Governing the Financial System

A Theory of Financial Resilience

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Abstract

We develop a theory of financial stability based on insights from the literature on polycentric governance and institutional resilience. We contend that top-down regulatory approaches to achieving financial stability will prove ineffective, due to various knowledge and incentive problems. In contrast, a polycentric banking system contains an evolved and mutually compatible set of overlapping rules that align incentives and generate knowledge, promoting financial stability. In short, bottom-up approaches to financial stability are institutionally resilient; top-down approaches are not. We conclude our analysis by framing our contribution in light of Nobel laureate E. Ostrom's "design principles" for robust governance institutions.

JEL codes: E42, E44, E58, G28, P16

Keywords: central banking, Elinor Ostrom, financial crisis, financial regulation, free banking, monocentric, polycentric, resilience

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1. Introduction

The 2007–2008 financial crisis has sparked a renewed discussion of ways to combat financial instability. Some argue that central banks should take a more active step, moving beyond monetary policy narrowly conceived to stewarding the health of the financial system. In addition, there is renewed interest in financial regulation by various governments' executive agencies, intended to complement the role of monetary authorities in taming financial turbulence.

The present approach for achieving financial stability is monocentric, as exemplified by the creation of the Financial Stability Oversight Council and the expanded powers of the Federal Reserve.[1] The most notable strand of literature that defends this approach focuses on the importance of "macroprudential" policy (e.g., Hanson, Kashyap, and Stein 2011; Galati and Moessner 2013; Engel 2015). Previous "microprudential" approaches to regulation focused on bank-specific characteristics, such as capital ratios. Macroprudential policy, in contrast, emphasizes the importance of stabilizing the financial system as a whole by granting regulatory organizations the authority to take direct action on variables linked to systemic risk (Bernanke 2011).

Macroprudential policy proposals have been criticized as unlikely to meet their goals as a result of being plagued by a host of information and incentive problems (Salter 2014a; Salter and Tarko 2017). Some key questions regarding these problems have received insufficient attention: Does the information necessary for regulatory solutions to financial instability exist in a form

[1] Although multiple organizations are responsible for financial oversight and governance, the system is monocentric as the final decision-making authority is neither fractured nor concurrent. We specify what the polycentric alternative looks like later in the paper.

that can be put to use by regulators? And do regulators and market actors have the necessary incentives to behave in a way conducive to stability?

To better understand the causes of financial stability (and instability), we build a theory of financial *resilience*. Resilience is a property of the institutions that govern social systems. Thus, financial resilience refers to the institutions that make a financial system stable. By "stability," we have in mind two properties of financial systems: their ability to minimize the likelihood of balance sheet shocks from causing systemic insolvency, and the ability to minimize the possibility of such balance sheet shocks in the first place. This broad definition is often the starting point in the various literatures that explore why some financial systems frequently are in danger of insolvency, and why others are not.[2] In this paper, we do not take a stand on which particular mechanisms link balance sheet shocks to financial instability. In our view, these mechanisms are themselves institutionally contingent, and thus the level of generality at which we can speak about them is limited. Instead, we focus on the supporting institutions governing financial systems,[3] as institutions are the ultimate determinants of whether the agents, private or public, possess the knowledge and incentives to reconcile private pursuits of profits with social well-being.

In contrast to standard macroprudential policy literature, we offer a *polycentric* conception of financial governance. A polycentric system of governance is composed of many decision centers, in which "each unit exercises considerable independence to make and enforce rules within a circumscribed domain of authority" (Ostrom 2005, 283). Theories of polycentric

[2] In many cases, the financial system as a whole is still solvent; it is only groups of banks that are insolvent. But given the difficulty of ascertaining which is the case in real time, and because the literature on financial crises makes reference to the insolvency of the financial system as a whole, we continue to use this definition over the course of our argument.

[3] Most of our discussion takes place within the immediate context of banking. But our framework really applies to the process of financial intermediation as a whole, which is why we use the phrase "financial system" instead of merely "banking system."

governance are most well known in the context of governing common-pool resources. These theories, most prominently advanced by economics Nobel laureate Elinor Ostrom (1990, 2005, 2010; see also Aligica and Boettke 2009), can also be applied to the governance of financial systems. Of particular interest is a subset of this literature concerned with the theory of "institutional resilience," that is, the theory of how polycentric systems evolve rules for coping with shocks while avoiding over-optimization problems (Costanza et al. 2001; Janssen, Anderies, and Ostrom 2004; Ostrom 2005, chap. 9; Young et al. 2006; Toonen 2010; Aligica and Tarko 2014). Important ideas regarding the institutional foundations of robust governance systems have yet to be applied to financial governance; as far as we are aware, we are the first to do so.[4,5]

Historically, laissez-faire or free banking systems seem the best real-world approximations of polycentric banking systems. Such systems are characterized by a multiplicity of banks, whose IOUs constitute the economy's (inside) money, and are subject only to the ordinary law of property, contract, torts, et cetera, as well as whatever voluntary governance arrangements that arise between banks. But free banking has a poor reputation in terms of stability (e.g., Solow 1982; Diamond and Dybvig 1983; Goodhart 1985, 1987; Monnet and Sanches 2015; Sanches 2015), although it still has its advocates (e.g., Selgin and White 1994a, 1994b; Selgin, Lastrapes, and White 2012). The theory of institutional resilience helps explain *under what conditions* a polycentric banking system can be expected to provide *greater* financial stability than the present monocentric approach.

[4] The closest related work is Salter and Tarko (2017), which explores whether polycentric banking systems can deliver aggregate demand stability.

[5] Whether financial stability is a public good or a common-pool resource is debatable. The case of common-pool resources is the more difficult one, but the theory of institutional resilience applies to all types of collective issues.

Advocates of top-down macroprudential regulation argue that laissez-faire financial systems are plagued by a host of information and incentive problems that, unless corrected by some governance mechanisms, would result in several market failures. But this argument, in itself, does *not* grant the desirability of top-down financial regulation. The costs created by top-down macroprudential policy could be greater than the problem it is trying to solve. Governance must indeed be provided, but government regulation is only one form of governance. We expand the space of institutional possibilities by exploring how different bottom-up banking and financial mechanisms can also operate. This broader comparative institutional analysis leads us to conclude that the endogenous governance of polycentric financial systems can indeed, under certain conditions, outperform government regulation.

