

Financial Entropy and the Optimality of Over-Regulation

by

Alan S. Blinder, Princeton University

Griswold Center for Economic Policy Studies

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I. Preview

One frequently hears, often as a complaint, about the financial regulatory “pendulum” swinging too far in one direction or the other—from excessively tight regulation to excessively lax, and vice-versa. My concern in this paper is precisely with those swings. I will argue that, in fact, they may be optimal. Rather than searching for some sort of long-run equilibrium in which the marginal costs and marginal benefits of financial regulation are equated, we should expect a never-ending game of cat-and-mouse between the industry and its regulators in which first one side and then the other gains the upper hand—in a kind of cyclical equilibrium.¹

In true Minskyan fashion,² a period of financial tranquility—not to mention an asset price boom—begets regulatory complacency and deregulation as the industry, trumpeting its wondrous successes and ignoring its excesses, makes inroads against supervision and regulation. That regulatory laxity, however, hastens the inevitable crash, which brings harsher regulation in its wake—maybe even over-regulation. Both the tighter regulation and market participants’ newfound attention to risk combine to create a far safer financial environment in which financial ructions become rare—for a while. Then the whole cycle repeats.

In this sort of world, the conceptual objective of policymakers should not be to move the financial system from a “bad equilibrium” to a “good equilibrium,” as economic models often assume, but rather to push the process, on average, in a positive direction. Because of what I will call “financial entropy,” doing so will require periods of “over-regulation.”

All this will be made more concrete and specific in Sections IV and V below. Then I will breathe life into the conceptual framework by applying it to several current issues in financial regulation in Section VI. But to set the stage, let’s briefly consider why we have a financial industry and why we regulate it in the first place.

¹ I am hardly the first person to make such an observation. See, for example, Aizenman (2011) and, in less detail, Tirole (2014).

² See, for example, Minsky (1986).

II. Why do we have finance? Why do we regulate it?

While an exhaustive list would be lengthy, I think a financial system should serve four main purposes:

The first, though very important, will play no role in this paper: creating, developing, and running cheap, efficient, and reliable payment mechanisms for financial transactions of all sorts—including, of course, cross-border transactions. The common metaphor “financial plumbing” offers an appropriate image of how messy things can get if such mechanisms break down.

The other three purposes, which will be my focus here, pertain to *mismatches* of some sort:

Intermediation: Financial markets and financial institutions intermediate between savers and investors or, as I prefer to put it, between lenders and borrowers.³ Over any period of time, some economic units (households, business firms, governments,...) have more funds coming in than going out; they want to be lenders. Other units have, or want to have, more funds going out than coming in; they may want to be borrowers. Financial markets and institutions help such prospective lenders and borrowers “meet” to settle on prices, quantities, and other terms.

Maturity transformation: Such intermediation often involves maturity transformation because of mismatch between the two parties’ desired contract lengths. The classic example, of course, is a bank, which borrows short from its depositors (the ultimate lenders, who want short-maturity assets) and lends long to its loan customers (the ultimate borrowers, who want longer-maturity liabilities). In such cases, the bank becomes the counterparty to each transaction, e.g., providing borrowers with long-term financing and lenders with short-term saving vehicles. In so doing, it exposes itself to maturity mismatch in the opposite direction. While this observation is trite, I repeat it here because I have often heard it claimed that financial intermediaries should *not* engage in maturity transformation; it’s too dangerous. On the contrary, maturity transformation is one of the core functions of finance. The trick is to do it safely, which may involve e.g., moderation and/or hedging.

³ Not all lenders are savers, and not all borrowers are investors. In the lender-saver classification, equity providers count as “lenders.”

Stores of value: A third, closely related, mismatch involves moving value through time. The period of time may be short, as when a household wants to smooth consumption relative to a lumpy schedule of paychecks (weekly, monthly,...) Or it may be long, as when a worker wants to save for retirement. Naturally, different sorts of financial institutions and/or financial instruments have arisen to bridge gaps of different length (compare checking accounts with term life insurance). Once again, the financial firm takes the opposite side of each transaction: absorbing funds when customers want to invest them, and returning funds when customers want to cash out. Activities like that can pose risks of illiquidity (or even of insolvency) to some financial institutions (e.g., bank runs) but not to others (e.g., withdrawals from a mutual fund). It depends, among other things, on the nature of the instrument.

As long as all parties are well informed and there is sufficient competition—two big and important *ifs*—free markets should be able to handle all three of these mismatches well. So why, then, is finance so heavily regulated in virtually all societies? I group the answers into four broad categories:⁴

1. *To protect borrowers and lenders:* The two big *ifs* mentioned above must be vigorously protected; otherwise sophisticated parties will fleece the unsophisticated and/or monopolists will reap huge rents. This is familiar territory, hardly unique to finance.

2. *To protect taxpayers:* For many reasons, virtually every country provides some sort of government safety net to backstop (parts of) its financial system. Deposit insurance and the lender-of-last-resort function of central banks may be the most familiar examples, but there are others. Such a safety net tacitly turns the taxpayer into the “counterparty of last resort.” And since most taxpayers have limited means and play no role in financial transactions that go awry, they must be protected by their government—perhaps by regulations that limit their exposure. So, for example, we have safety and soundness regulations designed to limit claims on the deposit insurance fund, orderly resolution procedures (such as least-cost resolution) to minimize taxpayer liability, Bagehot-

⁴ Notice that “to protect banks” does not make the list. The justification of the much-maligned “too big to fail” (TBTf) doctrine is to protect the financial system and the economy

like principles that take most of the risk out of central bank emergency lending, and various mechanisms designed to limit moral hazard.⁵

3. *To limit financial instability:* Moving closer now to the macroeconomic concerns on which I will concentrate, history amply demonstrates that financial instability can impose substantial spillover costs on third parties. Some of these costs take the form of extreme volatility in asset prices, that is, bubbles and crashes. Other costs arise when, e.g., the failure of markets and/or institutions threatens the financial plumbing. Perhaps the most worrisome spillovers stem from contagion from one institution (or one market, or one country) to others, whether or not that contagion has a sound, rational basis. Each of these provides a rationale for financial regulation.

4. *To reduce macroeconomic instability:* The spillovers from extremely adverse financial events—crashes, runs, failures, etc.—are rarely if ever confined to the financial sector. They typically infect the real economy, sometimes seriously. Furthermore, financial-sector problems and macroeconomic problems often interact in vicious cycles. For example, when a banking crisis causes a recession, many “good loans” turn into “bad loans,” thereby exacerbating the banking crisis—which in turn wreaks further havoc on the real economy.⁶ Knowing that these kinds of risks and interactions exist, a government may want to regulate its financial sector to make it safer—even if such regulations cause microeconomic inefficiencies.

