8. Innovation as Sedimentary Layers: Diffusion, Imitation, and Incremental Innovation

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Hello Berkeley IFR Seminar,

It’s a pleasure to be part of your seminar series and I hope this paper is of interest. This is a draft chapter in a longer monograph on the subject of innovation and regulation. The monograph looks at the trajectory of “regulation and governance” scholarship over the last 30 years. I explain the rise of the so-called “regulatory state” in the 1980s and 1990s, out of what had been known as the “Welfare State” in the postwar years.
This project was spurred in part by the UK Financial Services Authority’s Turner Review, from March 2009. In his analysis of the origins of and appropriate responses to the financial crisis, Lord Adair Turner made this observation:

An underlying assumption of financial regulation in the US, the UK and across the world, has been that financial innovation is by definition beneficial, since market discipline will winnow out any unnecessary or value destructive innovations. As a result, regulators have not considered it their role to judge the value of different financial products, and they have in general avoided direct product regulation, certainly in wholesale markets with sophisticated investors.1

As a scholar of regulation, and financial regulation in particular, this comment was provocative. I cannot speak for transnational financial regulation as a whole, though I have my doubts that financial regulation “in the US, the UK and across the world” was quite so wholesale or monolithic as all that in its embrace of innovation and market discipline. The Turner Review does not pretend to have done the empirical work needed to support that assertion.

The empirical work I do in an earlier chapter of the monograph subjects the regulation & governance scholarship written by legal scholars, 1980-2010, to qualitative review, to investigate the Turner Review’s charge. I conclude that, though there are different perspectives, overall there was no claim that innovation would be “by definition beneficial” because the market would winnow out unproductive ideas. At the same time, in spite of lots of sunny talk about the benefits of regulatory innovation, these scholars (of which I am one) operated at best on an impressionistic and partial understanding of what private sector looked like, how it developed, for what purposes, and to whose benefit.

The book has a few distinct purposes, but one purpose is to try to demonstrate that innovation can actually pose real risks to regulation itself, and that regulation scholars need to have a far better understanding of what innovation looks like in order to grapple with it. I argue that thinking of innovation (in general, and financial innovation in particular) explicitly as a regulatory challenge is a novel approach, which produces a new set of questions and a new set of responses. For example, where an efficiency-oriented account of an innovation might see a potential to reduce the regulatory burden, a regulation-oriented account might, quite plausibly, see arbitrage. The efficiency-oriented account has been dominant over the past few decades but it is not the only reasonable account. This does not mean that the goal of regulation should be to arrange itself in formal opposition to innovation, like some caricature of a “red tape”-loving 1970s bureaucrat. Far short of that, it means simply

1 The Turner Review, March 2009, at 49.
that regulators and scholars of regulation need to adopt an authentic, endogenous, regulation-oriented perspective on innovation, which values and safeguards regulatory authority and is alive to the ways in which innovation can present challenges as well as opportunities (for regulators and more generally).

I draw on the innovation literature, which describes two main kinds of innovation – “incremental” and “radical” – and make the argument that, assuming these are meaningful categories, they should call for different regulatory responses. What you have here is the draft chapter that discusses incremental, or what I call “sedimentary” (my term) regulation. To be clear, I plan to point out how the same innovation – perhaps I will use securitization of consumer debt as a broad example – can, depending on framing and scale, be seen as incremental / sedimentary innovation, and/or radical / seismic innovation, and/or “bad” / pure rent-seeking innovation.

The final part of the book is more normative, and talks about the ideological role that innovation plays in modern Western societies and the sometimes underappreciated tradeoffs – in terms of justice, or equality, or security – that we pay in valuing it as highly as we do. I am not anti-innovation, but I argue for appreciating innovation to be the regulatory risk that it is.

Questions I would especially appreciate your feedback on in this chapter (along with obvious and important questions about whether it makes sense and is persuasive) include: (1) Is the network analysis discussion necessary, or helpful? (2) Are the examples too varied? (3) What example(s) come to mind as financial innovations that could be framed as radical or incremental depending on framing? (4) Proportionality: where is there too much, where too little?

Thank you! I look forward to the visit.

Cristie

What is “Sedimentary Innovation”?

Relative to “seismic” innovation, the “sedimentary layers” metaphor refers to what is actually the more common kind of innovation: incremental improvements on new inventions, arising through collaboration or knowledge networks and based on imitation, tweaking, translating, and diffusion. Innovation scholar Christopher Freeman describes the shift in emphasis in regulatory and policy work from radical innovations to “incremental” or sedimentary innovations:
Radical innovations...tended to overshadow incremental innovations, both in policy making and in descriptive analysis for a long time. ... an important change in emphasis in policy making [has been] the recognition that the vast majority of firms do not make radical innovations, but all can and should make incremental innovations and adopt new products processes first made by others.²

A simple, one-move example of an incremental innovation would be Apple Corporation’s iPad. Its launch was accompanied by debate about whether it was an “innovation” at all, or just a scaled-up version of an iPhone.³ With the phone as a cognitive anchoring device, it was difficult to imagine that an iPad might be something different, yet what seemed like just a difference in physical size altered the user experience in considerable ways, and gave rise to follow-on innovations and functions. (Both phone and tablet also of course generated imitators.)

Or consider rail safety: in July 2013, an unattended freight train carrying 72 cars of crude oil derailed and exploded in Lac Mégantic, Québec, causing forty-seven deaths.⁴ It produced one of the largest oil spills in Canadian history. The Lac Mégantic derailment serves as an example of the risks and unpredictability of sedimentary innovation. The sedimentary innovation of major rail shipment of crude oil products, stemming from increased oil prices and political pressures not to build pipelines, combined with railway deregulation⁵ to create serious gaps in rail safety. Leading up to the disaster, shale oil and bitumen transported by rail in Canada had increased from 500 carloads in 2009 to an estimated 140,000 carloads in 2013, in an effort by oil companies to reap profits from the increase in oil prices.⁶ As Tim Shufelt writes, “For the Canadian oilpatch, railways were an inelegant—if necessary—substitute for highly controversial pipelines.”⁷

In this example are the hallmarks of the phenomenon I want to consider: “sedimentary” layers of innovation, each perhaps unremarkable on its own (and not flashy in technological terms) and yet, collectively, highly consequential. The move to

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rely on rail to transport crude oil in these quantities is a process innovation, and produces manufactured risk, but its incremental development and multifactorial causes make it hard to detect until a focusing event, like the disaster, arises. By then much damage is done.

By contrast to the ‘seismic’ (or ‘radical’) innovations, ‘sedimentary’ (or ‘incremental’) innovations do not call for a “new column and a new row in a complete input-output table,” but just “new coefficients in the table of existing products and services”. Sedimentary innovations are comprised of small improvements to equipment and organization from engineers, technicians, managers, workers, product users and others. Diffusion tends to contribute to sedimentary innovation. Innovation, particularly sedimentary innovation, is not always underpinned by a technological change, or a clearly visible trajectory from specific technology to innovative outcome.

Our language and our literature are full of allegories for the problems posed by the small drip-drip of incremental change: one can suffer death by a thousand cuts, Gulliver was tied down by the Lilliputians, there is a last straw that can break a camel’s back, and (apocryphally) frogs can be boiled alive if the water in the pot is heated gradually enough. While the concept of sedimentary innovation is in some ways analogous to the ‘incremental’ innovation that Freeman & Soete describe, the metaphor of ‘sedimentary’ innovation also helps emphasize the dangers of gradually increasing, piling-up innovation in a way that the word ‘incremental’ does not. Sedimentary innovation can bury the structures designed to contain it, and can fundamentally shift the landscape even while not appearing to be doing much at all.