Our contribution complements a growing literature whose authors are both skeptical of the performance of existing institutions before (e.g., Taylor 2007, 2009; Leijonhufvud 2009; Borio and Disyatat 2011; Calvo 2013; see also Cachanosky and Salter 2017, and the references therein) and after (e.g., Sumner 2011, 2012; Hetzel 2012; see also Sumner 2015) the financial crisis, as well as those who question the desirability of these institutions in general (Selgin, Lastrapes, and White 2012; Boettke and Smith 2013, 2015a, 2015b; Aguiar-Hicks, Hogan, and Smith 2015; Hogan 2015). A genuinely institutional perspective is necessary if meaningful progress is to be made to prevent future crises. Getting the "rules of the game" right at the various levels of social interaction, rather than continuously tinkering at the edges of an existing regulatory apparatus, offers the best chance of securing a financial system that is robustly governed while still promoting sustainable growth via efficient capital allocation.

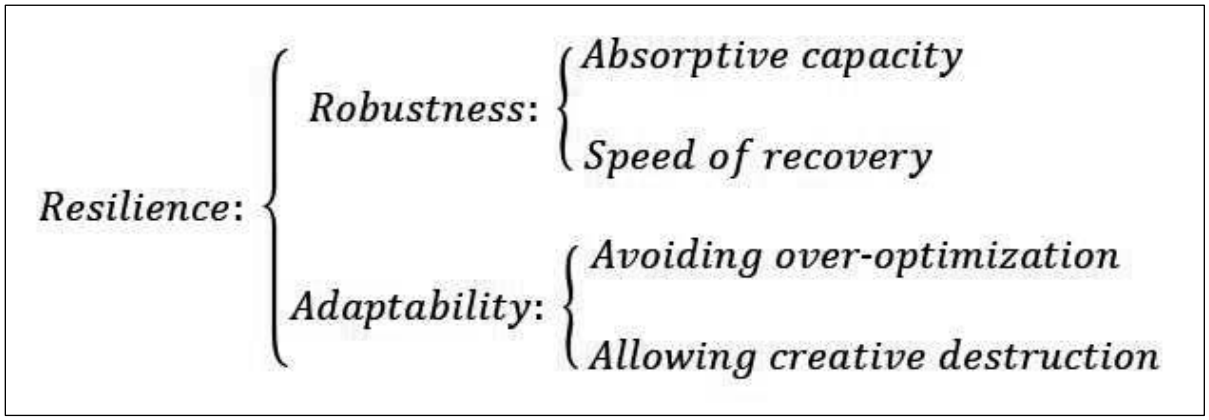
We organize the remainder of this paper as follows: Section 2 provides an overview of institutional resilience in general, to ground later analysis. Section 3 briefly recapitulates why

top-down regulatory solutions are unlikely to deliver financial stability. The section highlights the problems that must be overcome to prevent crises. Section 4 lays out the specific knowledge and incentive problems that need to be solved in the course of financial intermediation. Section 5 shows how polycentric banking systems can overcome these problems and provide robust financial governance. Section 6 engages the "design principles" for robust governance devised by E. Ostrom. We show that polycentric financial governance meets the requirements that follow from these principles, while current top-down approaches do not. Section 7 concludes by discussing the implications of our argument.

2. Institutional Resilience in Polycentric Systems

The institutional approach to resilience is summarized in figure 1 (adapted from Tarko 2017, chap. 4).

Figure 1. Aspects of Resilience



The concept of "robustness" (Adger 2006) includes, first, the system's *absorptive capacity*, that is, its ability to experience a large shock without major negative consequences. The bigger the financial institution that can be allowed to fail without massively disrupting the

whole system, the higher financial absorptive capacity the system has. Second, robustness also refers to the *speed of recovery*. Even if the shock has a large initial impact, some systems recover quicker than others. In the context of financial stability, we can think of the speed with which the market rebounds after a financial crisis. For example, the Great Depression was massively prolonged by flawed monetary policy, such as the Fed's failure to prevent a collapse in the monetary base (e.g., Friedman and Schwartz 1963), as well as prolonged discount-window lending, which undermined the existing double-liability regime (e.g., White 2011). Various nonmonetary policies, such as misguided regulations that increased the costs of doing business (e.g., Cole and Ohanian 2004), also worsened the Depression. This package of policies created an institutional system with a low speed of recovery.

Robustness provides only a static, equilibrium approach. Most problematically, it assumes that it is desirable for the system to return to the same state of affairs it has had before the shock. But this may not be true. For example, the vulnerability to the shock may have revealed a design error. A resilient system learns from past errors and adapts to new conditions (Gunderson 2000; Folke et al. 2002). This concern brings to light two very different challenges to resilience: over-optimization and allowing "creative destruction."

The mathematical theory of over-optimization was developed by Carlson and Doyle (1999, 2000, 2002), who refer to the problem of "highly optimized tolerance" (HOT). The idea was later adopted by Elinor Ostrom and her collaborators as a basis for their theory of ecological resilience (Janssen, Anderies, and Ostrom 2004, 2007; Young et al. 2006; Janssen and Anderies 2013; Ostrom 2014). Carlson and Doyle have demonstrated a striking mathematical phenomenon: optimization to cope with past shocks can itself create *previously inexistent* vulnerabilities with respect to other, unforeseen sources of uncertainty.

This is a more subtle version of Nassim Taleb's (2010) "black swan" problem or Frank Knight's (1921) uncertainty-risk distinction. A black swan problem is when some mistaken underlying assumptions lead to flawed risk assessment, such as when financial institutions underestimated the system-wide fragility caused by leverage in the run-up to the financial crisis. For example, Foote, Gerardi, and Willen (2012, n.p.) conclude their analysis of Lehman's precrisis scenarios by noting that

> the authors of the Lehman report were bullish about subprime investments not because they believed that borrowers had some "moral obligation" to repay mortgages, or because they didn't realize that the lenders had not fully verified borrower incomes. The authors were not concerned about losses because they thought that house prices would continue to rise, and that steady increases in the value of the collateral backing the loans would cover any losses generated by borrowers who would not or could not repay.