III. The big tradeoff: Less mean for less variance

That last point is central. It is probably generically true that regulations limiting dangers to taxpayers and to the macroeconomy impose microeconomic costs in terms of both static and dynamic inefficiencies. Put somewhat too simply, financial regulations (a) distort decisionmaking in financial markets, thereby giving rise to conventional deadweight losses, and (b) dull, or some cases eliminate, incentives to innovate, thereby potentially reducing the economy-wide rate of technical progress. Given the wonders of compounding, the dynamic costs are likely to dwarf the static costs—

⁵ Critics will note that there are also rules and regulations that *exacerbate* moral hazard. Fair point.

⁶ This is the idea behind the “financial accelerator.” See, for example, Bernanke, Gertler, and Gilchrist (1999).

eventually. So the big tradeoff in financial regulation is about how much to limit innovation in order to keep the financial system safer and the economy more stable.

Formally, we can imagine a social planner solving a dynamic optimization problem something like this: Think of real GDP at some future date, Y_t , as a stochastic variable from today's viewpoint.⁷ Many factors will influence the probability distribution of Y_t . But if the government toughens regulations between now and then, the mean of Y_t will probably be lower (which is bad) while the variance will probably also be lower (which is good). Conversely, if the government is less regulatory, both $E(Y_t)$ and $\text{Var}(Y_t)$ will probably be higher. There is in principle an optimal level of—or, more likely, an optimal time path for—financial regulation. That's the *static efficiency* part of the story, which is what most economic models are designed to study.

Here is a prominent recent example. In 2010, the Bank for International Settlements (BIS) established a Model Assessment Group to estimate the effects of higher Basel III bank capital requirements on real GDP in 16 countries plus the Eurozone. The main channel through which higher capital charges reduce GDP in these models runs from higher lending rates to reduced lending volumes to lower economic activity. In total, the group's technicians used nearly 100 models to estimate these effects in different countries. Naturally, the models did not all agree. The BIS (2010b, p. 2) summarized the results as follows:

“...bringing the global common equity capital ratio to a level that would meet the agreed minimum and the capital conservation buffer [under Basel III] would result in a maximum decline in GDP, relative to baseline forecasts, of 0.22%, which would occur after 35 quarters. This is then followed by a recovery in GDP towards the baseline.”⁸

That's about 2.5 basis points off the growth rate for about nine years (the Basel standards are phased in very slowly) before the effects start to dissipate.

To what should that be compared? Measuring the *gains* from greater macroeconomic stability is more elusive, but it is hard to imagine they could be worth *less* than 2.5 basis points of GDP growth per year. Indeed, a wide range of estimates from the BIS expert group (BIS, 2010a, pp. 8-20)

⁷ Y_t could easily be a vector.

⁸ These estimates include cross-border spillover effects.

suggested that they are *far greater* than this—especially if some of the crisis-induced output losses are permanent. James Tobin’s famous quip that it takes a lot of Harberger triangles to fill an Okun gap is apposite here because the macroeconomic damage from financial instability can be large. For example, by the time the United States returns to full employment, the cumulative effects of the Great Recession could top 50% of a year’s GDP; and in many other countries, the ultimate losses will be far larger.⁹ Tobin was not thinking about Okun gaps anywhere near that large.

Moving from the macro to the micro, it is worth mentioning that most of the risks from financial instability *to individuals* are undiversifiable and uninsurable. If my bank fails, the FDIC protects me from loss up to an account balance of \$250,000; and I may be able to obtain insurance for larger amounts.¹⁰ But if hundreds of banks fail all over the country, and the economy tanks as a result, no insurance policy will protect me or my business from the losses from recession.¹¹ Such losses are highly correlated across individuals and firms, making it unlikely that there are enough winners from recessions to make a private market in recession insurance viable. (The government might be able to do better, but that’s an issue for a different paper.)

Let’s now turn from *static* inefficiencies to *dynamic* efficiencies—things that can affect *growth rates*. Total factor productivity (TFP) growth is one main reason why $E(Y_t)$ grows over time, and financial innovation is presumably one of the many factors behind overall TFP growth. If we could parse out the contribution of financial innovation to TFP growth and then estimate the marginal (presumably negative) effects of more regulation on financial innovation—two tall orders—we could estimate the toll financial regulation takes on growth. (The variance-reducing effects of financial regulation would constitute the benefits, as before.) Such dynamic inefficiencies could be much larger—eventually—than the static inefficiencies just discussed. Plainly, however, measuring such effects in general is an impossible task owing, among other things, to the huge range and

⁹ The U.S. figure is based on CBO estimates of potential GDP. Haldane (2010) estimates a *minimum* loss of *global* output of 90% of a year’s GDP.

¹⁰ Disclosure: I am a part owner of a company, Promontory Interfinancial Network, involved in such a business.

¹¹ Despite the best efforts of Bob Shiller. See, for example, Shiller (2012).

heterogeneity of possible financial innovations—which are limited only by the imaginations of inventors (and financial market participants have proven themselves to be highly imaginative).

At least two other major considerations favor regulation over *laissez faire*. One is the question of whether the innovations stifled by financial regulation are really *valuable*. Economists are accustomed to thinking of *all* innovations as valuable. After all, inventions raise TFP, don't they? Or at least raise people's utility by providing new products. But is that always, or even usually, true of *financial* innovations? You don't have to go all the way to the Volcker extreme to recognize that many financial innovations are designed for regulatory arbitrage (example: off-balance sheet SIVs) or to enable clever financiers to pick the pockets of unwary and unsophisticated customers (example: opaque OTC derivatives).¹² These are social *gains*? If financial regulation succeeds in reducing regulatory arbitrage, deception, and rent-seeking behavior, are we to count the implied "distortions" of free-market behavior as costs? I don't think so.

Second, remember that the bases of all those Harberger triangles are *reductions in quantities*. Are we so sure that shrinking the financial industry is a bad thing *per se*? Thomas Philippon's pathbreaking work on the size of the industry should at least give us pause. Philippon (2012, 2013) estimates that the share of the financial industry in U.S. GDP has risen almost steadily from World War II to 2010, from about 3% to about 8%. Both price and quantity grew, and he estimates that the per-unit cost of financial intermediation did not decline despite impressive innovation, massive investments in IT, and claims of huge economies of scale? Seems odd.

Philippon's research thus paints a picture of (these are *not* his words) a bloated, rent-seeking, inefficient, and overpaid financial industry that is focused much more on churning assets than on any of the important purposes outlined earlier in this paper. If so, the case that shrinking the industry would be harmful to society seems weak.

One final and important point: I have been talking about *shrinking* the financial industry. But is that what tighter regulations really do? Perhaps. But some regulations clearly *shift* human resources

¹² Paul Volcker (2009) famously quipped that "the most important financial innovation I've seen in the last 25 years is the automatic teller machine."

and assets out of the regulated sector (e.g., banks and broker-dealers) and into the unregulated sector (e.g., hedge funds and other shadow banks)? If it's more the latter than the former, there is at least a case that overall financial risk might *increase* when regulations are tightened.¹³ But even in that case, *systemic* risk probably decreases because hedge funds are so much smaller than banks.