Alongside these darker images, we also have a romantic account of sedimentary innovation, just as we have a romantic account of seismic innovation. The image of vision plus perseverance as the basis of innovation, or the eccentric who, in the fullness of time (and perhaps posthumously) was proved right, is a familiar cultural stock figure whose existence affirms the values of hope and hard work. Sedimentary innovation may be less “magical” in the popular imagination than radical innovation,

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12 Actually, if a frog were placed in gradually heating water, it would attempt to escape the water as the temperature rose. See Karl S. Kruszelnicki, Frog Fable Brought to Boil, CONSERVATION MAGAZINE, (Mar. 3, 2011), at http://conservationmagazine.org/2011/03/frog-fable-brought-to-boil/.
but it too occupies a space in our cultural universe. Sedimentary innovation also occupies a space in the flexible regulation literature, which we need to understand before we can delve more deeply into the ways in which sedimentary innovation also represents a challenge for that literature.

**Sedimentary Innovation as Regulatory Opportunity**

This image of sedimentary innovation, and progress, underpins a range of pragmatist, experimentalist and evidence-based regulatory prescriptions. In fact, the idea of incremental, step-by-step progress underlies important regulatory touchstones such as the ‘race to the top’, and the use of regulatory competition to foster productive innovation. Louis Brandeis’s famous claim that federalism permits multiple laboratories for democracy, alluded to in chapter 3, *assumes sedimentary innovation*: it establishes a legal architecture for running parallel experiments, with a view to increasing the rate of beneficial discoveries and innovations.

Focusing on the upside potential of sedimentary innovation, Charles Sabel and Michael Dorf describe developments in hospitals, prisons, etc. [briefly describe contexts in Democratic Experimentalism article]. They use the term ‘bootstrapping’ to describe the process in which incremental innovations in different jurisdictions create a structure conducive to experimentalism, arguing that it is a positive self-reinforcing process.13 Bootstrapping is


> **[T]he process of incremental change in which a favourable balance of risks and returns encourages first steps from many diverse starting points, and each move points the way down one of several paths that eventually leads to a roughly similar outcome.**

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[maybe more here on Sabel & Simon “Destabilization Rights”, “Minimalism and Experimentalism in the Administrative State”, the virtues of incrementalism and of designing for contingency]

Art Wilmarth is among the scholars who channels Justice Louis Brandeis, when he argues that one of the strengths of the dual-banking system in the US was that it promoted private sector innovation. In his view, competition within the dual banking system may explain why US banks are in his view innovative relative to, for example, European banks:


Congress’ decision to separate commercial banking and investment banking in 1933 had an ironic but important effect on competition and experimentation in the U.S. financial markets. In the long run, the decentralized financial industry structure mandated by the Glass-Steagall Act encouraged competition between money center banks and large securities firms. That rivalry in turn fostered a progressive deregulation of U.S. financial markets after 1970, spurred continuing innovation by U.S. banks and securities firms, and gave them a clear technical superiority over European universal banks.15

Moreover, and interesting for our purposes, competition among state regulators, and between state and federal regulators, promoted further instances of cooperative innovation between private and public sector. Competition helped generate a reflexive loop of regulatory innovation, ultimately producing very significant change. The examples Wilmarth points to begin as private sector innovations. However, they achieve success once they are embraced and championed by regulatory actors, operating in competition with each other [too many long quotes still]:

[The dual banking system has permitted states to act as “laboratories” in experimenting with new banking products, structures, and supervisory approaches, and Congress has subsequently incorporated many of the states’ successful innovations into federal legislation. In addition to the examples ... of checking accounts, bank branches, real estate loans, trust services, and NOW accounts, the state banking system originated reserve requirements, deposit insurance, adjustable-rate mortgages, automated teller machines (“ATMs”), bank sales of insurance products, interstate electronic funds transfer systems, interstate bank holding companies, and supervisory agreements that promote cooperative oversight of multistate banking organizations by state bank regulators, the FRB, and the FDIC.16]

Competition between state and federal bank regulators then spurred further sedimentary innovation. In a now-familiar pattern, the result is pressure to demonstrate regulatory innovativeness and flexibility:

During the 1980s and early 1990s, the [US Office of the Comptroller of the Currency]’s success in obtaining court decisions expanding intrastate branching opportunities for national banks forced many states to adopt laws granting statewide branching privileges to state banks. During the same period, state initiatives allowing state banks to offer securities and insurance products encouraged federal regulators to take similar steps. These state and federal regulatory innovations helped persuade Congress to enact GLBA in 1999, which removed legal barriers separating the banking industry from the securities and insurance businesses. Thus, the regulatory competition for bank charters has placed continuing pressure on


state officials and the OCC to demonstrate that they can provide innovative, responsive, and cost-effective supervision to their regulated constituents.\textsuperscript{17}

Saule Omarova, speaking in less sanguine terms about the same industry, also has tracked how the business of banking changed over time. She looks at the way in which, from the mid 1980s onward, the OCC gradually broadened its statutory interpretation of what a bank does, using first the “look-through”, then the “functional equivalency”, and finally the “elastic definition” approach. Omarova emphasizes how, at each stage, decisions by regulators precipitated the growth of financial innovation, allowing financial institutions to take greater and more complex risks. The relationship is a reciprocal and reflexive one.

Moreover, like the innovations to which they contributed, the regulatory innovations were subtle, incremental, and operated “under the radar” in a way whose consequence could only be recognized in retrospect. As Omarova says,

Contrary to an implicit assumption underlying most conventional explanations, the financial innovation of recent decades did not happen “naturally”; it was not some generalized evolutionary force but, to great extent, a product of policy choices and decisions by regulatory agencies. Moreover, some of the most influential of those decisions escaped public scrutiny because they were made in the subterranean world of administrative action invisible to the public, through agency interpretation and policy guidance.

… It was not the highly visible acts of Congress but the seemingly mundane and often nontransparent actions of regulatory agencies that empowered the great transformation of the U.S. commercial banks from traditionally conservative deposit-taking and lending businesses into providers of wholesale financial risk management and intermediation services.\textsuperscript{18}

The banking story illustrates the nature of sedimentary innovation, as well as the relationship between regulatory innovation and private sector innovation: these are series of incremental changes, which collectively lay down a markedly different landscape than existed prior – even while a clean, coherent account may be most readily available only after the fact. In similar fashion, the broad-scale securitization of residential mortgages did not happen overnight. It took place, as did other moves toward maturity transformation, the speculative use of derivatives, the growth of leverage, in incremental steps.\textsuperscript{19}

\textsuperscript{17} Arthur E. Wilmarth, Jr., The OCC’s Preemption Rules Exceed the Agency’s Authority and Present a Serious Threat to the Dual Banking System and Consumer Protection, 23 Ann. Rev. Banking & Fin. L. 225, 259-260 (2004) [citations omitted].


\textsuperscript{19} Moreover, the availability of 30 year mortgages in the US has been connected to the ability to securitize those assets in the markets. Richard Green and Susan Wachter, “The American Mortgage in Historical and International
Sedimentary Innovation as Regulatory Challenge

What should not be lost here is that sometimes, private sector innovation can force the hand of a regulator, or (as Wilmarth notes above) can help identify regulatory champions for an innovation not because it is in the public interest but because it is in the regulator’s competitive interest vis-à-vis other regulators. This is one account of the repeal of the Banking Act of 1933, more commonly known as the Glass-Steagall Act (GSA).20 The GSA restricted commercial banks from involvement in the securities industry, and was formally repealed via the Financial Services Modernization Act of 1999, better known as the Gramm-Leach-Bliley Act (GLBA). The $70 billion merger between Citicorp, Inc. and Travelers Group Inc., which violated certain provisions of the GSA and the Bank Holding Company Act of 195621, has been claimed by some to have led directly to the GLBA.22 While the merger did not become legal until after the GLBA had been implemented, it had been announced prior to the approval of the initial draft of the GLBA.23

The Sabelian account of regulatory bootstrapping, and the deep potential of incremental change, is important. At the same time, managing sedimentary innovation – having the presence of mind to bootstrap the “right” things, curtail the “wrong” things, identify both and identify the difference between them – is a challenging prospect. Sedimentary innovation holds out the possibility of meaningful benefits, certainly; as an object of regulation, however, it can also be both hard to see, and hard to handle. The first problem is our own human fallibility as identifiers of relevant information and rational decision makers. Beyond that lie further problems that relate to the nature of innovation itself.