Furthermore, "despite its foreboding name, the 'meltdown' scenario was actually optimistic with respect to the observed fall in housing prices that began in 2006" (2012, n.p.). In Taleb's account, the possibility of such mistaken assumptions is covered by Knight's concept of uncertainty. What Carlson and Doyle show is that black swans are also *created* by the optimization process. They are not purely exogenous. As Carlson and Doyle (1999, 1424) put it, "the most important feature of HOT states is the fact that the high performance and robustness of optimized designs with respect to the uncertainty for which they were designed [i.e., in economic parlance, risk], is accompanied by extreme sensitivity to additional uncertainty that is not included in the design." This leads to "profound tradeoffs in robustness and uncertainty."

As a result of optimization, we obtain a system that is characterized by "(1) high efficiency, performance, and robustness to designed-for uncertainties; (2) hypersensitivity to design flaws and unanticipated perturbations; (3) nongeneric, specialized, structured configurations; and (4) power laws" (Carlson and Doyle 1999, 1423). The system is "robust-yet-

fragile": As it is optimized to the *known* sources of danger, the system develops, as a side effect, weak points thanks to complex interconnectivities, which open up the possibility of "cascading spread of damage due to the seemingly innocuous breakdown of individual parts" (Carlson and Doyle 2002, 2540).

The importance of this phenomenon for financial systems is obvious. The regulatory bodies create rules to cope with past challenges and shocks, but, in the process of optimizing the rules in such a manner, they run the risk of creating new, previously inexistent vulnerabilities. A striking example of this are complex derivatives such as collateralized debt obligations (CDOs), which, in combination with excessive leverage, played a key role in the 2007–2008 financial crisis. Derivatives can and do perform a useful social role in helping financiers more accurately pool and price risk. But in a monocentric system, derivatives can also be used to capture quasi-rents by skirting clumsy regulations. Furthermore, regulatory evasion is not limited to the creation of esoteric financial instruments. It can involve instruments that are much easier to understand, but are still apt at skirting formal rules. For example, the Glass-Steagall Act, which separated commercial and investment banks, was rendered powerless by such market innovations long before it was actually repealed. The final de facto blow to it came with a 1984 Supreme Court decision that "established the principle that banks and brokerage firms could cross the Glass-Steagall lines through subsidiaries" (Vogel 1996, 226). As Vogel (1996, 31) has noted, "Ironically, the rigid segmentation between banks and brokerage firms in the United States has created incentives for financial innovation not found in countries without such barriers, such as Germany."

This brings forth the question about "creative destruction." An adaptable system is the result of the constant exploration of alternative innovations (Miller and Page 2007). The

fundamental challenge is that we do not know beforehand what the best solutions are. A polycentric system allows simultaneous and parallel practical explorations, while a monocentric one allows only academic theoretical debates. The lack of foresight also raises the hard question about how to effectively regulate innovations that could have highly disruptive, but hard-to-foresee, consequences (Thierer 2016).

The institutional approach to this question is to look at the likely purpose of such disruptive innovations. When these innovations are designed to circumvent existing regulations to capture the quasi-rents created partly by those regulations, the social value of disruptive financial innovations, like those discussed above, is questionable. By contrast, financial innovations will be benign or beneficial in a polycentric system, which does a better job of generating information and aligning incentives. (The exact nature of these innovations, and their similarity to existing financial instruments, is hard to predict.) To put it differently, in a monocentric system, a lot of money can be made by creating financial innovations that game the system or evade regulations. In contrast, in a polycentric system the main incentive is to make innovations that create social value. For example, as noted by Stringham (2015, 67–69), when a single stock market is allowed to exist and fraudulent traders cannot be easily excluded from it, the incentive to engage in fraud is considerable and actually threatens the integrity of the entire stock market. By contrast, a polycentric system of several competing stock markets both reduces the risk of fraud and provides a wider diversity of services. The same logic applies not just to stock markets, but to the entire financial system.

Regulatory evasion is not the end of the story. Along the lines of the HOT concept, it can generate previously inexistent vulnerabilities. Regulations create incentives to discover such regulatory evasions, which basically render obsolete the robustness calculations that formed the

basis for setting up the regulations in the first place. Elinor Ostrom has highlighted this problem as crucial for properly understanding how to design a resilient system: "As soon as one design has proved itself in one environment, innovations in strategies adopted by participants or changes in the environment in which a humanly designed system is in operation will produce unexpected results" (Ostrom 2005, 255). As such, simple equilibrium analysis "can be difficult to apply to systems in which some components are consciously designed," and one has to consider the "*endogenous processes* within a given system of interest and . . . address normative considerations associated with incentives and decisions" (Janssen and Anderies 2013, 434; emphasis added).

The only way to avoid the problem of highly optimized tolerance is to decentralize the system and create "small isolated clusters that would be highly robust to changes in probability distributions or flaws" (Carlson and Doyle 1999, 1423). Such a solution to the resilience problem is deliberately inefficient in terms of economies of scale.[6] However, the only way in which a complex system can be made resilient is by giving up the goal of maximum short-term efficiency, keeping the scale low, and implementing redundancies. The emphasis on polycentricity and diversity—that is, preserving a redundant variety of institutional devices rather than adopting a one-size-fits-all solution—should be understood from this perspective that stresses the importance of coping with uncertainty rather than just risk.

To summarize, a polycentric system tends to be more resilient than a monocentric one because it fares better on all the components of resilience (table 1). Polycentric systems tend to have higher absorption capacities because shocks do not affect simultaneously the whole system in the same way. Because they preserve institutional diversity, and hence a diversity of beliefs

[6] We are not claiming bank size, per se, causes or precipitates financial crises. We are merely pointing out the tradeoff between robustness to existing probabilities of crisis, and robustness to changes in the underlying parameters, on the specific margin of bank size. How this applies in particular circumstances is an empirical issue.

about how to organize human affairs, they are less vulnerable to the problem of putting all their eggs in one basket. Similarly, apart from emergency situations in which quick agreement on one common action is vital, the speed of recovery tends to be higher in polycentric systems. Such systems are more market-like, and the information about who needs what has to travel a shorter chain of command. Furthermore, a diversity of approaches is available, which overcomes the problem of not knowing exactly which is the best solution and thus risking a bet on the wrong solution. Polycentric systems are much less vulnerable to the problem of over-optimization—of highly optimizing the whole system to previous challenges, which opens up new vulnerabilities. Finally, polycentric systems are far more entrepreneurial than monocentric ones, simply because they allow diverse points of view to coexist—not just in theory, but in practice.