IV. The Financial Entropy Theorem

As if all this weren't complicated enough, I will now explain why even this characterization of the long-run tradeoff between financial innovation and safety is too simple. I begin with a "theorem" which I will first "prove" and then elaborate on via a series of examples:

THE FINANCIAL ENTROPY THEOREM: Financial regulations and their effectiveness tend to get weakened over time by (a) industry workarounds, (b) regulatory changes, and (c) legislative changes. The main exceptions come during and after financial crises or scandals, when public revulsion against financial excesses enables, perhaps even forces, a tightening of regulation.

The premises on which the entropy theorem is based are roughly as follows. I don't think any of them is even modestly controversial, although a few (e.g., the first two) may be truer in the United States and the United Kingdom than elsewhere.

Premise 1: The monetary rewards for successful producer activity in the financial sector are enormous, among the largest society has to offer prospective talent.

Premise 2: Because of these huge potential payoffs, the financial industry attracts an inordinate share of the nation's top brainpower and most innovative talent. People who pursue careers in finance are not just smarter than the average person, they are also more creative, more avaricious, and less risk-averse—maybe even risk-loving.

Premise 3: Because many financial regulations reduce the (actual or potential) profitability of financial firms, finding ways to innovate around regulatory roadblocks ("regulatory arbitrage") pays off handsomely.

¹³ See, for example, IMF (2014). But this is not so clear to me since, as I have emphasized, hedge funds operate with less leverage and (relatively) much more MOM ("my own money") than OPM ("other people's money"). See Blinder (2013), pp. 81–84. More on this later.

Premise 4: There is at least some truth to the regulatory capture theory, if not indeed to Stockholm syndrome. While the wheels of financial commerce are only rarely greased by bribery, and some regulators are truly tough, financial regulators often share the perspectives of the regulated industries—especially in good times, when nothing seems to be going wrong.¹⁴

Premise 5: Money talks in politics. Financiers have a lot of it and spend a lot on lobbying both the legislative and executive branches of government.

Premise 6: Major legislation is difficult to pass. So what has been legislated tends to stay on the books.¹⁵

Premise 7: Financial regulators do not have anything close to the independence that, say, most central banks enjoy in making monetary policy. In worst cases, financial regulators are under direct political control.

Premise 8: In normal times, politicians have little compunction about pressuring financial regulators to bend in the direction of the industry.

Premise 9: The principle exceptions to Premises 4-8 come immediately following a serious financial scandal or catastrophe. Then regulators stiffen their backs, politicians run away from financiers, and tightening regulation becomes much easier—if not obligatory.

If you grant these nine premises, the proof of the theorem follows easily. Start with any set of financial laws and regulations inherited from the past. Firms in the industry will virtually always perceive some of these regulations as wrong-headed interferences with commerce (Premise 3). Large firms with smart and highly-motivated workforces will rationally assign a cadre of talented and well-paid employees to find legal ways to circumvent such regulations, that is, to avoid the spirit of the law while adhering to its letter (Premises 1-3). Indeed, prodding from the top of the house might not even be necessary, as smart, ambitious employees will see the opportunities and go after them (Premises 2 and 3).

¹⁴ This is sometimes called *cognitive capture*.

¹⁵ This is the one premise that is highly American and applies less to other countries. It is not essential to my argument, though it helps. That said, the premise probably applies with even greater force to international agreements, which are extremely difficult to change.

Given the enormous complexities and ambiguities in financial laws and regulations, clever people will be able to find loopholes, gray areas, and other ways to get around regulations. Some of these workarounds may utilize new instruments created by financial engineering. Novel and even unknown risks may inhere in such instruments, but the “masters of the universe” involved in creating them will probably be long on self-confidence (after all, they are earning a fortune, right?—Premise 1) and short on both judgment and risk aversion (Premise 2). Besides, the rewards for successful regulatory arbitrage are palpable and immediate while the risks are conjectural and delayed. This establishes part (a) of the theorem.

By Premise 6, the governing statutes tend to remain unchanged for long periods of time. To the extent that these laws interfere with profit-making activities by financial firms (Premise 3), smart people working in these firms will have strong incentives to get (a) the laws, (b) the implementing regulations, and (c) the enforcement of those laws and regulations altered in their favor (Premises 1-3).

Changing legislation is the more difficult route (Premise 6), but it is certainly possible—except when the industry is held in disrepute (Premise 9). The influence of money will be terribly one-sided in most legislative battles (Premise 5) because of the usual interplay between concentrated gains and diffuse losses.¹⁶ And the natural path for politicians, other than those whose ideological predilections point strongly in the other direction, will be to “follow the money” (Premise 8). This establishes part (c) of the theorem.

Typically, however, it is easier to work on regulators than legislators (Premises 4, 7, and 8), so rational financial executives will concentrate on that (Premises 2 and 4), perhaps enlisting politicians to help them (Premises 5 and 8). Such political pressure can be effective (Premise 7), especially when regulators are predisposed toward sympathy with the industry’s concerns anyway (Premise 4).¹⁷ In normal times, there is little countervailing force pushing in the opposite direction since the issues tend to be obscure, the general public is rarely engaged with them, and regulators have

¹⁶ See, for example, Olson (1965).

¹⁷ This last clause takes no view on whether the industry’s desired changes are in the public interest or not.

minimal contacts with the general public, anyway. Hence virtually all the intellectual, financial, and political firepower pushes toward lighter, not heavier, regulation. That establishes part (b) of the theorem.

The big exception, of course, comes in the wake of financial scandals, market crashes, and other serious ructions, when the public, the politicians (perhaps fearing the public wrath), and the regulators (fearing congressional and embarrassed by their recent failures) all turn toward tougher regulation. In such times, the usual barriers to tighter regulation recede or disappear (Premise 9).

Let me illustrate how the financial entropy theorem works with a few examples.

Glass-Steagall: The Glass-Steagall Act (1935) arose out of the carnage of the Great Depression and the resulting anger at the financial industry, whose excesses were publicized by the Pecora hearings. It made many huge changes in law, including separating banking from investment banking.¹⁸ Thus crisis beget regulation.

In the 1960s and especially the 1970s, investment banks and other nonbank institutions started to figure out ways to poach business away from commercial banks. For example, checkable money market funds resembled bank accounts (albeit uninsured ones) and commercial paper substituted for bank loans to major corporations. Some broker-dealers actually opened (or bought) banks. Seeing their franchise values imperiled, commercial banks began to fight back in the 1970s and especially the 1980s, assisted by favorable regulatory rulings from the Federal Reserve and the Office of the Comptroller of the Currency (OCC).