At still other times, sedimentary innovation creeps under, around, and through regulatory structures in unexpected ways. Consider the September 2007 Asset-Backed Commercial Paper (ABCP) Crisis in Canada – not a consequential event in global terms, but an illuminating and familiar one in regulatory terms. The crisis is

Context”(2005) http://repository.upenn.edu/cgi/viewcontent.cgi?article=1000&context=penniur_papers; also Tobias Adrian and Hyun Song Shin. Liquidity and Leverage, 19 JOURNAL OF FINANCIAL INTERMEDIATION 418, (2010).

20 The biography of Sandy Weill, former chief executive and chairman of Citicorp, outlines the strategy employed by Weill and Citicorp Chairman John S. Reed, to force the repeal of the GSA. Academy of Achievement, Sanford Weill Biography, available at http://www.achievement.org/autodoc/page/wei0bio-1.


historically interesting because it foreshadowed the larger credit crunch that followed in the US in 2008, but also because the way in which ABCP was distributed in Canada demonstrates the corrosive behind-the-scenes effect that financial engineering can have on discrete regulatory provisions. The commercial paper regime in Canada established a blanket exemption for commercial paper from certain securities law requirements, on the basis that any kind of commercial paper that could possibly be devised would still have to operate within a well-understood practical limits: its salability. The ABCP regime was premised on the view that commercial paper was inherently safe, for reasons that were related to its short term nature and the limits of its marketability. Yet, through innovation, the market for commercial paper was fundamentally transformed in ways that undermined that view completely.

“Commercial paper” by itself is a promissory note used to secure short-term loans (that is, loans due in less than 270 days). The loan is not secured by underlying collateral. Investors are willing to buy it on the strength of the issuer’s reputation, buttressed by a good credit rating from a recognized credit rating agency. For this reason commercial paper has typically been issued only by banks or large financial institutions, where default is very unlikely. “Asset Backed Commercial Paper” (ABCP) is a similar promissory note but one that is also secured by collateral. In the event that an ABCP issuer cannot honor the ABCP when it comes due, the investor may lay claim to the underlying assets. In the years leading up to the crisis in 2007, ABCP was issued by banks and other large financial institutions, as well as some non-bank parties.

Under Canadian securities laws, ABCP could be distributed under an exemption from the disclosure and regulatory requirements that otherwise would have applied to securities distributions to the public (CSA, NI 45-106). The rationale for the exemption was that ABCP was a very safe investment with a very low risk of default. That view in turn was based on a series of assumptions that would have been entirely reasonable in an earlier era: first, the only issuers that would be able to market commercial paper successfully would be very sound and reputable institutions, because no one would buy unsecured IOUs from anyone else. (Working from this assumption, the fact that ABCP was secured by assets presumably helped compensate for any additional risk.) Second, the risks associated with commercial paper were lower because the paper would mature and the investor would be paid back in 270 days or less. The likelihood that a reputable institution would suffer a default event within such a short time window was very small. Third, as a condition of the exemption, the commercial paper had received an acceptable rating from an

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24 Proposed amendments to this provision aimed to limit this exemption but to date have not been enacted. See British Columbia Securities Commission 2011.
approved, arm’s length credit rating agency. Finally, like the rest of the exempt market, product sold under the commercial paper exemption would only be marketed to sophisticated institutional investors. Individual “retail” investors, who needed the protection that a prospectus (the mandatory disclosure document associated with distributions of securities) would have offered because they could not do their own research, would not even be buying ABCP.

In fact, each of these assumptions was flawed and reflected expectations about the financial markets that were no longer accurate. First, the fact that ABCP was marketable did not mean that it was safe. There was no relationship between the soundness of the financial institution offering the ABCP and the assets underlying the ABCP, which could often be of very poor quality. In particular, ABCP assets included high risk credit-default swaps (CDSs), including those on securitized American subprime mortgages. Moreover, financial institutions used ABCP to avoid capital adequacy requirements designed to ensure the institutions’ solvency: they moved long term credit obligations, such as mortgages, off their own balance sheets and into the ABCP conduit. Nevertheless ABCP was highly marketable, especially internationally, because it offered higher returns during an era of low interest rates. Second, the short 270 day window for the commercial paper was irrelevant. ABCP functioned more like a highly-leveraged liquidity fund than like old-fashioned commercial paper. ABCP issuers had to obtain a continuing stream of investors into ABCP in order to pay off the holders of maturing ABCP, in a never-ending cycle of “rollovers”. The ABCP issuer’s solvency completely depended on there always being a larger market for ABCP. Third, the credit rating agencies were not the zealous independent assessors they were thought to be, at least in the United States. Fourth, purchasers of ABCP were not always sophisticated investors, because purchasers did not always purchase on their own behalves. Thousands of retail investors also found themselves invested in ABCP. (Individuals’ pensions and savings were also affected when their pension and investment funds participated, although those funds were professionally managed.)

The market for ABCP in Canada froze completely in September 2007, after it had become clear that some ABCP (no one entirely knew how much) was exposed to the increasingly-toxic US subprime mortgage market. Once worried investors stopped

27 In the United States, the credit rating agencies were ineffective right up to the onset of the financial crisis, and their independence seems to have been compromised (Lowenstein 2008; Partnoy 1999). The story in Canada is different from the American one. In Canada, the Dominion Bond Rating Service (DBRS) imposed more stringent liquidity arrangements on some ABCP products in January 2007 and thereby seemingly hastened the moment of reckoning.
buying ABCP, ABCP issuers could not pay note holders whose maturing ABCP notes were coming due. Retail investors disproportionately held frozen ABCP at that stage, since savvier institutional investors had been rushing to dispose of their ABCP holdings in the weeks leading up to the market freeze. At that stage, as with the use of the commercial paper exemption in the first place, the gap between the opportunities perceived and seized by sophisticated actors, and the expectations of the regulators and retail investors around them, was clear.

In spite of these links between regulatory scholarship and sedimentary innovation, regulation scholars still lack a comprehensive picture of what sedimentary innovation looks like, and how as a phenomenon it may affect regulatory structure and strategy.

**Not a predictable or rational, easily modeled process**

Examples like the Lac Mégantic disaster or the ABCP Crisis in Canada show how impetui from multiple different arenas – increased oil prices plus political pressure not to build pipelines; or the development of structured financial products and a new banking model, plus a global “savings glut” and low interest rates, plus a looming mortgage crisis next door – can together accrete into a new set of practices or conditions on the ground, which profoundly influence the conditions with which regulation must grapple. Sedimentary innovation is a multifactorial phenomenon. What is more, the process by which sedimentary innovation accretes is an evolutionary, contingent, imperfect one that bears little resemblance to the clear, linear, goal-oriented innovative process we sometimes imagine.

Sedimentary innovation can be marked by a process of ‘bricolage’. In the financial context, Engelen et al. suggest that the idea of bricolage “has a double relevance to the process of financial innovation because it both describes the result of innovation, which in recent conjunctures has become a series of fragile long chains and it also characterizes the activity of innovation by the bricoleur at one nodal point in a

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28 Greenwood 2011.