Table 1. Polycentric Systems Tend to Be More Resilient

Aspect of resilience	Monocentric	Polycentric
Absorption capacity	*Lower*: Errors affect the entire system. Higher information costs lead to discovering the problem with a delay.	*Higher*: Errors affect only a subset of the system, and help is available from the other parts. Decision makers that spot a problem can act on it immediately, before the problem becomes too large.
Speed of recovery	*Lower*: Information costs are higher; errors of "one-size-fits-all" solutions have wide-ranging effects.	*Higher*: Lower information costs; diversity of approaches facilitates learning.
Over-optimization	*More likely*: No inherent break on over-optimization until it is too late. Higher regulatory complexity.	*Less likely*: Decision centers that over-optimize suffer costs long before the problem has the chance to expand to everybody. Simpler regulatory rules.
Creative destruction	*Less*: Opportunities for substantial entrepreneurship exist mainly at the top.	*More*: Numerous opportunities for entrepreneurship at different levels.

3. Market Failures and Financial Crises

Having outlined the essential features of institutional resilience in polycentric governance systems, we can now show how insights from these kinds of governance systems can apply to financial governance, with the goal of preventing financial instability.[7] Financial systems are a network of institutions using a wide variety of complex instruments. But the function of the financial system as a whole is easy to state: coordinate the investment market—that is, bring together those in want of funds and those offering funds, and provide credible assurances that loans are going to be repaid. Various methods of corporate financing and risk management can thus be understood as mechanisms that enable the tendency toward clearing in capital markets in a least-cost manner.

Suppliers of funds can deposit the money in a bank, buy stocks, or buy bonds (usually via an investment fund acting as an intermediary). Banks and investment funds provide liquidity to entrepreneurs to support their investment plans. Some of these entrepreneurial plans succeed and generate profits, parts of which are used to repay the loans up the chain of lending all the way to the initial lenders. The banks and investment funds are also insured, which offers a cover for streaks of bad luck. Furthermore, credit rating companies provide additional information to help the decision-making of investment funds and insurance companies. Under normal circumstances, this decentralized system works smoothly. Of course, errors are made all the time, as no one can know for sure which investment plans will succeed or fail, but the errors are compensated by the

[7] This section is adapted from Salter (2014b).

successful investments. Such a system is essential for economic growth, as otherwise most entrepreneurs would lack capital.[8]

The smooth operation of this system is governed by prices—interest rates, insurance premiums, stock prices, and asset prices, among others. When accurate, these prices contain information about the relative risk of different investment plans. From this perspective, it makes sense to view financial crises as essentially an information problem. In other words, they would not exist if accurate common knowledge was available to depositors, investors, and insurers. The common knowledge (stored in interest rates and the prices of various assets, stocks, and bonds) is imperfect in the sense that various assets, stocks, and bonds are often mispriced—as revealed by later events. A financial crisis occurs when some substantial fraction of these prices are suddenly revealed to be inaccurate. The errors here are not just at the individual level, as part of the normal noise in any market; instead, they end up embedded in the constellation of prices in the financial system. The question hence becomes, which system can discover these system-wide errors faster and which system provides the incentives to correct these errors quicker: the polycentric system of self-regulation or the monocentric regulatory authorities?

Given the complexity of the entire financial system, and our space constraints, we are going to focus here on a key part of this system: the banking sector. The essential feature of banking is financial intermediation—"borrowing short and lending long." Overwhelmingly, this feature is associated with banks holding fractional reserves. Banks create deposits in exchange for financial resources that depositors provide to banks. Banks use these resources to finance

[8] Is the standard narrative regarding deposit insurance and credit rating agencies correct? Perhaps not, but we take it for granted here as we want to tackle the "hard case" and make our own position as strong as possible. For a perspective on these policies that more closely fits our own, see Hogan and Luther (2014, 2016).

their asset portfolios. The difference between the return on a bank's portfolio and what it pays to deposits is thus its profit.[9]

Understanding systemic danger involves ascertaining depositors' views on the safety of their deposits. When a banking system is functioning well, bank liabilities are *information insensitive*. Depositors are confident their funds are safe; as such, it is not privately profitable for depositors to invest in acquiring private information concerning their bank's health (Gorton 2010, 20). Individual banks may make bad investments, in which case depositors have reason to withdraw their funds and transfer them to another bank. But so long as such events are isolated, depositors have no reason to worry about the performance of the banking system as a whole (Bordo 1990).

The situation is quite different when events such as balance sheet shocks (falling prices for banks' assets due to widespread sales) call into question the integrity of the entire financial system. In these cases, bank liabilities become *information sensitive*: there is now a private payoff for depositors (and creditors to the bank, more generally) to incur costs to ascertain the likelihood that their held bank liabilities will be honored. In difficult cases, when depositors have reason to suspect organizational solvency due to asymmetrically distributed and costly-to-acquire information (Gorton 1988), each depositor has an incentive to withdraw their funds as quickly as possible. Provided depositors' redemption demands exceed banks' on-hand medium of redemption, banks will be forced to sell assets at fire sale prices, which then weakens the financial health of other banks as well. Such events are not worrisome merely to banks but also to the financial system as a whole, especially when non-bank

[9] Financial intermediation could still take place if banks based themselves not on debt contracts but equity, making them quasi-mutual funds. But this significantly increases the transaction costs associated with financial intermediation, which probably explains why such "limited purpose banking" (Kotlikoff 2010) has not featured prominently in financial markets, and would not without significant changes in the fundamental rules governing financial firms.

financial organizations are performing quasi-banking activities, as they did on the eve of the financial crisis (Gorton 2010).[10]

