected investors to view the MBS market's meltdown as an opportunity to evaluate the quality of the prepayment-risk models, the unanticipated effectiveness of the market at providing homeowners with liquidity, and the applicability of the bond analogy to MBS. However, instead, investors interpreted the *en masse* prepayments as a confirmation of the theory that consumer behavior is sensitive to interest rates (and that investors need to pay attention to the prepayment risk).

The analogy of MBS to bonds lived on despite the evidence that the prepayment risk—and, hence, the duration of MBS—could not be controlled. In 1997, Public Securities Association changed its name to Bond Market Association. The change of name signified acceptance of the bond analogy by the industry players.

Prior to the 1990s, the repayment of mortgages underlying most of the MBS, including the CMOs in the market, was guaranteed either directly, by the federal agencies issuing the securities, or implicitly, by government-sponsored entities such as Fannie Mae and Freddie Mac (Frame & White [37, 2005]). Once players not backed by the U.S. government took an active role in issuing new MBS, a need arose to analyze the risk of default (or 'credit risk') of the mortgages underlying the new securities.

In 1993, the growth in non-government-backed CMOs encouraged the Public Securities Association to introduce the Standard Default Assumption (SDA) curve. This tool was meant to be

the mirror image of the association's Standard Prepayment Model (PSA curve): "The SDA curve relates to defaults just as a PSA curve relates to prepayments"(Fabozzi [29, 2001]).

The SDA was the first of many instances in which securities dealers addressed the credit risk in MBS by copying the structural features of tools that they used to address the prepayment risk. They introduced new securities with complex structures such as tranching, subordination of risk, and surety wraps (a type of insurance against defaults). New models were built to predict the performance of the new securities.²¹²²

The new securities were based on the assumption that defaults of geographically dispersed mortgages are independent. A correlation in defaults among such mortgages was ruled out as implausible. But what if everyone defaults at once?

In 2006, mortgage delinquencies reached historic lows as consumers used the MBS-fueled supply of credit to refinance their mortgages instead of defaulting on the loans. The new delinquency numbers were input into historical default models, which, in turn, predicted further improvements in the performance of mortgages. Like the prepayment-risk models in the early 1990s, the credit-risk models of the late 2000s failed to take into account the impact that liquidity provided by the market for MBS would have on end-consumer behavior and, consequently, the performance of MBS.

As investor demand for new MBS slackened, lenders reduced the availability of mortgage credit leaving consumers unable to refinance their mortgages. This inability to refinance, in turn, gave rise to a wave of delinquencies. The assumption that mortgage defaults were independent across geography proved to be unfounded.

²¹Here, performance means credit risk or anticipated percentages of default in the mortgage portfolio under different scenarios.

²²For a detailed comparison of MBS to bonds along the key features involving credit risk, see Table 4 on page 54.

In 2008, more than three million households in the U.S. were served with foreclosure notices (Armour, [7, 2009]).²³ The bond analogy that helped develop the market for mortgage-backed securities also contributed to its demise, with the aftereffects of the meltdown spilling over into mortgage lending to end-consumers.

6 Analysis

The gestation period leading up to the 2008 mortgage crisis be broadly understood in three phases:

1. 1968-1983 – experimenting with different ways to control the prepayment risk in order to turn mortgages into bonds
2. 1983-1993 – applying tranching²⁴ to prepayment risk
3. 1993-2008 – applying tranching to default risk.

6.1 Phase I: 1968-1983

Prior to 1968, mortgage lenders financed their operation from one of two funding sources: deposits and government purchases of mortgage loans. These sources of funding were viewed by lenders as scarce and fickle. Moreover, the privatization of Fannie Mae and threats to Ginnie Mae's funding as the U.S. struggled to finance the war in Vietnam introduced additional uncertainty into mortgage funding.

Mortgage bankers looked to the capital invested by pension funds, insurance companies, and

²³By comparison, about 450,000 households were foreclosed on in 1933, the peak year of the Great Depression (Alston [5, 1984], Wheelock [133, 2008]). (This number includes both farm and non-farm foreclosures.) For a detailed comparison of how this statistic compares to previous foreclosure episodes in the U.S. history, see Figure 2 on page 50.