29 Claude Lévi Strauss coined the term bricolage in its current usage. Claude Lévi Strauss, *The Savage Mind*, 11 (1962). The bricoleur is someone who works with his or her hands. What distinguishes bricoleurs from other craftspeople or engineers is that while they are skilled in many diverse tasks, their projects are not dependent on the availability of particular materials or tools. In Lévi Strauss’s words, id. at 11, *His universe of instruments is closed and the rules of his game are always to make do with ‘whatever is at hand’, that is to say with a set of tools and materials which is always finite and is also heterogeneous because what it contains bears no relation to the current project, or indeed to any particular project, but is the contingent result of all the occasions there have been to renew or enrich the stock or to maintain it with the remains of previous constructions or destructions. The set of the ‘bricoleur’s’ means… is to be defined only by its potential use or… because the elements are collected or retained on the principle that ‘they may always come in handy’.*
chain.” The fragile long chains of innovation they describe are the product of financial intermediaries fashioning retail-ready financial products out of the wholesale material available, rent-seeking at each “conjuncture” along the way. It is also bricolage at each discrete nodal point, since “financial innovation does not correspond one-on-one with specific knowledge or technology”. Engelen et al. challenge the dominant accounts of financial innovation “in mainstream finance, social studies of finance and Marxist political economy which, all in different ways, argue or imply that science (represented by finance theory) or some other form of rationality (like class interest calculation) either is financial innovation or drives financial innovation”. Instead, they argue, bricolage undertaken under changing, unstable circumstances will produce, inherently, unstable long chain innovations.

The examples below of the impact of network effects, geography and diffusion, and the influence of financial market incentives illustrate the point that sedimentary innovation proceeds in unpredictable and multiple ways in the context of financial innovation.

**Impact of network effects**

Robert Merton once described what he called the “financial innovation spiral effect” – the knock-on financial innovations and collateral agreements that are spawned by a particularly generative financial innovation. [CHECK exact argument: generally, a financial innovation can become standardized. Thereafter, bilateral agreements and other arrangements that are based on the now-standardized innovation can emerge, ostensibly further fine-tuning the allocation of risk between willing parties.] The spiral effect adds complexity and unpredictability to the path of financial innovation, and that complexity is multiplied by the complex, varied and interconnected nature of the financial system that deploys those financial instruments. The financial system is a complex network of institutions such as domestic banks, overseas banks, central banks, insurance companies and investment firms, and they are linked together in multiple ways: through transactions, through products and services, through markets, and through the financial infrastructure of clearing, settlement, and trade depository functions. Increasing mergers and acquisitions have turned regional banks into global ones. The complex network characterizing the financial sector also means that certain hubs – or “global systemically important

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financial institutions” – need increased protection/scrutiny to prevent failure of the system. However, networks can gain purchase at several different levels, as described below. With regard to sedimentary innovation in the financial context, the relevant point is that networks are complex pathways through which innovation proceeds, and accumulates. Network analysis is still a developing approach, and this means that our understanding of how sedimentary innovation progresses is also still partial at best.

**Networks as Institutional Phenomenon**

In the period following the financial crisis, network analysis based on computer simulations has begun to provide new insight into global financial interconnectedness and how such networks can or cannot absorb stress. Minoiu & Reyes (2013) analyzed cross-border lending in 184 countries from 1978-2009. They find a relatively unstable network, notably a high degree of volatility in interconnectedness rankings by borrower nations in the periphery of the network. The core of the network, the lending countries (France, Germany, Switzerland, UK, Japan, US) remain relatively stable. They also find connectivity falls during financial crises, with the recent crisis being an especially large perturbation (though in fact they did not find that pre-crisis connectivity was especially high).  

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Markose et al. (2012) modeled the CDS market, finding J.P. Morgan to be the most dominant bank in the network (followed by European banks and then other US banks like Goldman Sachs and Citibank).³⁵

Social networks and social geography

Within networks, geography – including social geography and cognitive geography – influences how innovative ideas diffuse, and how they evolve through diffusion.

In some cases, physical geography may affect economic activity. One example of this is in the context of small island economies, which Hampton & Christensen argue are locked-in to dependence on offshore finance and have become tax havens.³⁶ The rate of diffusion of financial innovations (e.g. electronic banking technology like ATMs, debit cards, direct deposits) can also depend heavily on the demographics of the market (e.g., education, race/ethnicity, age).³⁷ Even despite heavy supply-side pressure to adopt innovations, demand-side can be resistant to adopting innovations in certain contexts.

But perhaps the most interesting aspect of the social geography of financial innovation, when considering innovation as a regulatory challenge, is “supply side” social networks as influencing the incremental development, diffusion and evolution of new technology, products and practices. Writing from a sociological perspective,

Donald MacKenzie describes the famous 1998 downfall of the hedge fund, Long-Term Capital Management (LCTM) in social network terms. Salomon Brothers, headed by John Meriwether, reputedly “the most talented bond trader of his generation”, developed LCTM’s, with Nobel laureate partners Robert Merton and Myron Scholes. The fund was so successful that other investors starting imitating it, creating a “superportfolio” of overlapping arbitrage positions. Network effects such as these tend to create homogeneity – this decreases the stability of the entire system, and can for example, increase contagion effects.

What may have been especially important in the globalization of securitization is what we might call “cognitive geography”, or even the geography of professional social hierarchy: the sense that innovations diffuse out from knowledge or practice cores, much in the way that Boaventura de Sousa Santos describes “focal objects” in his analogy of law to cartography. De Sousa Santos refers to the distortions that are unavoidable aspects of map-making as projection. Depending on the purpose to which a map is put, a cartographer will compromise as to how to distort the globe, for example choosing to depict distance accurately at the expense of area. Projection and distortion happen outward from a focal object determined by the context surrounding the creation of that particular map. De Sousa Santos applies the concept of “focal objects” to law and argues that the legal accounts that are created with a particular focal object at their center will be distorted in various ways when moving out from that point. Financial innovation, too, seemingly rippled outward from core financial centres in a way that demonstrated the intellectual and reputational sway of centres like London and New York.

On explaining how local/regional crises turned into a global one, Roger Lee expresses surprise at:

> the geographical spread of the CDO market from New York to London, and then on to continental Europe (‘contra’ home bias and the historical significance of local markets). At that distance, decisions appear to have been made on the ‘reputations’ of offering banks, the claimed superior innovativeness of Anglo-American markets and the rumour-mill of actions taken by competing banks in other jurisdictions. Whereas institutions involved in currency trading have

had to develop rigorous checks on cross-market positions on a 24/7/365 basis, this type of discipline was apparently not applied to participation in exotic products.  

Lee states that by taking on the known and unknown risks associated with the CDO market, institutions effectively were gambling on the stability of the Anglo-American markets. These institutions “joined (perhaps unwittingly) the leverage applied to those markets by agents who stood most to gain, at least in the short-term from the leverage game.”

Of course, social geography also means that the crisis imposed a differential effect on the poor. Where unemployment rose in the US and UK, levels of malnutrition and even death can be expected to rise in the poorest parts of the global economy. As Minouche Shafik, the permanent Secretary of the UK’s Department for International Development, noted:

> those consequences are far more severe, frankly than anything we will experience as a result of this crisis... And this crisis is unfolding in poor countries more slowly more quietly and perhaps a bit less dramatically—it’s because the families who are having to cut back on the quality of food they eat are poor and isolated and in rural areas and so we don’t see them on the front page of the Financial Times or the Wall Street Journal but that doesn’t make the effect any less real.

The nature of the market and the first mover advantage

In considering the innovative trajectory of private, for-profit actors – particularly from a regulatory standpoint, by comparison to regulation of other sectors – the nature of the market in question is relevant. In finance, an important aspect of the market is the benefit it confers on “first movers”.

An older study by Tufano found that first-to-market was beneficial in terms of lowering costs and gaining market share. However, in a more recent study Lopez &

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44 *Current Affairs* (BBC Radio 4 broadcast, Mar. 19, 2009)  

Roberts⁴⁶ found that lead-time (the time between when the pioneering firm enters the market and when the next firm enters) is actually a better predictor of market share than the order of market entry. In fact, between the three innovations they studied (pension funds, credit cards, debit cards), they found that pioneer firms in the latter two of them failed to gain any long-term market advantage. They conclude that there are advantages to early-entry generally, but being the pioneering firm may only be advantageous if a firm can establish a long lead-time before a competitor imitates. What remains true is that, once imitation begins, profitability falls sharply off.