The overwhelmingly dominant perspective on how to ameliorate these problems holds that various regulations can force banks to behave in a manner more consistent with the health of the financial system as a whole. Microprudential approaches focus on changing the behavior of individual banks and other financial organizations; in the aggregate, each bank behaving in a stability-conducive manner will result in a stable financial system. Examples include regulatory standards for individual bank capital, leverage, and liquidity. Macroprudential approaches reject this conclusion, holding that regulators need to act directly on variables that determine systemic risk, which may not be evident if the sole focus is on individual financial organizations' balance sheets, without reference to how these organizations collectively interact.[11] Systemic risk is related to the procyclicality of a financial system, so constraints on banks' loan-to-value and debt-to-income ratio are proposed as macroprudential tools. But both microprudential and macroprudential policies rely on discretionarily crafted rules. We contend that top-down regulatory solutions in general are inadequate. In particular, those implementing top-down regulations face knowledge and incentive problems that make financial stability unlikely. Achieving financial stability necessitates more extensive revision of the "rules of the game."

[10] A contrary view is that depositor loss of confidence is a signal that a *specific bank* is performing poorly. Thus withdrawal of funds improves, rather than hampers, the performance of the financial system by facilitating a reallocation of scarce savings to a more worthy recipient. But there is still the chance of pecuniary spillovers, resulting in the familiar difficulties in ascertaining which banks are insolvent as opposed to merely illiquid. Rather than delve into this difficult question, which would require several papers, we accept Gorton's (2010) narrative for the purposes of showing that even given this narrative, polycentric systems outperform monocentric systems. For an extended treatment of the potential beneficial effects of depositor withdrawal, see Kaufman (1988); for the role of depositor monitoring in maintaining the health of financial systems, see Hendrickson and Salter (2017).

[11] This is not to deny there is some overlap between the microprudential and macroprudential tool kit. Macroprudential advocates usually are also in favor of capital and leverage regulations that can resemble microprudential tools, for example. But the general framework within which these tools are used, as well as the purpose of the tools in the first place, can be quite different.

4. Knowledge and Incentives

In the following subsections we explicate the various knowledge and incentive problems with regulatory solutions to financial instability.

4.1. Knowledge Problems

Knowledge problems render top-down regulatory solutions impractical because of the informational burden these problems place on regulators. In particular, the information regulators would need is dispersed and private, and hence does not exist in a form that regulators can harness. Even if it did, this is still a highly complex nonlinear system in which small changes to a few variables can have large cascading effects, thus rendering the relationship between financial stability (or constituent parts of financial stability) and other variables virtually impossible to ascertain by regulators in a manner necessary to yield sufficient control.

The following is a (by no means complete) list of specific knowledge problems confronted by regulatory solutions.

- **Risk versus uncertainty.** Ever since Knight (1921), economists have noted an important distinction between risk and uncertainty. All risk assessment is based on underlying assumptions that can fail unexpectedly, especially when conditions change and agents have strong incentives to discover regulatory evasions. Regulators may come to have an acceptable appreciation of the risk of systemic events, but they cannot grapple with the inherently uncertain aspects of knowing which financial shocks will engender financial panics.

- **Financial instability and emergence.** Regulatory solutions frequently imagine financial instability as a simple result of the interaction of a handful of key variables. In this context, "simple" means "of the same order of complexity as its determinant variables." But this is incorrect. Financial instability is emergent: it is the *product* of the action of financial organizations, but it cannot concretely be *reduced* to these actions. Whether regulation focuses on bank-level characteristics (as in microprudential regulation) or attempts to target instability directly (as in macroprudential regulation), failing to take into account that financial instability is a phenomenon of a higher order of complexity than its constituent parts (Wagner 2010, 2012) cannot but result in a host of unintended consequences. Regulators focusing on a few key variables also overlook the previously mentioned incentives to discover new methods of evading regulations.
- **Information and institutions.** Can the above problems be sidestepped by taking a purely empirical approach? Rather than attempt to grasp financial instability theoretically, perhaps regulators can simply build models that rely on rote prediction based on past observed crises, and implement solutions based on the predictions of such models. But as we have seen, it is precisely such an approach that leads to the problem of highly optimized tolerance and the creation of systemic vulnerabilities. Far from being sophisticated, this fundamentally misguided approach fails to grasp a key lesson of complexity theory. An empirical relationship discovered in one institutional context can fail in other contexts and hence cannot produce reliable generalizable regulatory rules. Any relationship observed in the data will invariably break down if an attempt is made to exploit this relationship for the purposes of control (Goodhart 1975; Lucas 1976). We

also cannot assume that all empirical relationships that hold under some control-oriented institutions will also hold under competition-oriented institutions.

- **Regulatory effects on information.** There are two types of knowledge problems (Boettke, Tarko, and Aligica 2017). The more trivial case is when the information might be available, but it is too costly to gather. The more interesting case is when, absent the market process that generates it, the information is not available at all. It is this second type of information problem that is widely neglected when top-down regulations are proposed. This is particularly relevant to cases when financial regulation reduces the competition present in financial markets by creating barriers to entry, or more familiarly in US history, barriers to branching.[12] This reduced competition leads to prices being less informative and less responsive to real-world events.[13] In other words, the information that would be generated and embedded into prices in a more competitive system is now destroyed. The issue is not only that regulators cannot *gather* the relevant information better than the market participants themselves, but also that regulations *reduce* the quantity and quality of the available information. Thus, rather than addressing the financial market failures by somehow making prices embed higher quality information, regulators make these failures worse.

4.2 Incentive Problems

The above knowledge problems show that even if regulators' incentives were perfectly aligned with achieving financial stability, the informational constraints they face make their task very

[12] In the United States, restrictions on branching within states and across states significantly contributed to the turbulence of financial markets both before and during the National Banking System (Bordo, Redish, and Rockoff 2011; Calomiris and Haber 2014).
[13] This problem is of course made even worse when prices are actively distorted, as when monetary expansion affects interest rates.

difficult. But regulators' incentives are never perfectly aligned with achieving financial stability. Just as we must honestly assess the incentives facing market actors in order to come to a realistic appraisal of social outcomes, we must also honestly assess the incentives facing political actors. Furthermore, we must also assess what incentives market actors face, given their knowledge of the incentives political actors face.