The biggest steps came in 1987, when a series of Federal Reserve rulings allowed several large banks to establish and then expand “Section 20” subsidiaries to conduct activities normally associated with investment banking, such as underwriting and dealing in certain types of securities—despite the serious reservations of Fed Chairman Paul Volcker. After that, the Glass-Steagall wall began to erode and then eventually crumble via ever-more-permissive regulations. Congress finally

¹⁸ And also from insurance, but I’ll have nothing more to say about that.

repealed the Glass-Steagall separation entirely in 1999.¹⁹ But by then it was close to meaningless anyway.

Thus the Glass-Steagall story illustrates all three parts of the Financial Entropy Theorem: industry workarounds, loosening of regulations, and finally legislative repeal.

Interstate banking: Restrictions on the ability of banks to branch across state lines—or even to branch *within* states—had a long history in the United States, reflecting America’s traditional hostility to concentrated economic power. Two hundred years after Hamilton started the Bank of New York, even the largest U.S. banks, some of which operated in many countries, were still limited to a single state. In this instance, industry workarounds were ineffective for quite a while. One reason, of course, was that local banks often were happy to keep out potential competitors.

The ban on interstate banking finally began to break down, under both market and lobbying pressure, in the 1980s. In 1980, Maine was the only state that allowed out-of-state banks to acquire local banks. By 1990, 46 states allowed out-of-state banks into their markets, though a number imposed regional or other restrictions.²⁰ This unwieldy patchwork of state-by-state regulation was finally ended in 1994, when Congress abolished most restrictions on interstate banking as part of the Riegle-Neal Act.

So in this case, while sympathetic regulatory rulings certainly helped, deregulation was largely accomplished through legislation. But it took a long time.

Derivatives: Derivative instruments are the new guy on the banking block. Financial derivatives did not really blossom until the late 1980s and early 1990s; but then they grew like kudzu. Dealing in derivatives falls more within the natural domain of broker-dealers than of banks; but as noted above, most megabanks had large broker-dealer affiliates by the 1990s. In fact, just prior to the financial crisis, two of the biggest derivatives dealers were JP Morgan Chase and Citigroup.

¹⁹ This repeal, part of the Gramm-Leach Bliley Act, is often blamed for the financial crisis—falsely in my view. See Blinder (2013, pp. 266–267).

²⁰ See Mengle (1990), p. 3.

The history of regulating derivatives, if you want to call it that, is one of malign neglect. The 1990s saw several well-publicized “accidents” (to use a too-polite term) with derivatives—at Merrill Lynch, Bankers Trust, and Barings—followed by the Long-Term Capital Management calamity that almost brought down the world’s financial system in 1998. Yet derivatives remained unregulated despite increasingly desperate pleas from Brooksley Born, who then headed the Commodity Futures Trading Commission (CFTC).

Regulatory capture and extensive industry lobbying, it seems to me, go a long way toward explaining what amounted to a case of regulatory malfeasance. But, as if that weren’t enough, Congress chipped in with the odious Commodity Futures Modernization Act of 2000, which actually instructed regulators to keep their hands off derivatives. This horrific gap in the regulatory system was a major contributor to the worldwide financial crisis; and the gap was only partially closed by the Dodd-Frank Act (2010). (See below.) International negotiations over regulating derivatives have been going on—but maybe not going far—for years. It remains a struggle.²¹

V. The Optimality of Over-regulation

In discussing financial regulation, conservative economists, conservative politicians, and industry representatives often make the valid point that it is possible to *over-regulate* as well as to *under-regulate* the industry. And they offer the Dodd-Frank Act as an example of regulatory over-reach. Perhaps the financial system was under-regulated in the years leading up to the crisis, they may (or may not) concede, but it’s certainly over-regulated now.

I have my doubts that Dodd-Frank really swung the proverbial pendulum too far in the regulatory direction. But it would have been entirely rational to do so. The reason is an important corollary of the Financial Entropy Theorem:

THE OVER-REGULATION THEOREM: When major financial reforms are made, which is generally in the aftermath of a serious financial crisis, it is rational to make the new laws and corresponding regulations “too tough,” that is, to over-regulate the industry.

²¹ Among the many recent news stories that could be cited, see Miedema (2014) or Ackerman, Burne, and Dendrinou (2014).

The proof is almost immediate. Let $B(R_t)$ and $C(R_t)$ be, respectively, the benefits and costs of regulation, R_t , and let $B'(R^*)=C'(R^*)$ define the optimal degree of regulation, R^* .²² According to the Financial Entropy Theorem, R_t has a *systematic* downward drift. Suppose it also has a random component, e.g., $\Delta R_t = -\beta t + \varepsilon_t$, where ε_t is a zero-mean iid random variable and β is the time trend toward weaker regulation.²³ Over any time period of length T , the *expected* change in regulatory stringency is therefore $-\beta T$. Regulators know this. So, at the discrete intervals when regulations can be tightened, R should be set *above* R^* .

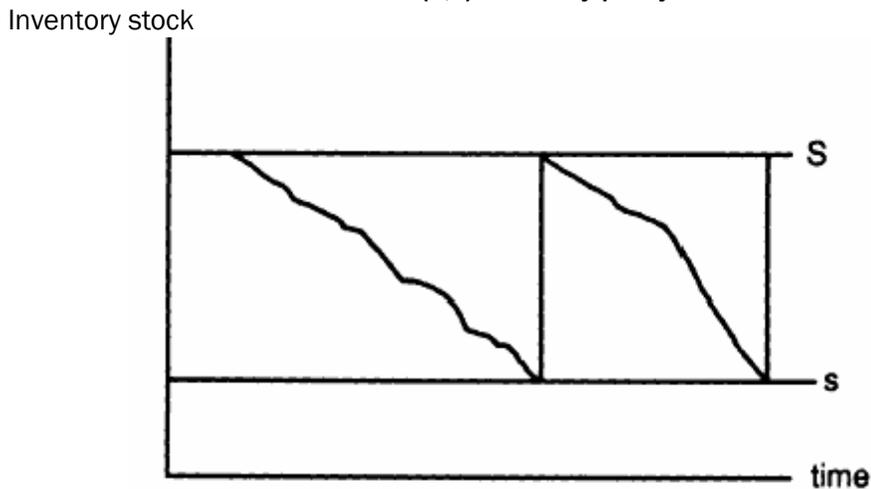
The reasoning here is similar to that behind the well-known (S,s) model of inventory management. In that canonical model, sales in each period (which deplete inventories) are stochastic. But because there is a fixed cost of re-ordering to replenish inventories, it is not optimal to maintain a fixed “optimal” inventory *stock* (analogous to holding $R=R^*$) at all times. Instead, the optimal inventory *policy* is defined by a lower bound, s , below which the inventory stock is not permitted to fall, and an optimal order size, $S-s$, which brings inventories back to S after each order. (See Figure 1.)²⁴ In some sense, an inventory stock of S is “too high” and an inventory stock of s is “too low.” But as long as the stock remains between S and s , it is optimal for the firm to allow inventories to drift downward stochastically.