²⁴In this section, I refer to tranching and averaging out of risk (what the technique was meant to do) interchangeably.

other prudentially-regulated institutional investors in the bond market as a solution to the scarcity of funding for mortgage loans. The bond market was viewed as a stable pool of money that could be used to finance future mortgage lending throughout the business cycle.

Mortgage-backed securities (MBS), authorized by Congress in 1968 and issued by Ginnie Mae in 1970, were viewed by mortgage-lending industry participants as a half-way step in turning mortgages into bonds. Thus, the analogy between mortgages and bonds was originally introduced as a solution to the problem of funding scarcity in the mortgage-lending market.

At the time when MBS were issued, conventional bonds traded in the market were viewed as having default risk, but not having prepayment risk. In contrast, MBS, issued by Ginnie Mae and government-sponsored entities such as Fannie Mae and Freddie Mac, were viewed as having prepayment risk, but not having default risk²⁵. The prepayment-risk problem had to be solved in order to address the original goal of having investors view MBS as bonds. MBS traders decided to address the prepayment risk by effectively averaging out prepayment decisions across customers by tranching prepayments.

The analogical reasoning here was more complex than an issue of mistaken categorization. The industry participants knew that mortgage-backed securities did not fit into the bond category. In response to this mismatch, the industry participants had to create tools to make mortgage-backed securities (the target object of the analogy) look more like bonds (the source object of the analogy).

6.2 Phase II: 1983-1993

The tranching MBS (also known as a Collateralized Mortgage Obligation or a CMO) were introduced by Freddie Mac in 1983 and accepted by prudentially-regulated institutional investors as

²⁵This was due to the presence of either explicit or implicit government guarantees.

bonds.

Once the system participants accepted the tools for managing the mismatch between mortgage-backed securities and bonds as legitimate, they also accepted the analogy with MBS. Their acceptance of the analogy triggered another round of comparison of mortgage-backed securities to bonds.

Bonds still had no prepayment risk, but had default risk, whereas MBS, now CMOs, were viewed as having neither prepayment, nor default risk. The new comparative logic made MBS traders comfortable with introducing default risk into MBS. The introduction of default risk into MBS entailed skipping the step that involved acquiring (and paying for) government guarantees of mortgage repayment and replacing the government guarantees with tranching, a tool forged in building the acceptance for the ‘MBS are like bonds’ analogy.

6.3 Phase III: 1993-2008

Starting in 1993, government guarantees that the mortgages would be repaid were replaced by tranching, a carbon copy of the risk-management tool that the traders used to manage prepayment risk. In the eyes of the market participants, in addition to doing all the things government guarantees were supposed to be doing, the averaging-of-risk tool had the advantage of being free.

The introduction of credit risk into MBS and the accompanying second round of tool creation were meant to further the functional similarities between mortgage-backed securities and bonds. Once the prepayment risk was deemed addressed, default risk was introduced to make mortgage-backed securities even more bond-like.

1. A series of Federal Reserve interest-rate cuts between 1991 and 1993 triggered a correlation

in the end-borrowers' prepayment patterns. The mortgage borrowers refinanced *en masse*, resulting in the evaporation of the mortgage interest held by MBS investors.²⁶

2. The correlation rendered the tranching tool ineffective at addressing prepayment risk. However, the evidence that prepayment risk in MBS could not be managed by the averaging tool did not force industry players to update the comparisons of MBS to bonds made in 1968 and 1983.
3. The other missed lesson of the 1994 crash was the inefficacy of the averaging-out tool at managing risk in the presence of correlation.

By the time of the 1994 MBS meltdown, the role of the averaging-out tool in enabling the transformation of mortgage-backed securities (and, by extension, of mortgages) into bonds had been forgotten. The failure of the technology meant to realize the transformation of mortgages into bonds had not been incorporated into the system's memory.

In 2008, a slowdown in the MBS market triggered a correlation in mortgage defaults. The correlation in defaults rendered the averaging-out tool ineffective at managing the default risk, resulting in losses of money for the investors and of homes for the end-borrowers.