The following incentive problems seem especially pertinent:

- **Central banks and emergency lending.** This problem focuses specifically on one group of financial regulators and overseers: modern central banks. Central banking orthodoxy (Bagehot [1873] 1896) holds that if central banks are to prevent financial panics by providing emergency loans, that they should extend these loans only on good and familiar collateral, that they should charge a penalty rate, and that these procedures should be credibly announced to the public beforehand. In practice, central bankers have failed to adhere to these practices. It is arguable that European central banks more or less adhered to Bagehot's rules during the late 19th and early 20th centuries (e.g., Schwartz 1986; Bordo 1990; Goodfriend 2012). But they have not done so since. The Fed, for its part, never has. For example, during the most recent crisis, the Fed loaned money on collateral of dubious quality, failed to consistently charge penalty rates, and behaved in a generally ad hoc and uncertain manner, undermining public expectations (Hogan, Le, and Salter 2015). Central bankers have not shown themselves capable of the restraint necessary for even *general* regulatory solutions to work.
- **Time inconsistency.** More generally, financial regulators' short-run and long-run incentives are radically at odds. In the long run, financial regulators would not find it in their interests to underwrite excessive risk-taking by bailing out irresponsible firms. But

in the short run, no financial regulator, whether a central banker or agent of an executive agency, wants to risk allowing a financial panic to unfold on his watch. Especially in the United States, "too big to fail" has been the rule, not the exception, for regulatory approaches to nascent financial distress since the 1984 Continental Illinois bailout (Hetzel 2008).

- **Moral hazard.** Market actors will change their behavior in response to perceived changes in how financial regulators will behave. Not only have financial regulators failed to credibly commit to allowing large financial institutions to face the costs of their excessive risk-taking, but they have also actively promoted this risk-taking by repeated bailouts. Financial organizations respond by constructing riskier portfolios than they otherwise would. This, of course, significantly increases the likelihood of financial panics. It is a mistake to conclude that financial instability is the product of market actors' poor incentives alone; those poor incentives are better understood as a profit-maximizing strategy in an environment where regulators have credibly committed to using the public to underwrite market actors' losses (Bordo 1990; Hetzel 2012; Calomiris and Haber 2014).
- **Logic of bureaucracy.** As famously pointed out by Milton Friedman, public-sector organizations usually face an adverse incentive structure: the worse the problem is, the more resources they obtain. This adverse incentive structure affects the capacity of many public-sector institutions to actually solve the problems they are supposed to solve (Wagner 1989; Harvey and Conyers 2016). The same issue affects the financial regulations bureaucracy as well. To be clear, we are not saying that financial regulators *deliberately* prolong and create crises. The point is that the standard mission creep

problem of all bureaucracies (Niskanen 1968) makes recovery slower and crises more likely. To effectively mount a response, an entire bureaucratic machinery has to be put in motion. In the language of resilience theory, this makes the speed of recovery slower. Furthermore, the increasing bureaucracy and more arcane rules enhance all the knowledge problems discussed earlier.

In the terms of the theory of resilience, these incentive problems decrease the system's absorption capacity by making it more vulnerable to smaller shocks, reduce its speed of recovery by bureaucratizing the recovery process, and create an unfortunate moral hazard slippery slope. The combination of time inconsistency and moral hazard means that, paradoxically, the regulators both massively overspend on measures theoretically aimed to increase resilience and, *by the same measures*, create greater systemic vulnerabilities. The absorption capacity is reduced mainly because of the systemic move toward riskier investment portfolios. This means that the system becomes more vulnerable to smaller shocks than before. The absorption capacity may also be partly reduced because of the subjective element: stability depends on confidence, and confidence partly depends on the actions of regulators. When, due to the time inconsistency problem, regulators get spooked even by relatively minor events, this can get transmitted into a(n) (unjustified) loss of confidence on the market. Hence, what would have been a small, largely inconsequential shock can be amplified into a genuine threat.[14] Last but not least, rent-seeking, regulatory capture, and revolving door problems enhance all these incentive problems.

[14] The regulators, especially the Federal Reserve, are of course aware of this problem, but awareness does not imply constant success in avoiding it.

4.3 Summary

Regulatory solutions to financial instability are fraught with knowledge and incentive problems. Knowledge problems make it systematically unlikely regulators *are able* to create financial stability. Incentive problems make it systematically unlikely *it is in their interests to do so*, which, in turn, also changes the optimization calculus of market actors. Genuine solutions to financial stability must come at a deeper institutional level. On the basis of the theory of resilience summarized in section 2, we contend that polycentricity in financial governance can meet this challenge.

5. Free Banking and Polycentric Financial Governance

Although historical free (or laissez-faire) banking systems have a somewhat poor reputation, it is interesting to note that many of them exhibited specific mechanisms that both reduced the likelihood of financial shocks escalating into financial panics, and rendered the occurrence of such shocks less likely in the first place (Salter and Tarko 2017). This offers valuable insights into how a stable polycentric financial governance could work.

Most commonly, the objections to historical free banking are intertwined with objections to the gold standard. However, especially in a modern context, one can imagine a polycentric financial system with many other types of goods composing the monetary base (medium of redemption). For example, one can consider either various cryptocurrencies or systems anchored in large baskets of goods that would not be vulnerable to supply shocks or gold-hoarding obstacles to adjusting money demand. Hence, we are disentangling here the mechanisms for financial governance from monetary base issues. The choice of the monetary base is itself *endogenous* to the operation of the system. The fact that central banks choose fiat money is the

result of their incentive structure, as this is the best tool for discretionary economy-wide top-down management, and whatever monetary base a polycentric system would choose would be the result of its incentive structure.

What determines the incentive structure in a polycentric system? Not all decentralized and lightly regulated banking systems constitute polycentric banking systems. The key feature of any polycentric system is that the constituent organizations operating within that system are governed by an overarching set of rules, which, depending on their details, are more or less successful in aligning the information and incentives of individual actors with broader social goals such as financial stability. These rules are typically not enforced in a top-down regulatory fashion—by authoritative nonmarket actors who can be conceived as operating outside, or upon, the polycentric system—but by mutually agreed-upon rules for monitoring and enforcing agreements that punish privately beneficial, but socially costly, behavior. This is not to say there is no role for the public sector; in fact, the public sector frequently performs important functions by protecting parts of these systems by protecting property rights, enforcing contracts, and upholding a nondiscriminatory rule of law.