Tufano estimates that replicating a financial product may cost 50–75% less than the innovator’s original investment.⁴⁷ In the case of financial services in the U.S., the Securities and Exchange Commission (SEC) in many cases forces “inventors” to disclose some degree of information about the products they create. Because first mover advantage dissipates quickly in financial services, pressure to keep ahead of imitators is keen. Engelen puts it more colourfully than most:

*In the absence of a general system of property rights in financial innovation, novelty and rapid upscaling are critical because doing the same thing year after year brings in imitators and encourages commodification which reduces first-mover high profits for the institution and high bonuses for the individual. While newness in itself is no guarantee of success, novelty matters within each conjuncture. This incidentally also limits collective memory and respect for older, established members among intermediary groups. More exactly, what matters is scalable differentiation because the high margins on financial innovation are generally taken early in the product cycle. In a world where profit arithmetically equals margins times volume, the intermediaries of the financial sector (just like big pharmaceutical firms) need not have striking originality but can instead pursue differentiation and mass sales through a succession of blockbusters. The last conjuncture’s blockbuster was securitization in the wholesale markets which spawned umpteen differentiations that could be scaled up, generating large volume and fees, above all because they connected with retail feedstock from mass saving and borrowing.*⁴⁸

In this way, the nature of the market, and its incentives to continue to reverse-engineer and tweak existing innovations, actually operates in tandem with the tightly knit, homogeneous social geography of the “bright lot” operating in finance to produce endemic herding behavior. Even for ‘old school’ depository banks, more than 70 years before this financial crisis, John Maynard Keynes famously observed

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that “[a] ‘sound’ banker, alas! is not one who foresees danger and avoids it, but one who, when he is ruined, is ruined in a conventional and orthodox way along with his fellows, so that no one can really blame him.”49 While the drivers – particularly the profit advantage to be gained through leverage – were different in the contemporary investment banking context, a strikingly similar conformist sentiment was just as famously uttered by Chuck Prince, Citigroup CEO, in 2007. Dismissing concerns about liquidity in the credit-fuelled economy, he said, “[w]hen the music stops, in terms of liquidity, things will be complicated. But as long as the music is playing, you’ve got to get up and dance.”50

Peter Haiss also suggests that financial sector herding behaviour may have been one cause of the financial crisis.51 Where competitive pressure is high, banks seem to be especially likely to exhibit herding behavior. For example, it may be economically rational for the individual bank to evade capital requirements by offloading assets via credit derivatives and securitization, if a major competitor starts to do so. Systemic risk and failure cost, however, may rise, and the individual bank may even be aware of this, but still has incentives to follow those who do it. Common incentive systems (stock-capitalization driven bonus systems, short-term profit oriented “management by objective” scorecards etc.) reinforce that it is more acceptable to err with the crowd than to swim against the tide for the individual banker. Although bank regulation certainly is necessary to provide the public good of financial stability, too tight regulations may cause more cost by inducing herding behavior than what can be gained by more stability. In fact, economic risk does not disappear because of regulation, it is only shifted elsewhere, as banks herd in regulatory arbitrage.52

[SUM]

51 Peter Haiss, Bank Herding and Incentive Systems as Catalysts for the Financial Crisis, 7 The IUP Journal of Behavioral Finance 30 (2010).
52 Peter Haiss, Bank Herding and Incentive Systems as Catalysts for the Financial Crisis, 7 The IUP Journal of Behavioral Finance 32 (2010).
Sedimentary Innovation and Rent-Seeking

[tentative argument: that, relative to radical innovation, sedimentary innovation is more conducive to rent-seeking activities. Radical innovative contexts are characterized by too much uncertainty to allow participants to identify or take advantage of interstitial rent-seeking opportunities. Once there is more collective experience with a particular innovation, there is incentive to tweak it in marginal ways, or add another layer of parties or detail, in ways that might line market participants’ pockets. By contrast, radical innovations could tend to be “captured” by first movers, creating monopolistic or oligopolistic structures. These are distinct regulatory challenges that require distinct responses.]

How to make sense of sedimentary innovation as a regulatory and social challenge?

Humans’ familiar and predictable cognitive limitations take a particular form when it comes to sedimentary innovation

We probably all know, now, that as humans we are not terribly good decision makers under all conditions. Overall, we tend to read too much into things that make a forceful impression on us, particularly things with which we have personal experience, and we read too little into things that do not make such an impression.

Perhaps for this reason, when making inter-temporal choices, we tend to value the present more than the future.53 When calibrating the costs of low-probability, high-impact events – something else we struggle with – the temptation to discount low probability future events is considerable. Thanks to the availability heuristic, we tend to confuse (1) how easy it is to think of an example of something with (2) the probability it will occur (e.g. my friend had a heart attack, so heart attacks must be more common than I thought).54 Thanks to anchoring and adjustment, we judge probabilities by reference to pre-existing starting points, which may or may not be reasonable or even relevant to the question at hand. Nor are we especially numerate.


Anything above basic numeracy, like the complex probabilities that characterize risk, is challenging for most of us.\(^{55}\)

We tend to see what we want (or expect) to see. Confirmation bias, meaning the tendency to interpret evidence in a way that confirms one’s existing beliefs and expectations\(^{56}\), distorts our perception of risk and inhibits our ability to see the unexpected, including unexpected confluences or developments producing or arising from sedimentary innovation.\(^{57}\)

Particularly relevant to our ability to respond to sedimentary innovation, we do a poor job of registering more incremental phenomena. We are simply not wired to detect gradual change very well.\(^{58}\) In psychophysics, Weber’s Law says that humans’ ability to detect difference in the magnitude of a stimulus will depend on the difference’s proportionate magnitude in relation to the background situation. For example, while most people can hear a whispered voice in a quiet room, they may not notice someone shouting in their ear at a rock concert, if the shouting is not louder, by a certain minimum proportion, than the background rock concert noise.\(^{59}\) We acclimatize; we habituate; we become “change blind”. How we respond to risk will be a function of how much risk we were taking previously (as anyone who has traded a large mortgage in for a larger one knows). How much we register change, and innovation, will also be a function of how much change we are used to. Thus sedimentary innovation can escape notice and, absent a focusing event, we seem able to become accustomed to very high levels of risk so long as it accretes slowly.

We may also over-extrapolate from our own experience, and assume too much about what we do not know. For example, we may anchor our perception of risk to something that has proven not to be risky for us (statistics notwithstanding), or not risky at our particular scale. For example, one may think that a financial innovation that seemingly poses low-risk to the firm that developed it also poses low-risk to the entire sector collectively or to society generally. Or, because a past financial innovation has been low-risk, a newer and similar but in fact much riskier financial innovation may be judged to be lower-risk than it is, because it is only an adjustment to, and recognizable in the terms of, the earlier low-risk innovation.


On the other hand, we tend to jump to conclusions about significance when confronted with a striking event. As Rajeev Gowda says,

*in tandem with the availability heuristic, the use of the representativeness heuristic suggests that people can be readily persuaded that a few examples of unfortunate results are an adequate representation of a policy’s overall performance. Presenting a sequence of inferences which seem believable may persuade people towards such conclusions. This could lead to support for an unwarranted overhaul of the policy. The representativeness heuristic could also affect people’s willingness to support risk management policies, e.g., flood risk-reduction measures, if the adduced sequence of future events leading to such disasters does not seem believable.*

In the regulatory context, all of this means that (to the extent we think about regulation at all when things seem to be going fine), we are more likely to focus on striking “seismic” innovation as a regulatory challenge, even if we understand that sedimentary innovation is more common, and often more influential.

Our rationality is “bounded”. But beyond that, humans do not always even try to operate on a rational plane. We are also emotional beings, and our decision-making process can be influenced, or even dominated, by emotion. Fear and anxiety can be strong emotional drivers of regulation and risk-related decision-making. Consider the heavy regulatory burden imposed on nuclear power compared to conventional fossil fuels. As journalist William Saletan noted when writing on the Fukushima crisis, there have only been 31 direct fatalities from nuclear power in the last 40 years, but over 20,000 in the oil supply chain and 15,000 in the coal supply chain. The ratio of fatalities per unit of energy produced is 18 times greater for oil than for nuclear. But the fear of nuclear disaster provokes dread in a way that a steady drip-drip of conventional fatalities does not, and we regulate in response to our dread.