²² R can be a vector instead of a scalar, and R^* will change over time if the functions $B(\cdot)$ and $C(\cdot)$ do. These complicate but do not change the argument.

²³ This particular stochastic process is by no means necessary; ΔR just has to have a negative mean. For example, it is plausible that the industry fights harder for deregulation when R is higher.

²⁴ In reality, R is multi-dimensional. Figure 1 is meant metaphorically.

Figure 1
The (S,s) inventory policy



In the regulatory application, politics, industry lobbying, and the inertia built into the American system of government combine to create a sizable fixed cost of achieving major regulatory change (Premises 5 and 6). So pro-regulation officials know they will have only sporadic opportunities to tighten regulation. Specifically, crises or scandals—which *do* happen, but at unpredictable moments—temporarily reduce the fixed costs of getting significant legislation passed or major regulations promulgated (Premise 9). They also know that regulation will almost certainly grow lighter during the intervals between such galvanizing events (that’s the Financial Entropy Theorem). So when a chance to raise R arises, it should be reset *above* R^* . A simple, but not mathematically accurate, way of thinking about the optimality of over-regulation is that it gets the degree of regulation “right on average” over time.

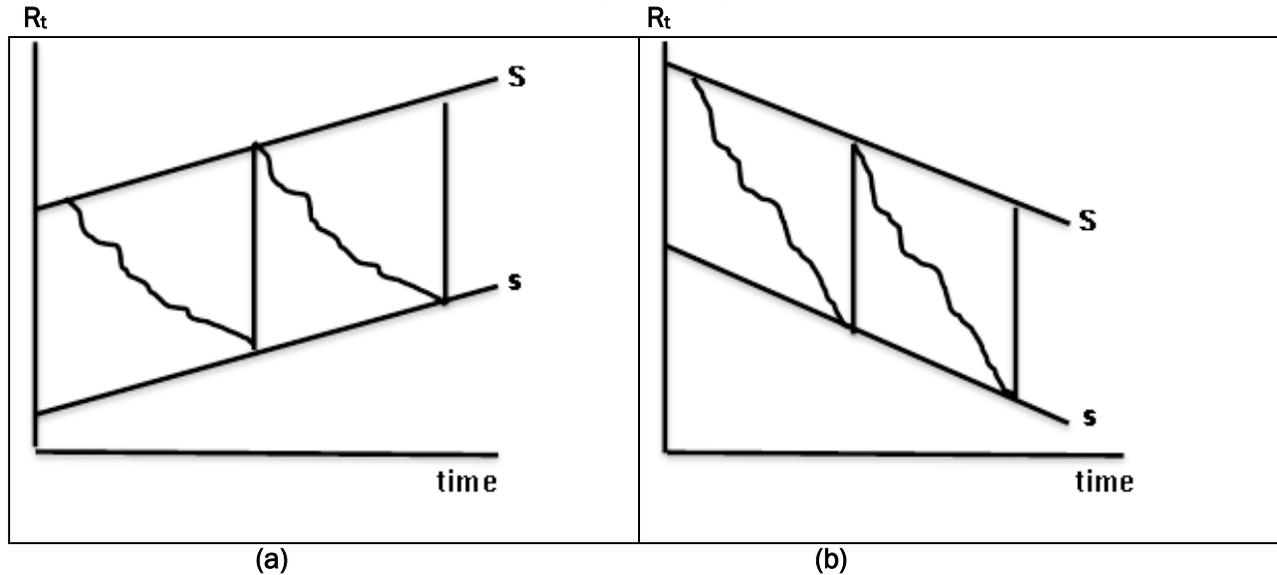
Two final points about the (S,s) analogy. First, unlike in the inventory case, changing laws and/or regulations imposes adjustment costs on firms in the industry. This fact should moderate regulatory changes.

Second, the standard (S,s) model delivers bounds, S and s , that are *constant* over time. But if the firm has a secular growth (or decline) trend in sales, both S and s will be rising (or falling) over time. One important question in the application of (S,s) reasoning to financial regulation is whether

the corridor in which R meanders is tilted upward (toward heavier regulation) or downward (toward lighter)—as indicated by the two panels of Figure 2.

The long-run tilt of the regulatory corridor has several major determinants. One is the pace of financial innovation and whether it produces more or less *complexity* over time. Somehow, the answer always seems to be “more,” which probably calls for more and more detailed regulations. But *more* regulation might not spell *tighter* regulation.

Figure 2
Secularly rising or falling regulation



Why not? Because financial regulators can never move as quickly as financial markets. When I was a bank regulator, I used to quip that our job was to stay one or two steps behind the markets.²⁵ We could never hope to be as nimble as the markets. But things got worrisome when we slipped four, five, or six steps behind. When the pace of financial innovation accelerates, for whatever reason, regulators will almost certainly fall further behind fast-moving market developments. So even if they write *more* regulations, or arch their eyebrows more often and more sternly, effective regulatory constraints on financial activity are likely to *loosen*, not tighten. Thus my suspicion—it is not more than that—is that the long-run regulatory corridor has a natural tendency to slope *downward* over time, as in Figure 2(b).

²⁵ The author was Vice Chairman of the Board of Governors of the Federal Reserve System in 1994–1996.

This natural tendency toward lighter regulation may be either mitigated or exacerbated by broad political forces. If a country's politics swings to the right, as in 2000, political and bureaucratic barriers to regulation will rise, thereby strengthening the tendency toward lighter regulation. If a country's politics swings to the left, as during the New Deal, those same barriers will be weakened and regulation will become tougher. Thus there may be political "long swings" in the degree of effective regulation. But if periods of right-leaning and left-leaning politics roughly balance out, the natural economic tendency toward lighter regulation will eventually win out. One interesting research question in political economy is what sorts of institutional arrangements might counteract this tendency.²⁶

VI. Appraising the Long-Run Effects of Some Recent Reforms²⁷

Let me now use the theorizing above to consider some recent financial regulatory reforms and speculate on how they might evolve over time.

VI.A Systemic risk regulation

One of the most shocking inadequacies revealed by the financial crisis was the absence, in most nations, of any regulator responsible for system-wide risk. Instead, the global norm was to confine regulators to "silos." In the United States, for example, bank regulators watched over the banks, securities regulators minded the security markets, basically no one monitored the derivatives markets, and so on. Indeed, the regulator for X often encountered a "stop sign" if it peered too closely into the Y business. Thus the newly-perceived need to control *systemic* risk called for new institutions that cut across regulatory silos.

In the U.S., the Dodd-Frank Act (2010) established the Financial Stability Oversight Council (FSOC), chaired by the Secretary of the Treasury and including all the financial regulators. Its purview is the entire financial system, and its remit is to focus on *systemic* risks. A new division of the Federal Reserve Board staff in Washington essentially provides staff support for the FSOC via the Chairman of the Fed, as does a new Office of Financial Research in the Treasury. A few months after Dodd-

²⁶ Aizenman (2011) takes a stab at this.