In the Anglo-American legal tradition, these roles are chiefly performed in the context of decentralized judicial decisions based on case particulars, out of which emerges a general body of the common law. It is perhaps no accident that so many of history's most notable successes with free banking—the Suffolk Banking System in 19th-century New England, Scotland during the 18th and early 19th centuries, and Canada for virtually all its pre–World War I history—developed against the backdrop of decentralized, rivalrous, and overlapping arbitration and enforcement systems (White 1989; Dowd 1992, 2015; Selgin and White 1994a, 1994b), as such

a system can more easily mesh with the network of overlapping institutions that constitute a polycentric banking system.

A polycentric financial system is thus not one *without* regulations, but one in which the regulations are created endogenously by the actors, rather than exogenously by a government regulator. How are these endogenous regulations created? The most interesting and important institution in this regard is the interbank clearinghouse. These are institutional questions, and institutional questions demand institutional answers. Historically, the institution that stands out in performing these functions is the interbank clearinghouse. Let us see how the information and incentive problems can be addressed in a polycentric system in a manner that diminishes the market failures.

The next three nested institutions, we claim, are the most important in providing robust financial governance and, historically, were indeed able to stop financial crises from happening—or mitigated them if they did—due to the knowledge-generating and incentive-aligning properties of the rules in question.

5.1. Medium of Redemption versus Medium of Exchange

The first important feature of polycentric banking systems is the distinction between the medium of redemption (the monetary base) and the medium of exchange. The inside-outside money distinction[15] gave banks the necessary information to ascertain whether they were maintaining an adequate supply of liabilities in circulation, conducive to the needs of trade. Banks not only had the information but also faced the proper incentives. Underissuing would be unprofitable, since it would be leaving money on the table; overissuing likewise would be

[15] In particular, the difference between the medium of redemption and the day-to-day medium of exchange. In historical free banking systems, the former was usually gold or silver, while the latter were transferable *claims* to a specific amount of gold or silver.

unprofitable, since it would result in outside money redemption (usually in the form of adverse clearings by other banks, which come to acquire the excessively loose bank's liabilities), forcing liquidation of potentially profitable assets on the bank's balance sheet. By giving banks the information and incentives necessary to maintain monetary equilibrium, banks could prevent spikes in liquidity demand from having deleterious effects on the financial system.

In the aggregate, if money demand rises, banks notice that they have fewer of their own liabilities presented to them for redemption, and they build up reserves of the medium of redemption. This is a signal that the public is more willing than before to give banks a zero-interest loan, to which they respond by issuing more liabilities into circulation. The result is maintenance of monetary equilibrium—a money supply elastic to the needs of trade, permitting necessary relative price adjustments for an efficient allocation of resources, but minimizing the negative effects on real economic activity caused by disequilibrium in the money market.

Although the importance of the medium of redemption–medium of exchange distinction is most obvious in cases of short-term macroeconomic stability, it also matters for financial stability (Salter and Hendrickson 2017). This is because a currency not elastic to the needs of trade means that if money demand rises, banks must liquidate assets in order to meet the increased short-term liquidity demand. If enough banks do this at once, the balance sheet shock may destabilize the financial system. Consider, for example, the differing structure of the Canadian and US banking systems in the latter part of the 19th century. The United States had legal restrictions limiting banks' supply of notes, with the float of bank liabilities limited by banks' purchase of government bonds as collateral (Smith 1990). There were no such restrictions in Canada, except a minimum capital requirement to obtain a charter. Come the harvest season, when farmers required liquidity to facilitate bringing their crops to market,

there was little change in the size of note circulation in the United States but significant spikes in interest rates, as we would expect from banks trying to sell off assets to meet increased money demand. In contrast, Canada's note circulation was approximately 20 percent higher in the autumn harvest season than in the winter, and there was no noticeable seasonal fluctuation in interest rates. Thus a banking system that more closely matches our typification of a polycentric banking system, by virtue of the institutional foundation of inside versus outside money, can prevent monetary factors from causing balance sheet shocks that necessitate a socially costly and system-wide portfolio readjustment for financial organizations (Schuler 1992, 88; Selgin and White 1994a, 1994b).

5.2. The Interbank Clearinghouse

The interbank clearinghouse can be viewed as an evolved mechanism for governing financial organizations' behavior. Profit-maximizing banks, in a polycentric (and hence also a decentralized and competitive) system, have incentives to cooperate *to a limited degree* in establishing some regular mechanisms by which they can clear liabilities against each other. Banks initially decide to accept each other's notes to increase the float of their own notes, and possibly also to engage in "note-dueling" strategies. This means banks consciously acquire a large volume of their competitors' notes, hoping to put competitors in financial stress by presenting these notes all at once and demanding redemption. While this seems like a plausible strategy that might raise fears of anticompetitive behavior, historically such behavior was unprofitable, and hence was usually discontinued quickly. Banks, which initially cleared liabilities bilaterally, eventually came to clear multilaterally to economize on transaction costs. In addition, once the institution of the clearinghouse evolved to perform this function, banks

in a polycentric system discovered that there are scale economies with the clearinghouse collecting and sharing information, enforcing minimum-quality standards (such as capital ratios), and facilitating low transaction cost emergency lending, should a member bank of the clearinghouse system so require.

These functions are very similar, on the surface, to proposed regulatory solutions. Information sharing among clearinghouse members helps to overcome well-known asymmetric information problems; maintenance of quality standards through bank examinations and capital requirements (Gorton and Mullineaux 1987) prevents any one bank from free riding on the reputation capital that comes from being a member of the clearinghouse association in good standing; and facilitating emergency loans fulfills a role similar to that of a lender of last resort (White 1989, 233). Rather than being the fortuitous result in a very small number of banking systems, the emergence and governance functions of the clearinghouse appear in numerous cases: "Eventually all the banks within an economy will be connected through one or a small number of clearinghouses. . . . The histories of the best-known early clearinghouses, in London, Edinburgh, and New York, all conform to this general pattern" (231).