6.4 After 2008

The averaging-out tool seems to have emerged unscathed from the crisis of 2008. 2010 saw the introduction of a bond insurance pricing scheme that relies on averaging out bond risk across the tranches.²⁷ The averaging-out tool as an approach to risk-management seems to have survived both

²⁶Lew Ranieri, one of the visionaries behind the averaging out of prepayment risk, and many less centrally positioned industry players lost money in the event (Carroll & Lappen [13, 1994]).

²⁷Interview, October 18, 2010

a near miss and a full-blown accident. Its unexpected longevity will continue to wreak havoc in the financial markets for the foreseeable future.

7 Discussion

This paper set out to explore the negative consequences of analogical reasoning applied to diffusion of innovation. The idea that analogical reasoning can have negative consequences has received limited attention in the research on cognitive psychology and organizational learning. Similarly, the possibility that innovations have negative consequences has not been fully explored in the diffusion-of-innovation literature. Through a longitudinal process study design, I have tried to understand the processes by which decision-makers reliant on analogical reasoning go astray and how diffusion of innovation can lead to disaster.

This paper also set out to examine the hypothesis that the use of a bond analogy in the creation and marketing of MBS led to both the development of the market and to its subsequent collapse. This hypothesis was laid against the historical developments of the MBS market between 1968 and 2008 to see how well it explains the unexamined assumptions that the players made in the rise and fall of the market. I will now discuss the tightness of this fit and how it compares with the fit of other hypotheses that have been offered to explain the crisis.

The securities authorized by the 1968 Act of Congress had to be positioned against the spectrum of existing securities. The framing of MBS as bonds was neither inevitable, nor necessarily strategic. MBS could have for instance been framed as a new class of fixed-income securities that, while sharing some features with bonds, were neither bonds nor stocks. Such positioning might have slowed the development of the market; indeed, the markets for the securitization of other

loans—such as auto and credit card receivables, which lagged the securitization of mortgages by about 15 years—received precisely such positioning as investment banks formed structured credit divisions.

The framing was also not necessarily strategic. As late as 1981, fixed income research analysts made about half the money of equity research analysts (Donnelly [20, 1985]). The attraction-selection-attrition paradigm in psychology (Schneider [106, 1987], Schneider, Goldstein, & Smith [107, 1995]) and the adverse-selection model in economics (Akerlof [6, 1970]) would suggest that the more imaginative thinkers interested in financial markets when the MBS market was getting started would have found themselves drifting towards equity and away from fixed-income markets.

An argument could be made that the bond traders in the 1970s did not operate with sufficient cognitive complexity to imagine a fixed-income product that was not a bond (Suedfeld & Tetlock [118, 1977], Tetlock [120, 1985], Macrae, Milne, & Bodenhausen [79, 1994], Tetlock [121, 2000]). The bond traders might have operated with a cognitive schema so coarse that when presented with any security whose category membership was ambiguous, their natural instinct was to see bonds. When presented with the potentially ambiguous stimulus that the new securities represented, bonds could have been the most plausible, even if not the most strategic, option.

Whatever the cognitive models may have been, the bond traders in question were quite clear on the fact that the pass-through MBS, as authorized by Congress and issued by Ginnie Mae in 1970, were not bonds. They could not have been bonds unless and until prepayment risk and, with it, the duration of the new securities were addressed or at least controlled. However, in the bond traders' vision, this major difference could be taken care of with some adjustments to the structure of the MBS or, more specifically, by tranching of the prepayment cashflows according to investor preferences.

This tranching was supposed to enable the investors to hold a functional equivalent of callable bonds and to forget about the complexities of MBS and the underlying collateral. Adoption of prepayment tranching was viewed as both a necessary and sufficient condition of MBS becoming bonds. Once the tranching structure was adopted, the assumption that this structure would enable securities' issuers to control the duration of the MBS and, thus, functionally make MBS into bonds became implicit.

When the tranching failed to protect the investors from the prepayment risk in 1994, the original rationale for introducing the structure in order to manage securities' duration was never re-examined. Even as Lew Ranieri, the first head of the Salomon Brothers mortgage department, and other advocates of marketing MBS as bonds incurred financial losses (Carroll & Lappen [13, 1994]), it appears that no one considered the question of whether this failure suggested a fundamental flaw in the original logic of the idea that MBS and, by extension, mortgages could be made into bonds.