²⁷ This section borrows from Blinder (2014).

Frank passed, the EU created the European Systemic Risk Board (ESRB), chaired by the President of the ECB and staffed largely by ECB personnel. The UK established a new Financial Policy Committee (FPC) of the Bank of England, patterned on its Monetary Policy Committee (MPC), in 2013. (A predecessor had been in operation since 2011.) These and other agencies around the world are now at work.

Creating an institution with a *single focus*—in this case, systemic risk—is an important counterweight to the Financial Entropy Theorem. If the FSOC, ESRB, FPC, and others don't pay attention to emerging systemic risks, what else will they do? Nonetheless, a Minskyan view of the dynamic process suggests that enthusiasm for systemic regulation will wane over time. Whether support for these new agencies will fade, or even whether they will be weakened by politics, is a major question that only the passage of time will resolve. But there is reason to worry.

One predictable weakness of the FSOC, a committee composed of many regulators with disparate constituencies and interests, is apparent already: A particular industry may be able to use its (partially captured?) regulator to champion its interests against the FSOC. For example, the SEC dragged its feet over changes in the regulation of money market mutual funds that would reduce or eliminate their vulnerability to runs. And this despite the facts that (a) the vulnerability was apparent, (b) the presumably-powerful Federal Reserve was a vocal critic, and (c) such runs had actually happened in September 2008.

Finally, a note of irony here: To the extent that new systemic risk regulators around the world succeed in making major financial blowups less frequent, that will make the sporadic opportunities to strengthen regulation even more rare. The Financial Entropy Theorem and the Over-regulation Theorem will then become even more important.

VI.B Too-big-to-fail and resolution authority

Perhaps the biggest boost to post-crisis regulation came from the hatred—that is not too strong a word—of bank bailouts in all countries. The bailouts of 2008-2009 created a huge demand for ways to resolve what we now call systemically-important financial institutions (SIFIs) without

subjecting taxpayers to potentially huge costs—and without imperiling large parts of the financial system.²⁸

Did I say “resolve”? That’s the appropriate word in Europe, where work on the Single Resolution Mechanism (SRM) is progressing, albeit grudgingly. The rules have recently been agreed, but two nagging questions remain: Is the SRM target of a 55 billion euro fund enough? (Answer: No.) And where will the money come from? Given the number of countries involved and the absence of a Rawlsian veil of ignorance to mask their self-interests, it was predictable that funding would be the big stumbling block, Nations like Germany and Finland know they are far more likely to pay into the SRM than draw from it, while nations like Greece, Spain, and Portugal know they are more likely to be recipients than donors. How will German taxpayers like bailing out Greek banks? To ask the question is to answer it.

Since the United States is a single country, everyone knows where any bailout funds will come from. That said, Title II of Dodd-Frank calls for the creation of a new “orderly *liquidation* authority.” In 2009, the U.S. Treasury recommended that Congress give the authorities a choice between either *resolving* a sick SIFI or *liquidating* it. But Congress rejected that idea. There would be no more bailouts. Lest anyone miss the point, Section 214 of Dodd-Frank states unequivocally that “Taxpayers shall bear no losses from the exercise of any authority under this title,” and goes on to specify that any losses from a liquidation “shall be the responsibility of the financial sector, through assessments.” It is hard to imagine any future Congress loosening those strictures. (Imagine the vote!) So I doubt that this particular aspect of regulation will be weakened.

The Federal Deposit Insurance Corporation (FDIC) and the Bank of England have adopted the same concept for how to liquidate a large, complex financial institution.²⁹ The central idea is the Single Point of Entry. Under SPOE, a large financial holding company’s liabilities should be structured (e.g., with enough long-term unsecured debt) so the parent can absorb all the losses in a liquidation

²⁸ The different perspectives of experts versus the broad public on this matter are telling. The public cares (only?) about taxpayer expense; the experts care (mostly) about systemic risk.

²⁹ See FDIC & Bank of England (2012). For a good and thorough explanation and evaluation of the U.S. version of SPOE, see Bipartisan Policy Center (2013).

procedure, leaving the bank subsidiaries to carry on as usual—or as close to “as usual” as possible. In particular, bank depositors should not be “bailed in,” which runs counter to some past European practice (e.g., in Cyprus), but perhaps not to *future* practice.

The logic behind SPOE seems sound, even clever. But will it work in practice? Hopefully, we won’t get a definitive answer for a while because no SIFI will need to be liquidated. But I am concerned with, among other things, contagion via reputation. Suppose BigBancorp (the holding company) fails, grabbing headlines and imposing highly-publicized losses on its bondholders. Will other counterparties continue to do business-as-usual with BigBank (the subsidiary)? I have my doubts.

VI.C Higher capital requirements

When the financial crisis opened the door to stiffer regulations, one crying need was for more bank capital. Basel III came quickly (in 2010) and did improve upon Basel II by raising capital requirements for internationally-active banks and placing more emphasis on tangible common equity—what I like to call “real capital.” Another welcome change is that capital requirements will now be imposed on certain nonbank SIFIs.

But it’s mostly downhill from there. First, giving banks until 2019 to comply with the higher capital standard can only be called embarrassing.³⁰ Second, and perhaps even more astonishing, Basel III carries over the single worst regulatory innovation from Basel II: letting banks use their own internal models to measure risk. That this fox-guarding-the-chicken-coop provision survived the debacles of the 2000s is truly amazing. It must be one of the most egregious examples of regulatory capture ever. Third, Basel III continues to give rating agencies a central role in assigning risk weights to assets, despite their abysmal performance in the years leading up to the crisis—something Dodd Frank banned in the U.S.³¹

³⁰ Fortunately, many banks already exceed Basel III requirements. So this disgraceful error may not cause any problems.

³¹ The Basel Committee has approved the U.S.’s non-use of the rating agencies

The big non-debate, of course, is whether even Basel III sets banks' capital requirements too low. I call it a "non-debate" because there is little evidence that officials anywhere have given a second thought to imposing much higher capital requirements, despite academic protestations.³² The industry, of course, is portraying even the Basel III capital requirements as a threat to the foundations of capitalism.

Two concerns are most frequently raised in this regard. The first is that requiring banks to replace cheaper debt with more expensive equity in their capital structures will force lending rates higher. As noted in Section III, this is the regulatory cost that has garnered the most attention and the most attempts to estimate its magnitude, which looks small.³³

The second concern is that some financial activities will migrate out of comparatively well-regulated banks and into lightly-regulated or unregulated shadow banks. This worry has the ring of truth. But as counterweights, let's remember that many shadow banks, especially hedge funds, operate with far less leverage than banks—partly because they operate without a safety net and partly because the partners' own money is at risk.³⁴ Furthermore, if shadow banks grow large enough, they can be designated as SIFIs and subjected to bank-like regulation.