We also experience anxiety where we perceive something as unknown, and where we cannot (rightly or mistakenly) slot it into a pre-existing narrative. Therefore phenomena that seem new or different inspire more regulation than phenomena that

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seem like an extension from the familiar. How vivid the imagery associated with a bad event, and how far into the future it may occur, also influence its emotional valence. Sedimentary innovation is less unfamiliar and less emotionally evocative. In contrast to sea-urchin innovation, where risk is salient and people may over-estimate risk and over-regulate, when it comes to sedimentary innovation people may under-estimate risk and under-regulate.

This may be even more the case for financial risk, particularly because it tends to be counterbalanced by the glittering promise of financial return. Financial risk tends not to entail the same imagery as, for example, environmental risk. The TV-ready images of physical destruction, tar-covered shore birds or children being tested for radioactivity are absent. The emotional aspect may be one reason why environmental regulation is tighter than financial regulation.

This links to the status quo bias: given the choice, humans tend to prefer to maintain the status quo or to refrain from acting. The status quo and confirmation biases may make us unwilling to recognize, in the absence of a striking event, that facts on the ground have changed and demand a response. Coupled with the prospect theory – that we tend to value avoiding potential losses over having potential gains – these biases may help explain why regulators may be inclined to act aggressively ex post rather than comprehensively ex ante. Why change anything if there is no salient risk? Why “take the punch bowl away” when everyone is enjoying the party and nothing bad has happened?

**Sedimentary innovation generates epistemological problems and awareness problems**

One other cognitive bias hints at the larger epistemological problem that underlies sedimentary innovation as a regulatory challenge: the hindsight bias. The hindsight

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68 See William McChesney Martin, Chairman of the Federal Reserve from 1951 to 1970, in a speech to the New York Group of the Investment Bankers Association of America: “In the field of monetary and credit policy, precautionary action to prevent inflationary excesses is bound to have onerous effects – if it did not it would be ineffective and futile. Those who have the task of making such policy don’t expect you to applaud. The Federal Reserve, as one writer put it, after the recent increase in the discount rate, is in the position of the chaperone who has ordered the punch bowl removed just when the party was really warming up.” See William McChesney Martin, Speech (October 19, 1955), available at [http://fraser.stlouisfed.org/docs/historical/martin/martin55_1019.pdf](http://fraser.stlouisfed.org/docs/historical/martin/martin55_1019.pdf).
bias causes us to imagine, after viewing an outcome, that that outcome was always clear.\textsuperscript{69} The hindsight bias influences policy evaluation. As Gowda says,

\begin{quote}
When faced with negative outcomes, the hindsight bias may lead people to criticize the decisions leading to failure as if the negative outcome should have been foreseen as inevitable rather than merely probable. Closely related to the hindsight bias, the outcome bias leads people to judge the goodness of risk-related decisions on the basis of their outcomes....The hindsight and outcome biases could generate charges of incompetence or corruption to explain the failures of policies which may have failed by chance.\textsuperscript{70}
\end{quote}

These biases also make it simpler for us to conclude after the fact that we were mistaken ever to have run the risks we did. While, for example, we may honestly have imagined that we were willing to run the tiny risk of a tsunami destroying a major nuclear plant in central Japan, it feels quite impossible to sustain that view after a disaster has occurred. But the fact that the terrible thing happened does not mean that we had not measured the risk, and been willing to run it, earlier. Surely even now, we are running many risks (consider driving cars, or using pesticides, or anthropogenic climate change) in our daily lives. We could not function without running some risks. Our after-the-fact assessment of which risks have been worth running is heavily skewed by which risks actually came, perhaps just by chance, to pass.

The hindsight and outcome biases are a problem for policy analysis regardless of the subject matter or innovation in question. However, the particular way in which they manifest in regard to sedimentary innovation is that they impose \textit{ex post} a level of certainty that simply was not present \textit{ex ante}. They suggest not only that damage could and should have been avoided, but also that we can have more success in avoiding it next time. In other words, when it comes to sedimentary innovation, the hindsight bias blinds us to the persistence of uncertainty itself. Every effort to improve regulation and avoid future harms – including the one we are engaged in here – is based on the somewhat delusional idea that we can avoid regret later, if only we improve our risk management processes enough.

In fact, we are hampered by our inability to see, in the moment, precisely what is going on. Anticipating problems or identifying key turning points, in a complex world full of what economists call “noisy” signals, is extraordinarily difficult.\textsuperscript{71} Moreover, it is impossible to predict which of multiple possible or probable outcomes will actually come to pass. This is not necessarily (or not only) a function of our limited ability to

\textsuperscript{69} Scott A. Hawkins & Reid Hastie, \textit{Hindsight: Biased Judgments of Past Events After the Outcomes are Known}, 107 Psychological Bulletin 311 (1990).


\textsuperscript{71} Thomas S. Kuhn, \textit{The Structure of Scientific Revolutions} (1962).
think clearly, to separate the causal wheat from the epiphenomenal chaff. It is also a function of the complex nature of causation. So, while there is a behavioral component to the challenge of regulating, including regulating sedimentary innovation, it is also a more fundamental epistemological one.

What may be less immediately obvious is how fragile any such coherent explanation is bound to be. Though it is no less true of the radical innovation story, it is especially with respect to sedimentary innovation that we can see the contingency and subjectivity in the causal account. Like determining proximate cause in a complex tort situation, determining (or predicting) how technological change and sedimentary innovation will co-evolve is an indeterminate process. This chapter will consider what the sedimentary analogy – as an analytical lens, as well as potentially a description of some aspects of the change in question – contributes to our understanding of recent structured finance innovations and regulatory responses to them.

The causal account of the relationship between regulation and sedimentary innovation is a complex one. Understanding financial innovation as a form of sedimentary, rather than seismic, innovation may be more useful for diagnostic purposes and more congruent with more features of that innovation. It yields a different analysis of the problem at hand and generates different prescriptions for its resolution. At the same time, we need to be alive to the ways in which the sedimentary account cannot be more than partial and imperfect in its ex post explanations of a complex phenomenon.

**Sedimentary innovation and regulatory boundaries**

Another aspect of the phenomenon of sedimentary innovation is that in complex, multipart systems, sometimes very consequential events happen in the interstices between existing regulatory regimes, or regulatory moments, or regulatory objects. Each component of regulation may focus on the “main effect”, from its vantage point, and miss developments in the cracks in between. The anchoring effect of existing regulatory structures makes us harder to see interstitial phenomena with the colour and depth that more central objects have.

Entities operate within a complex factual and regulatory matrix with layers of rules. Regulators may not see the connections of how public and private regulations interact, or how transnational and domestic regulations interact. Transnational governance does not overpower domestic legal regimes, but rather intersects with domestic and customary systems to generate elaborate combinations of regulations.

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Even leaving aside the impact of complexities such as private ordering and transnational regimes, it seems difficult to coordinate formal regulatory regimes.\(^{74}\)

Moreover, interactions may not be obvious because different regulators may interact in unanticipated ways. Consider the relationship between capital adequacy and the mortgage market. Presumably the size and robustness of the subprime mortgage market was not the main concern of the Recourse Rule in the United States, which allowed financial institutions to keep only one fifth as much capital on hand to cover triple-A rated mortgage-backed securities as for business and consumer loans.\(^{75}\)

Capital adequacy, not housing policy, was the Rule’s object. Similarly, in the US, 2005 amendments to the Chapter 11 Bankruptcy Code\(^{76}\) expanded the definitions of a “repurchase agreement” (a “repo” agreement) to include mortgage loans, and interest on mortgage loans.\(^{77}\) These amendments had the effect of facilitating the expansion of short-term repo financing. However, as Stephen Lubben writes, they had other effects that could be seen to have contributed to the financial crisis, including the Canadian ABCP Crisis alluded to earlier.\(^{78}\) As Mark Roe points out, Chapter 11 essentially subsidized derivative financial activity with bankruptcy benefits, thus increasing the use of derivatives and reducing market discipline.\(^{79}\) Of course, neither derivative financial activity nor housing and mortgage policy was the Bankruptcy Code’s concern. The same is true of the relationship between capital adequacy rules and macroeconomics – they interacted in unexpected ways. See e.g., Erik Gerding, “Credit Derivatives, Leverage, and Financial Regulation's Missing Macroeconomic Dimension” shows that macroeconomic policy (inflation policy, money supply, fiscal policy etc.) is actually affected by things like bank leverage ratios, because they are procyclical so pump more money into the economy in good times and pull money out in bad – without the regulator doing anything.