Also unquestioned lay the assumptions embedded in the tools that were supposed to make MBS into bonds. The very idea that tranching or averaging prepayments was a feasible strategy for addressing the prepayment risk and controlling the duration of MBS hinged on the assumption that prepayment decisions were independent of each other or not correlated across customers. This assumption, which proved not to hold in the series of interest-rate cuts between 1991 and 1993, lived on in the tools that were meant to make the MBS bond analogy a reality.

The assumption's longevity may have to do with what the sense-making literature describes as people's reluctance to drop their tools when faced with evidence of the tools' inefficacy (Weick, [131, 1993]). The analogical-reasoning approach goes further, by pinpointing a mechanism that could trigger such reluctance (Perrott, Gentner, & Bodenhausen [89, 2005]). Specifically, it

suggests that analogies can alter people's impression of a situation regardless of their pre-existing attitudes. The sharpest investigator presented with a persuasive MBS-as-bond analogy may fail to question what limits this analogy imposes on the analysis of the situation at hand or, in this case, the validity of the analogy.

One example of such blindness is that industry participants failed to anticipate the effects that the greater availability of home lending, facilitated by the existence of a larger MBS market, would have on the MBS market. Industry participants often cited greater availability of credit to homeowners as a rationale for the development of an MBS market. Traders argued that the market was needed to provide homeowners with greater liquidity and that the tranching features that would make MBS into bonds were needed to develop the MBS market.

Yet, the market's *raison d'être* of providing greater liquidity to homeowners was not incorporated into the MBS traders' own prepayment models. The prepayment models used Public Securities Association's Standard Prepayment Model (PSA curve), an historical running average of prepayment rates, as a benchmark for anticipated prepayments. This historical model was rendered inaccurate by the growth of the secondary market and the corresponding swell in the credit available to homeowners. As a result, the market participants were blind-sided by the feedback loop from the primary markets to the secondary markets triggered by their own actions in the secondary markets.

In predicting that the incorporation of bond-like features into MBS would address the prepayment risk, and marketing the resultant tranching MBS structures as bonds would improve homeowners' access to credit, the traders turned out to be half-right. Marketing tranching MBS structures as bonds attracted an influx of investor capital, which, in turn, improved homeowners' access to credit. However, the tranching did not protect investors from prepayment risk. Since the bond

analogy was not questioned in the aftermath of the 1994 MBS market crash, at least half of the lesson of the early 1990s was not learned.

Industry participants took the same tools that they had used to control prepayment risk in order to turn MBS into bonds and then used them to address default risk and to reach into previously untapped credit-risk segments. The unquestioned assumptions and the unlearned lessons that brought about the 1994 MBS market crash lived on in these tools. The assumption that prepayment decisions were not correlated across customers was replaced by the assumption that defaults were not correlated across geographically dispersed customers.

The lesson that historical benchmarks can prove inaccurate when the secondary markets undergo changes was also not learned. The Standard Prepayment Assumption curve gave way to the Standard Default Assumption curve. Like the Standard Prepayment Assumption curve in the 1990s, the Standard Default Assumption curve failed to alert the model users to the changes in the market for mortgages triggered by an influx of cash into the market for MBS.

One big difference between the MBS market meltdowns of 2008 and 1994 is that in 1994, the Wall Street modeling mistakes did not lead to any families losing their homes. Why was the spillover of the MBS markets into the market for mortgages not anticipated and stopped by either banking or securities regulators? In part, because neither set of regulators was accustomed to flare-ups in the bond market (or what they thought was the bond market) directly affecting consumers.

The MBS market was the first market on Wall Street to tie performance of securities directly to consumer outcomes. Even if the regulators had not bought into the bond analogy, anticipating and stopping the mortgage crisis would have involved unprecedented coordination between banking and securities regulators. While the repeal of the Glass-Steagall Act in 1999 dismantled the barriers for banks to engage in both deposit taking and investment banking, the regulatory oversight of the

banks remained siloed between the agencies that looked at the commercial banking side of the business and the SEC.