VI.D Restricting proprietary trading

Rightly or wrongly, many critics viewed proprietary trading by banks as among the leading causes of the financial crisis. So limits on proprietary trading became one focus of financial reform—on both sides of the Atlantic.³⁵ Three different, though related, approaches have now been adopted.

The United States included the so-called Volcker Rule, which forces proprietary trading out of FDIC-insured banks, in Dodd-Frank (2010). The UK's 2013 banking reform included the Vickers Commission's 2011 recommendation that only normal retail and commercial banking activities should be protected by the official safety net, leaving other financial activities—including trading, but

³² Most prominently from Admati and Hellwig (2013). That said, in September 2014 the Federal Reserve indicated it would propose capital requirements above Basel III levels on SIFIs. See Eavis (2014).

³³ According to the Miller-Modigliani theorem, changing the debt-equity mix should not change banks' weighted-average cost of capital at all—a point Admati and Hellwig (2013) emphasize.

³⁴ See again Blinder (2013), pp. 81–84.

³⁵ Japan seems not to have moved in this direction.

also other things—outside the “ring fence” that protects the retail bank.³⁶ In January 2014, the European Union adopted, after some modifications, the recommendation of an international group of experts headed by Bank of Finland Governor Erkki Liikanen that most trading be conducted in separate subsidiaries, rather than in the banks themselves.³⁷

The three approaches are first cousins, not siblings. All three aim to protect depositors and taxpayers from the consequences of trading losses. While Vickers and Liikanen keep trading under some sort of bank-regulatory regime (in a bank subsidiary), Volcker moves proprietary trading entirely out of banks (though with some exceptions, e.g., dealing in Treasuries and market-making activities). However, it is extremely difficult for regulators to distinguish between market-making and proprietary trading in practice. After all, the same trade could fall in either category depending on the bank’s other positions and the trader’s intent—which the trader knows, but the regulators don’t. This conundrum is one main reason why the UK gave up on the distinction and why it took U.S. regulators four years to agree on detailed regulations to implement Volcker. How they will work in practice remains to be seen.

While Volcker pushes bank holding companies (the American term) out of the trading business, Vickers keeps trading and other activities inside banking groups (the European term), but “ring fences” them away from core banking activities such as deposit-taking and commercial lending. Once implemented, UK taxpayers will be off the hook for any trading losses but potentially on the hook for, say, the consequences of outsized loan losses.

The Liikanen group also decided that distinguishing between market-making and proprietary trading was too difficult, so almost all trading should be segregated into separately-capitalized subsidiaries.³⁸ But the key word turned out to be “almost.” Liikanen made an exception for “hedged, client driven” transactions, which can remain in the bank. The EU’s final proposal (January 2014)

³⁶ Independent Commission on Banking (2011).

³⁷ High-level Expert Group on reforming the structure of the EU banking sector (2012)

³⁸ I have long advocated a Liikanen-like approach, but without the “almost” and with one important proviso: that the parent be prohibited from downstreaming capital to its trading sub to cover losses. See Blinder (2010). I first proposed this idea at a Federal Reserve conference in 2009. It was not popular!

defined “proprietary” as “for the sole purpose of making a profit for own account, and without any connection to actual or anticipated client activity or for the purpose of hedging the entity’s risk as a result of actual or anticipated client activity.”³⁹ Good luck making those distinctions.

How will these rules evolve over time? The financial entropy theorem makes a clear prediction: More and more trades will become “market-making” or “client-driven” or “hedged,” probably due to both regulatory interpretations and industry ingenuity. This promises to be a bigger problem for Volcker and Liikanen than for Vickers, which eschews such subtle distinctions.

VI.E Regulating derivatives

There is no doubt that wild and wooly derivatives played a major role in bringing on and propagating the financial carnage. The remedies seem clear enough, at least to me: Standardize derivatives and trade them on organized exchanges with price transparency, central clearing, and adequate collateral. Dodd-Frank pushes in this direction, but not hard enough. For example, by *volume* (though not by *riskiness*), most OTC derivatives are exempt from Dodd-Frank strictures. This was a clear lobbying victory for the industry.

Besides, Dodd-Frank governs only the United States. Europe in general seems way behind on pushing derivatives into safer trading environments—and more reluctant to do so. Indeed, many European authorities, not to mention the big banks, have been battling America’s CFTC, which has taken more aggressive positions for a long time. (More on this shortly.)

About eighteen months ago, *The New York Times* entitled an editorial on this subject, “Derivatives reform on the ropes.”⁴⁰ Since then, reform has taken a few more body blows. While disconcerting, these developments cannot be surprising given the enormous amount of money at stake. After all, banks that now earn a king’s ransom on some customized OTC derivatives would earn nickels and dimes on standardized, exchange-traded products. They don’t relish the prospect, and they let their regulators and legislators know that it no uncertain terms. Bank lobbying has been

³⁹ Mayer Brown (2014), p. 5.). The EU provision applies only to large banks and is not quite binding on member states.

⁴⁰ May 19, 2013.

pretty successful even while memories were fresh; the Financial Entropy Theorem predicts that lobbyists will succeed even more as memories fade.

VI.F Compensation incentives

In the popular debate, CEO compensation hogs the headlines. The sheer size of the bonuses that pliant corporate boards routinely bestow upon their chief executives seems obscene to many. In my view, however, these excessive pay packages are mainly matters of CEOs extracting rents from powerless shareholders. They rarely if ever pose systemic risks. If so, it's the shareholders who should try to block outrageous pay packages, not the government.⁴¹

Public policy should worry, instead, about the *incentives* embedded in the way *traders* are compensated. Before the crisis, it was common for banks, investment banks, and hedge funds to give traders what I call “go-for-broke” incentives. Winning bets made traders fabulously wealthy by awarding them a non-trivial share of the profits. On the other hand, if they lost the firm's money, their bonuses would vanish and they might (or might not) lose their jobs. But such losses were puny compared to the potential gains. Offering young, risk-loving traders such hugely asymmetric incentives was playing with fire. And we were all badly burned by excessive risk taking when the crisis broke—excessive, that is, relative to the best interests of either their superiors or their shareholders.⁴²

The post-crisis news here is relatively good, however. Substantial progress seems to have been made without much new regulation.⁴³ Many more businesses now realize that their previous compensation practices exposed them to outsized, even existential, risks. So their compensation packages now adjust for the amount of risk taken, include clawback provisions, make more payments in restricted stock, and embody other features that make traders and executives bear more of the downside risk. That should induce more caution.

⁴¹ In the United States, Dodd-Frank included the so-called say-on-pay provision, giving shareholders a nonbinding vote on CEO pay. These votes were negative in only about 3% of cases in 2012. See Krueger (2013).

⁴² One exception: If CEOs and other top executives share in the trading profits, then they inherit some of the skewed incentives of the traders.