It is difficult in the abstract to do enough systematic comparison of the interactions between different regulatory regimes or strategies, and this is a problem that exacerbates and is exacerbated by sedimentary innovation. Coordination failures between regulators is a familiar problem, not limited to the innovation context, but it is also a problem that is particularly relevant to the regulatory challenge that sedimentary innovation presents.

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\(^{75}\) Jeffrey Friedman & Vladimir Kraus, *Engineering the Financial Crisis* 2 (2011).


Sedimentary innovation and avoiding regulation

As noted in prior chapters, necessity is not always the mother of invention. Opportunity – including competitive advantage – can generate a lot of innovation. In seeking competitive advantage through innovation, clear opportunities exist for innovators that can “read down” a regulatory requirement that hampers their ability to compete or to make maximum use of their resources. Incentives to innovate thus arise when people identify a potential regulatory loophole. Examples of this can be seen in the repo market, off balance sheet transactions and ABCP.

The Turner Review famously pointed out that innovation very often was undertaken for the purpose of avoiding regulation, rather than to increase efficient allocation of capital. The sometime tendency of regulators to view innovation as beneficial, and to great humility about their ability to challenge it, imposed blinkers on their view of the purposes to which innovation was being put. As Martin Wolf has said, “an enormous part of what banks did in the early part of this decade-the off-balance-sheet vehicles, the derivatives and the ‘shadow banking system’ itself—was to find a way round regulation.” Financial engineers have been called “loophole exploiters” or “outlaws” because of their knack for seeking out and profiting from regulatory openings.

Sedimentary innovation and regulatory strategies

Bright line rules’ rigidity in the face of incremental innovation practically guarantees that they will be out of step almost by the time they are promulgated. [More – cite back to chapter 2] The response has been flexible regulation as described in Part I of this book. If an agreement on principles is actually masking not only a public, but also a regulatory incapacity to understand or work with the details of regulatory implementation – as was the case in the United Kingdom around principles-based prudential regulation, or in the US around the CSE Program – then the regulator will simply have ceded the regulatory field to private actors. The difference between what Ayres and Braithwaite call “enforced self-regulation,” and outright deregulation, lies in that gap. It matters very much what back-end processes are in

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81 Martin Wolf, Comment, Reform of Regulation has to Start by Altering Incentives, FIN. TIMES, June 23, 2009, at 11
83 Financial Services Authority Internal Audit Division 2008
84 SEC 2008
85 Ian Ayres and John Braithwaite, Responsive Regulation: Transcending the 80s (1992)
place, exactly, through which indeterminacy will be resolved. Sedimentary innovation is precisely the kind of problem that can undermine regulatory structures, flexible and otherwise.

Moreover, flexible regulatory structures can actually \textit{increase} the speed and prevalence of sedimentary innovation. As chapter 4 explains, a reflexive relationship exists between innovation-framing regulation and innovation itself. This is exemplified in the Basel II capital adequacy structures and principles-based account supervision practices discussed there. The link between innovation-framing regulatory structure and innovation has been identified elsewhere.

Moreover, the precise framing of regulatory strategy may not be well situated to deal with sedimentary innovation in particular. For example, speaking about risk-based regulation, Black and Baldwin write that “[i]n [RBR], the tendency is for regulators' gaze to be drawn to their highest risks and for regulators to be encouraged to pull back resources from lower risks.”\textsuperscript{86} They look at the strategies regulators use to manage conduct/conditions that are low risk individually but where the risks can aggregate to significant levels. Sedimentary innovation may never “trip the alarm” of a risk-based system. Black and Baldwin’s article points to the substrate of regulation, where \textit{risk} is perhaps not the operative concern. Where actuarial risks are lower, political and sociocultural risks are also lower – even though regulation still needs to operate. Sedimentary innovation, too, can appear innocuous to a risk-based regulator until it has progressed very far down the road, and – because it develops incrementally, through the actions of multiple parties and in response to multiple stimuli – by which time it is very difficult to unwind.

Other assumptions underpinning a regulatory regime can also be misplaced. Consider the ABCP story in Canada: it suggests that a regulatory regime that rests heavily on market discipline to police the boundaries of a regulatory exemption, and underestimates private innovation’s capacity to push those boundaries, will fail. More fundamentally, the ABCP example demonstrates how regulatory design can be based on expectations about the other forces that would provide “backstops” to keep what was essentially self-regulation robust, while permitting change and innovation. The marketability of commercial paper was expected to set a built-in limit on its riskiness, and the regulatory design substantially underestimated the potential impact of sedimentary innovation to erode that backstop.

Also flawed, in the Canadian ABCP regime (but surely elsewhere too) was the assumption underpinning the regulatory design, that the regulatory moment was the

crucial one – that is, that one could develop a robust and stable regulatory exemption that could establish a stable, predictable and effective regulatory exemption. In fact, the spaces before and behind formal regulation proved to be at least as important to regulatory outcomes, because of the fact of sedimentary innovation occurring around the regulatory moment. In the Canadian ABCP Crisis, asset-backed instruments created by bankers were pushed through a disclosure exemption in securities regulation – a space that was never intended to make risky products available to retail investors. The technical work that underpinned ABCP was both consequential and antecedent to the regulatory moment, but the regulatory structure was effectively oblivious to it. Nor did it contain any capacity to register the consequential and subsequent changes to market environment, or the changed nature of commercial paper, let alone to evaluate it in any meaningful fashion.

More central to present purposes, structural gaps can also be the product of attempts to manage change through regulatory tool choice. There is a reflexive relationship between regulation, and innovation. Looking at regulation from the perspective of the innovator’s perspective helps us to identify the weak spots, tools, and competitive opportunities embedded in the regulatory structure. The gaps can be a product of the porous nature of innovation-framing regulation – for example, the gap around regulatory risk analysis which was left to be filled by financial institutions’ proprietary risk modeling software. On the other hand, in places such as the securities law exemption for safe investments that opened the path for the ABCP Crisis in Canada, the gaps were the product of the opposite problem – of overly rigid legal or insufficiently context-sensitive forms being used, through unanticipated financial innovation, in ways never intended.\(^87\) As difficult a task as it may be, developing viable regulatory responses to extensive and continuous private sector innovation requires careful attention to these interactions, and an appreciation for just how much regulatory structure interacts with and is affected by private sector innovation within its bounds.

**Potential Regulatory Responses**

In terms of potential regulatory responses, at the simplest possible level is the recognition that loopholes and disconnects will be exploited. *Innovation presents a clear and persistent risk – perhaps the most significant and underanalyzed risk – to regulation itself.* In

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\(^87\) Beyond this paper’s scope, the corporate share itself also has been disassembled through the use of options and swaps, in ways that separate share ownership from economic stake. The result has been the new phenomenon of “empty voting” and “vote buying” that has fundamentally undermined corporate accountability and the market for corporate control (Hu and Black 2006)
order to improve regulation vis-à-vis sedimentary innovation, we can improve on the information we have about how sedimentary innovation permits loopholes and disconnects to be exploited. Better harmonization and collaboration between financial regulatory regimes domestically and transnationally (including around accounting rules, prudential regulation, bankruptcy and living wills) would also help reduce opportunities for regulatory arbitrage. Andrew Mullineux notes that while there does not appear to have been extensive exploitation of domestic regulatory arbitrage in the USA between overlapping regulators, there was some of it. Peter Haiss further suggests there needs to be macroprudential regulation and more supervision to incentives banks face on the regulatory side, as well as proper reward systems and structured decision making on the banking side, to limit herding behavior.