Securities regulators' acceptance of the bond analogy exacerbated the problems in the supervision of the MBS market that have been well documented in both academic articles and the popular press (Morgenson [83, 2008], Acharya & Richardson [3, 2009]). Specifically, once MBS were regarded as bonds, their supervision was effectively relegated to the credit rating agencies. These agencies rated the credit quality of MBS, and, following a 1975 SEC ruling, the banks were able to set regulatory capital requirements based on the ratings level received by the securities (Morgenson [83, 2008]).

The above analysis suggests that the bond-analogy hypothesis provides a cogent and coherent explanation of both the development and the denouement of the MBS market. Positioning MBS as bonds contributed to the market's development since market pioneers were able to draw institutional investors into the market, and the presence of these institutional investors served to provide homeowners with greater availability of credit—the market's *raison d'être*.

The unquestioned use of the bond analogy also set in motion the processes that ultimately contributed to the market's demise. The tranching structure that was meant to protect investors from prepayment risk and, thus, to turn MBS into bonds, was based on flawed assumptions. When tranching failed to protect investors from prepayment risk, this failure did not lead industry participants to question the applicability of the bond analogy. The analogy lived on, and the tools that failed to protect investors (along with the flawed assumptions they were based on) were transferred and applied to dealing with credit risk.

The tools failed to control the credit risk in the 2000s, the same way (and for the same reasons) they failed to control the prepayment risk in the 1990s. This time around, the failure put three

million families at risk of foreclosure.

8 Conclusion

This paper draws on research in analogical reasoning, diffusion of innovation, and the sociology of disasters to explore links between micro processes of analogical reasoning and macro outcomes of innovation-related disasters. The paper aims to build bridges among the three literatures and to augment the method repertoire of organization studies. This study is a first step toward filling the gap in our knowledge about the dark side of analogical reasoning that relies on structural features and uses systematic processing.²⁸.

Multiple explanations have been offered for the current crisis (Diamond & Rajan [19, 2009]). In spirit, my work is closest to Gennaioli, Shleifer, and Vishny's theoretical paper about how investor beliefs can contribute to market fragility (Gennaioli, Shleifer, & Vishny [41, 2010]). In terms of implications for academic research, my work highlights the importance of understanding the role of market participants' beliefs and the institutional logics in shaping market outcomes.

Other explanations of the crisis can be broadly characterized as focusing on incentives of individual players, the players' (ir)rationality, and the internal controls and governance of individual institutions (Keys et al. [67, 2010], Niles [87, 2010]). My analysis differs from these explanations in several key ways.

Incentives are about the choices people make while in the game, not about how the game was formed. Understanding how the game was formed allows us to consider alternative pathways that decision-makers could have traveled if presented with different choices. Also embedded in the

²⁸The gap corresponds to the white space in the upper right hand corner of Figure 1 on page 49

incentives story is the implicit assumption that bad outcomes result from bad intentions. While this assumption may hold in certain circumstances, studies of social phenomena suggest that this is not always the case (Merton [82, 1936]).

Moreover, even if the assumption held, it imputes a set of intentions to industry participants without correcting for a retrospective bias. Contemporaneous accounts and ethnographies of the field suggest that the market participants may have had the best of intentions at heart (Tett [122, 2009]). In investigating the bond-analogy hypothesis, I am agnostic as to the market players' intentions.

An important element in the story about the players' irrationality is that industry players should have known better than to act the way they did. This better knowledge is presumed to come from industry participants' prior experience with the market. The irrationality story assumes a constant set of players: the same people get to make decisions, observe the outcomes of the decisions, and update their beliefs on what they have observed.

Explicit questioning of the 'same set of players' assumption yields important implications for corporate governance. While the pay of the banks' top executives may be an important issue, of equal importance is trying to understand how financial institutions can be made to develop a better memory for both organizational and industry-level developments.

This memory development could come from, for instance, efforts to lengthen the tenure of an average bank employee. The rapid employee turnover in the banking sector and the layoffs associated with financial crises contribute to the destruction of organizational memory (Ho [57, 2009]) leaving us with no hope of learning from past crises in order to soften or head off potential crises yet to come.