⁴³ See Financial Stability Board (2011) and Board of Governors of the Federal Reserve System (2011).

The main driver of change here appears to have been the sobriety induced by the crisis, although regulatory authorities in a number of countries have taken useful actions by, for example, treating compensation incentives as part of a bank's risk-management system. Thus we might hope to defeat the Financial Entropy Theorem in this domain. But as a Minskyan, I still worry about what happens as financial activity proceeds without further blowups, as greed displaces fear, and as CEOs and boards forget what happened in 2008. Will the bad old practices return?

VI.G The need for international harmonization

The main motivation behind most of the activity in Basel since the 1980s is the (sensible) notion that *international* banking needs *international* rules. Uniformity across countries is one way to reduce opportunities for regulatory arbitrage.

But the importance of international harmonization varies greatly from one regulatory issue to another. Consider the issues dealt with in this section. It does *not* seem critical that different countries organize their systemic risk regulation in the same way (just do it!), restrict proprietary trading by banks in the same way (someone will do the trading anyway), or compensate traders in the same way (to each his own, as long as incentives are not crazy). The famous Basel accords, of course, have always concentrated on making capital standards in different countries (sort of) the same. This leaves two other regulatory issues where, it seems to me, the case for international harmonization is strong, but getting it done is difficult.

The first is the resolution of failing SIFIs, as the EU nations so clearly recognize in their Single Resolution Mechanism. Financial giants conduct huge volumes of business across national borders. They may have hundreds of subsidiaries, thousands of counterparties, and millions of existing contracts—perhaps spanning scores of countries. For such a global SIFI, life is international but death (or the prospect of death) is national. Bankruptcy laws and resolution procedures vary enormously across nations. If a global SIFI starts to fail, the resulting scramble for its remaining assets can lead to chaos, paralysis, legal uncertainty, endless lawsuits, and the like. Need I mention that the Lehman Brothers bankruptcy was chaotic—and is still in the courts?

While the *need* for harmonization is clear, how to get from here to there is not. I rather doubt that the rest of the world will adopt Dodd-Frank’s “orderly liquidation authority” since so many countries prefer resolution (and continued life) to liquidation.⁴⁴ But I also doubt that the United States will change its orderly *liquidation* procedure to make it consistent with the EU’s Single Resolution Mechanism. Remember, the U.S. Treasury wanted a resolution option, but Congress rejected it. So it appears that, the next time a global financial giant teeters on the brink of failure, world markets will have to deal with different resolution/liquidation regimes in different countries.⁴⁵

The regulation of derivatives also cries out for international homogenization. Unlike most of the instruments that underlie them (e.g., bonds, mortgages, forex,...), derivatives have no well-defined geographical home. A loan is booked in a bank. A bond is the liability of a corporation that is domiciled somewhere. But if an American calls his broker in New York, who trades a derivative in Singapore with a Japanese counterparty, and then debits or credits the funds to the customer’s account in London, which country’s regulations rule? With geography so arbitrary or even irrelevant, we can confidently predict that trading will migrate to the venues with the most lenient regulations (read: no regulations at all)—unless the major nations homogenize their rules.

So far, that has not happened. On the contrary, U.S. efforts (led by the CFTC) to impose a meaningful regulatory regime on OTC derivatives have run into stiff opposition—not only from the industry (which hears the death knell of capitalism sounding again!), but also from foreign authorities who complain (with some validity) about extraterritoriality. Just a few months ago, Bloomberg reported on successful efforts to escape U.S. regulations on derivatives trading in overseas affiliates of U.S. banks.⁴⁶

I am not optimistic about achieving international harmony in derivatives regulation. However, the task might be easier than harmonizing resolution regimes because, while the failure of a global SIFI is a rare event that might not occur again for years, accidents in the unregulated derivatives

⁴⁴ One of my favorite quotes from the financial crisis is from the anonymous European central banker who told journalist David Wessel (2009, p. 22), “We don’t let banks fail. We don’t even let dry cleaners fail.”

⁴⁵ One ray of sunshine: As mentioned, the US and the UK are adopting the same orderly liquidation regime.

⁴⁶ Brush (2014).

markets are almost certain to occur much more frequently. At some point, the world's governments might grasp the importance of agreeing on a global regulatory regime. It is even possible that, after suffering through a number of chaotic cross-border derivative disasters, the industry might come to welcome some regulatory clarity. At least we can hope. That said, the fact that even the biggest derivatives blowups in history (starting in August 2007) have not been enough to spur countries to act is sobering.

There is, however, one piece of good news about global harmonization: If and when an international agreement is painstakingly reached, it will be very hard to dismantle it via legislation or regulation. In that case, inertia will become regulation's friend.

VII. Summary

Financial markets are regulated for a number of (good) reasons. Chief among them is that financial instabilities spill over into the real economy, causing *macroeconomic* instability. While there are clearly other aspects to financial regulation, I characterize the "big tradeoff" as balancing the *net* benefits of innovation (netting out, e.g., harmful innovations) against those of living in a safer financial (and hence real) environment.

But even if such a rump optimum could somehow be achieved, it would not be an equilibrium state because of what I call *financial entropy*, that is, the natural tendency for both the stringency of regulations and enforcement to erode over time. I sketch a Minsky-type cycle of first lighter and then heavier regulation. In relatively placid times, financial entropy derives from industry workarounds (some of which are celebrated as "financial innovation"), from lighter-touch regulation and supervision, and from legislative changes that make life kinder and gentler for the industry. All these changes make it easier for financial excesses to build up during a boom—and they do. When the "bubble," or whatever it is, finally bursts, the government turns in a more regulatory direction and the lobbying power of the industry wanes. So, for a while, regulations tighten and tougher laws are passed. The tighter regulatory corset combines with prudence induced by the recent scare to

produce a safer financial environment for a while, few accidents happen, and the whole cycle repeats.

At the critical moments when regulations are tightened, it is rational for regulators and legislators to go “too far” because they know that whatever they do will be eroded over time. I call this result the *optimality of over-regulation*. But, of course, the over-regulation is transitory. If we imagine a scalar that indicates the tightness of regulation, it follows a path reminiscent of the (S,s) model of inventories—rising abruptly to a ceiling and then gradually sinking toward a floor.

In the regulatory cat-and-mouse game, financial innovation virtually always moves at a speed that regulators cannot match. Thus the regulators’ goal should not be keeping up with the industry. Rather, the sensible goal is not falling *too far* behind. This natural lag of regulation behind reality suggests a tendency toward lighter *effective* regulation in the long run.

I use this theoretical framework to speculate on the future prospects of several recent regulatory reforms, including systemic risk regulation, orderly liquidation or resolution, Basel III capital requirements, restrictions on proprietary trading by banks, regulating (or not) derivatives, and adjusting the pay incentives of traders. The news is mixed—after all, regulation has just recently jumped to the upper bound, S. But in every case, the Financial Entropy Theorem is lurking in the background.

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