All of this, however, is familiar ground. While useful, these suggestions do not respond to the question of how better to understand sedimentary innovation and its effect; nor do they address the epistemological and awareness problems described above.

There is no regulatory silver bullet. Sedimentary innovation operates like sedimentary layers themselves: it fills available spaces no matter how those spaces came to be. Nevertheless, promising options to try to augment regulatory capacity to track and respond to sedimentary innovation may include:

1. Building in “institutional contrarians”, a devil’s advocate role, into the decision-making process. “Regulatory contrarians” are defined by 3 features: 1) they are in a position of persuasive authority with access to media and officials, 2) they are affiliated with a regulatory entity but independent, and 3) they study the regulatory process to suggest improvements and point out flaws. Models include the ombudsman contrarian, consumer representative contrarian, investigative contrarian, and research contrarian. In the monitorship context, the addition of “institutional contrarians” could include more open and participatory regimes and recruitment of skills-based rather than reputation-based monitors to engage more diverse voices in order to resist groupthink. A diversity of voices operating within a regulatory

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90 Peter Haiss, Bank Herding and Incentive Systems as Catalysts for the Financial Crisis, 7 The IUP Journal of Behavioral Finance 50 (2010).


structure, combined with an affirmative structural role for alternative views in the
decision making context, may help increase the chances that sedimentary innovation
will be identified and responded to in a timely and well-calibrated manner.

2. Designing “nudging” mechanisms to compensate for predictable human biases.
   This is a “libertarian paternalism” approach that argues for creating choice
   architectures that favour a socially desirable response.93 However, there can be
   questions regarding infringement of autonomy and legitimacy when these nudges are
   implemented covertly.94 Relatedly, we need to understand what drives sedimentary
   innovation – self interest and competitive pressures. This means that incentive-based
   enforced self-regulation will have different effects depending on context
   
   • Kathryn Judge suggests we should be allocating resources away from
     what banks already have incentives to self-regulate (e.g. individual risk
     taking), and into areas where banks and society do not face the same
     incentives (e.g. to promote long term system stability), or to help
     promote the efficacy of interbank discipline (e.g. enforcing disclosure
     regimes).95
   • Consider also principles-based regulation & the incentive of banks to
     innovate around (a) new products for sale versus (b) compliance
     practices designed to keep up with the risks generated by those products.

3. Recognizing that for sedimentary innovation, diffusion and herd behavior based on
   social networks can be just as problematic, in the aggregate, as “too big to fail” or
   “too interconnected to fail”. [See also Erik Gerding blog post, The Conglomerate,
   Nov 12 2012.] Risk-based regulation based on easily tracked matrices, like threshold asset
   size, misses this. It requires a separate analytical frame.

4. Developing a much more fine-grained understanding of the mundane daily
   architectural decisions that structure decision-making. Annelise Riles argues that
   global financial governance is “a set of routinized but highly compartmentalized
   knowledge practices, many of which have a technical legal character.”96 Thus,
   understanding legal knowledge, knowledge that is especially resilient to crises but
   often left on the margins, is important in providing more effective financial
   governance. Identifying how mundane tools (like boring old commercial paper)

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94 Gideon Felsen et al., *Decisional Enhancement and Autonomy: Public Attitudes Toward Overt and Covert Nudges*, 8 Judgment and
change their purposes through sedimentary innovation could help us track those developments.

5. Treating systems as networks and focusing on hubs, as you would in network analysis, rather than on specific instruments. In the shadow banking system, this would mean regulating investment banks. In addition, increasing interconnectedness between banks may improve interbank discipline. Other banks are increasingly penalizing banks taking excessive risks. However, a bank may also see rewards in changing its risk profile to increase the probability it will be bailed out rather than allowed to fail – something that is socially costly.

6. Alternatively, regulation could focus on breaking connections, like systemic risk management tries to do, or putting ‘sand in the gears’ of risk transmission processes.

- See 2009 FSB report to the G-20 on systemic risk; also the huge amount of work done since then by the BIS, FSB, IOSCO identifying the factors that contribute to systemic risk and the data gaps relative to what we have now.
- Markose et al. (2012), who modeled the CDS market above, suggest that a tax should be placed based on the centrality of the banks in the network to mitigate systematic risk (a “super-spreader” tax).
- Using an engineering based approach, Schwarz suggests regulators should implement modularity – by closing off some components and only allowing these areas to interact in certain ways, to repair the component before the entire system fails. For example,

[a] market liquidity provider would... [provide] functional “modularity” to limit the consequences of financial-market failure by directly investing in securities of panicked markets. Financial markets rely critically on the supply of liquidity in the form of credit. If a failure deprives a particular market of liquidity, a market liquidity provider can restore liquidity before that market collapses and endangers other financial markets.


7. Building better institutional analytic capacity, to identify behavioral cascades earlier and to track “creep” in industry assumptions or standard practices over time.

- Research on the kinds of metrics we need – e.g., SEC’s new office of Risk Assessment
- Now FSOC’s Office of Financial Research (OFR): The OFR’s 2013 Annual Report states that its research mission is that it: “(1) monitors and develop metrics for reporting on potential threats to financial stability, while continuing to improve our understanding of how the financial system evolves in providing basic services; (2) assesses the causes and consequences of financial instability; (3) evaluates regulatory policies and risk management practices, particularly stress tests; and (4) contributes to improvements in the scope and quality of data used for financial stability monitoring”. 102
- Girardi & Ergün (2013) present multivariate GARCH estimation of CoVaR as an effective manner of monitoring systemic risk. 103 Value-at-Risk (VaR) is used widely by financial institutions to measure risk, however it is lacking in that it only considers an institution in isolation. Conditional Value-at-Risk (CoVaR) improves on this as it is able to capture risk spillovers by examining the VaR of institution \(i\) (or the financial system) conditional on institution \(j\) (or the financial system) being in financial distress. The use of the multivariate GARCH estimation allows us to incorporate changes over time into the measurement of the linkages between institutions \(j\) and \(i\).

8. Improving on pragmatic “muddling through”104 by building better incremental learning-by-monitoring structures as envisioned by experimentalist and new governance advocates.105

- Taking a problem solving approach, Felin & Zenger categorize innovations based on the type of problem they are designed to solve (e.g., high/low

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102 For commentary on the OFR’s activities see e.g.: http://economix.blogs.nytimes.com/2014/01/30/the-disappointing-office-of-financial-research/?_php=true&_type=blogs&_r=0; http://www.rooseveltinstitute.org/%5Bmenu-trail-parents-raw%5D/great-expectations-office-financial-research


complexity, high/low hidden knowledge), and identify different forms of governance (e.g. community, partnerships, hierarchies). When there is a mismatch, it leads to excessive costs and problematic incentives. Therefore, regulators and managers should be aware of what kind of innovation they are dealing with and implement the appropriate governance mechanism.106

• We should recognize the limits of data … (Sunstein presentation at Hebrew U?) – also the limits of temporality, and the difficulty of seeing ‘outside the bubble’ while in it. Ford 2011 Wisc L Rev

• Whitehead advocates a “Goldilocks Approach”: “a better approach to new financial risk regulation is to introduce it in stages-what I refer to as the "Goldilocks approach." Regulators should be authorized to phase-in or forego additional regulation over time as it becomes clear, through experience, what the likely impact will be.” (Charles Whitehead, The Goldilocks Approach: Financial Risk and Staged Regulation, 97 Cornell L Rev 1267, 1273 (2012))

Each of these options, and combinations of them, may make sense as responses to sedimentary innovation. The challenge will be to develop regulatory capacity and to implement these measures in a much more thorough and effective way than has been attempted so far, recognizing just how important it is to recognize innovation itself as a regulatory challenge.

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