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9 Appendix

		Features used for comparison	
		Surface	Structural
Type of Processing	Systematic	Gentner & Landers, [47, 1985], Gentner & Toupin, [48, 1986], Kaiser, McCloskey, & Proffitt [65, 1986], Holyoak & Koh, [60, 1987], Ross [102, 1987], Novick [88, 1988], Holyoak & Thagard, [62, 1995], Gavetti & Rivkin, [40, 2005]	?
	Heuristic	Gilovich, [51, 1981], Finkelstein, Whitehead, & Campbell, [35, 2009]	Medin & Ortony, [81, 1989], Read & Grushka-Cockayne, [94, 2011]

Figure 1: **Research on faulty analogies by type**

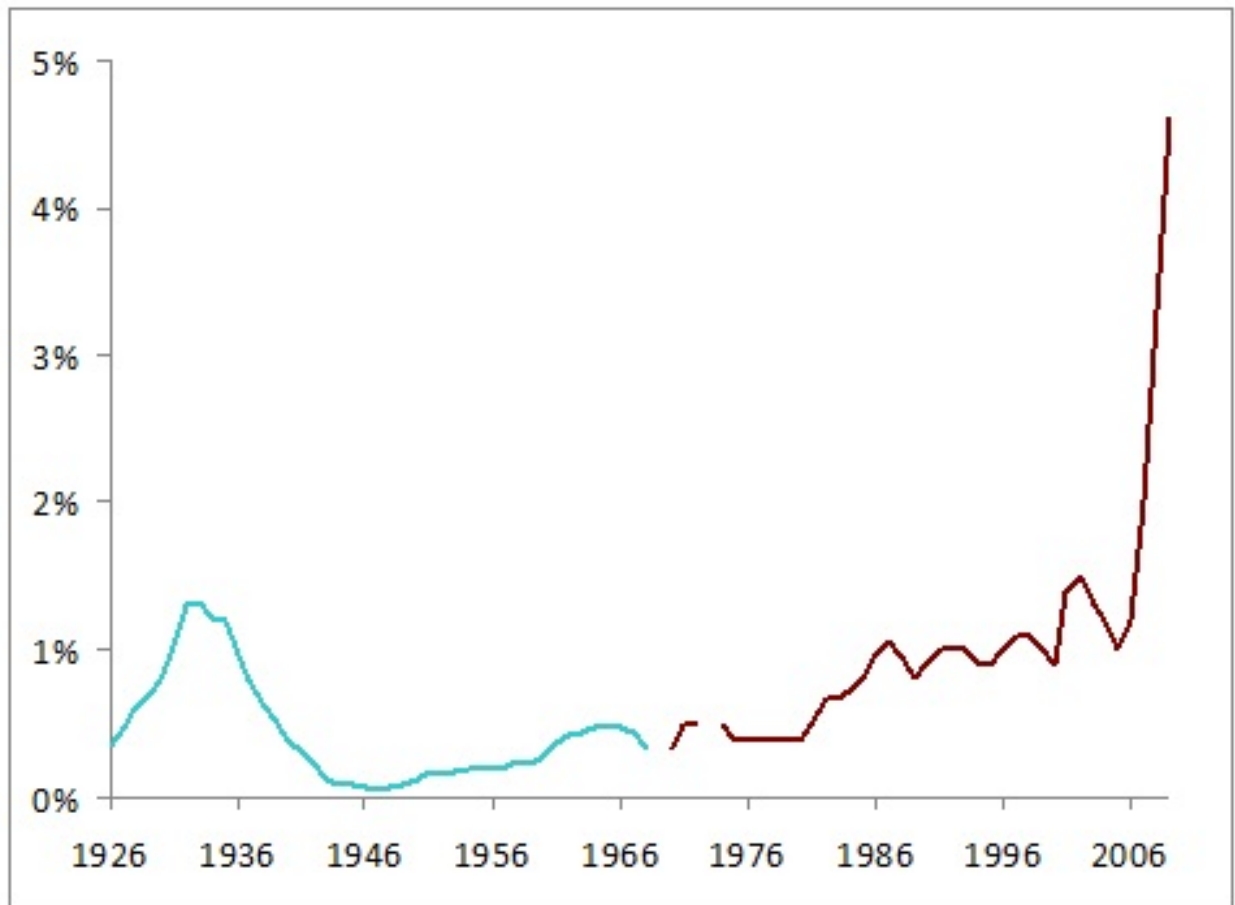


Figure 2: **Foreclosures on Non-Farm Residential Properties in the U.S. between 1926 and 2009**

1926-1968 data series is houses surrendered to the lender as % of mortgaged structures, using data from the Federal Home Loan Bank Board (FHLBB). Source: Snowden ([115, 2006]).

1969-2009 data series is loans in the foreclosure inventory at the year end as % of loans serviced by the participating companies, using data from the National Delinquency Survey of the Mortgage Bankers Association of America (MBAA). Source: *Statistical abstract of the United States* for 1987, 1988, 1991, 1995, 1998, 2001, 2004-2005, 2011. For a more technical description of the survey, see: <http://www.mortgagebankers.org/files/Research/NDSFactSheet.pdf>.

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Table 1: Mortgage-Backed Securities System: Players and Roles

Players\Roles	Home Sellers	Home Buyers	Mortgage Retailers	Mortgage Servicers	Mortgage Whole-salers	MBS Issuers and Re-sellers	Investors
Individuals							
Real estate developers							
Commercial banks							
Thriffs							
Investment banks							
GSEs							
Pension Funds							
Life Insurance Companies							
Rating Agencies							
Regulators							

Shaded areas in the table reflect the roles the players take on in the system.

Table 2: Mortgage-Backed Securities and Bonds

	MBS	Bond
Type of Issuer	Government sponsored entities, federal government, private issuers (e.g., banks, trusts).	Domestic corporations, municipal governments, federal government.
Maturity	Corresponds to the length of the underlying mortgage contract.	Non-collateral specific.
Coupon	Interest rate associated with the security.	Interest rate associated with the security.
Principal	Payment timing varies depending on the type of the loan.	Paid at maturity date (if applicable).
Collateral	Mortgages underlying the contract; no explicit recourse to the issuer's other assets.	In absence of other contractual provisions, assets of the issuer.
Call and Refunding Provisions	The underlying mortgages can be prepaid at any time. Investors receive the payments pro-rata as they occur.	Callable bond contracts specify restrictions on callability, including when the bonds can be called and the percentage of the principal that can be called.
Responsibility for Repayment	Rests with the issuing firm or government agency.	Rests with the individual borrowers of the mortgages being packaged.

Table 3: Call and Refunding Provisions Spectrum

Pass-Through MBS	Tranched MBS (CMO)	Callable Bond
The underlying mortgages can be prepaid at any time. Investors receive the payments pro-rata as they occur.	The underlying mortgages can be prepaid at any time. Prepayments are divided among tranches in a pre-specified order. More senior tranches are less exposed to prepayments than junior tranches.	Contracts specify restrictions on callability, including time when the bonds cannot be called, percentage of the principal that can be called, etc.

←

Less bond-like

More bond-like

→

Table 4: Bond Analogy and Credit Risk

	MBS		Bond
	Pass-Through	CMO	
Credit-Risk Structure	Each pool of pass-through securities has a single risk profile, and, if rated by a ratings agency, a single rating.	The senior tranches are less exposed to defaults than junior tranches. Each tranche of a CMO can have its own risk profile and a separate rating from a ratings agency. Thus, a single CMO with multiple tranches can have multiple grades assigned by the same agency.	Each bond issue has a single risk profile and if rated by a rating agency, a single rating.
Credit-Risk Rating	The risk rating is determined by the quality of the underlying mortgages (graded A, B, C, D by the originator), geographic dispersion, and conformance to either Fannie Mae's or Freddie Mac's underwriting guidelines.	The risk rating is determined by a combination of the quality of the mortgages underlying the CMO and the relative seniority of the given tranche.	Rated by the ratings agencies and assigned grades, AAA, AA, A, BBB, BB, B, etc. The credit rating is determined based on the issuer's financials and the seniority of the given bond in relation to other outstanding bonds from the same issuer.
Credit-Risk Mitigation	The securities may carry implicit or explicit government guarantees or private insurance.	The securities may carry implicit or explicit government guarantees. Privately issued securities may be structured to allow subordination of risk across tranches and may carry private insurance.	Federal and municipal bonds carry pledges of issuer revenue at the relevant level of government. Private bonds may be backed by collateral beyond the assets of the issuer.