The ability of the clearinghouse to prevent the perceived insolvency of even a large and interconnected bank from growing into a crisis can be illustrated by the Scottish banking system, and its response to the failure of the Ayr Bank. The Ayr Bank opened in 1769, and within three years it had become public knowledge that it had overissued its liabilities. The clearinghouse, fully operating by this point in Scottish banking history, facilitated a speedy return of Ayr's excess liabilities, which the bank could not honor. Ayr was forced to close, and this generated a sufficiently large spillover to force 14 of the 32 Scottish banks to close (White 1995, 27). Remarkably, this did not evolve into a systemic event: the banking system as a whole remained

solvent. Due to the efficacy of transactions conducted through the clearinghouse, other large Scottish banks were able to divest themselves of Ayr's liabilities before its failure, shoring up their own balance sheets. While there was a large spike in liquidity demand following the Ayr failure, it lasted only one business day, and the largest note-issuing banks could continue business as usual (29). In the language of resilience, the clearinghouse assured both a very high financial absorption capacity and a very fast speed of recovery.

Limited cooperation through the interbank clearinghouse provided governance concerning the maintenance of quality standards, information sharing, counterfeiting prevention, and more. It also lowered the transaction cost of emergency loans. It was in each bank's interest to follow the clearinghouse's rules, because being a member of the clearinghouse in good standing was a valuable stock of reputational capital. Information-wise, by facilitating regular clearings and emergency loans, the clearinghouse helped generate information concerning monetary equilibrium and the appropriate pricing premium for short-term liquidity in times of financial turbulence. The gradual evolution of the clearinghouse explains how, at each stage of newly acquired responsibilities, cooperation through the clearinghouse was both incentive- and information-compatible for banks.[16]

5.3 The Hard Budget Constraint and Extended Liability

Polycentric banking systems did not exist "on their own," isolated from the framework of institutions that governed commercial relationships more generally. Polycentric banking systems were embedded in a common-law legal system, subject to the general and familiar

[16] Some have worried that clearinghouses might promote cartel behavior by banks, but this is unlikely (Gorton and Mullineaux 1987; see also Gorton 1985). In brief, this is because the returns to collusive cooperation during non-panic times are too low to sustain collusion, as standard models predict. It is only during times of panic that *temporary* coordinated behavior to the benefit of all participating banks is sustainable.

laws of contract, property, and torts, as well as the laws governing the conditions under which individuals could organize in a corporate capacity. Two features in particular merit special attention: the presence of a "hard" budget constraint, and the requirements of an extended liability regime for shareholders. These two, in combination, gave banks strong incentives to behave in a manner conducive to financial stability (Turner 2014; Salter and Hendrickson 2017), and also partially constituted the framework of rules for generating the knowledge that they used to do so.

Hard budget constraints meant, in short, that banks in a polycentric system could not count on extra-market sources of liquidity if they found themselves subject to worrying portfolio shocks. Emergency loans could be facilitated through the clearinghouse, but this liquidity already existed within the system, as a function of other banks' liability float. Inability to pay back depositors, then, would have only one consequence: the triggering of liquidation procedures, which, due to extended liability, meant that depositors could claim the personal wealth of bank shareholders,[17] in proportion to an individual shareholder's total ownership of the bank. This obviously gave banks strong incentives not to overload their portfolio with exotic, or otherwise excessively risky, assets.

These two institutions, in combination with those discussed in previous subsections, also performed an informational role: with a hard budget constraint binding on the financial system itself, resources, including capital and risk, were subject to a competitive pricing process that could be used to determine the expected payoff of a portfolio and, in times of potential turbulence, ascertain on what terms emergency loans between one bank and another would be mutually profitable. In other words, these institutions facilitate the market process that *creates*

[17] Double, triple, and unlimited liability were common liability regimes in historical banking systems that we characterize as polycentric. Numerous objections have been raised against extended liability banking, but Salter and Hendrickson (2017) and Turner (2014) argue that, empirically, the costs are small relative to the benefits.

the information. The underlying institutions of property, contracts, torts, and partnerships and corporations ensured that banks could not have access to liquidity created ex nihilo by a nonmarket last resort lender. Individual and system-wide budget constraints were binding, and hence the information was as accurate as it could be. This, coupled with the requirement that bank shareholders' wealth would be subject to seizure should a bank fail to meet its obligations, provided strong incentives to economize on risk. It also created the necessary environment for the knowledge-generating features of the market price system, which banks relied on in conducting their general intermediation services.

6. Robust Financial Governance in Light of E. Ostrom's "Design Principles"

Let us return now to Elinor Ostrom's theory of resilient governance. After analyzing a variety of both successful and failing common-pool resources systems, she laid out a set of "design principles"—a set of heuristics about the basic functions that a successful governance system performs. Salter and Tarko (2017) contend that these design principles are actually helpful for understanding a wider variety of governance systems. We follow this idea here with respect to financial stability.

The design principles are (Ostrom 1990, 90; 2005, 259; 2010, 653; 2014; Wilson, Ostrom, and Cox 2013):

1) *Group boundaries are clearly defined*. In the case of the financial system, clearinghouses and financial exchanges, in the context of legal embeddedness, establish these boundaries. The membership in a given clearinghouse or stock exchange signals the adherence to certain rules. As previously discussed, clearinghouse membership was contingent on specific safety and information-sharing requirements. Historically these

exchanges also operated on a club-like basis, with voluntary rules for aligning knowledge and incentives (e.g., Stringham 2002, 2003, 2015).

2) *Proportionality exists between the benefits and costs of various actors*. This criterion is largely satisfied simply due to (a) the operation of the price system and (b) the common-law principles of bankruptcy. Conversely, when a financial institution fails, the laws relating to extended liability, which typically underlay polycentric banking systems (Turner 2014; Salter and Hendrickson 2017), assure a penalty proportional to the size of the damage.

3) *Most individuals affected by the rules are included in the collective choice group that can modify these rules*. This is one of the main differences between a polycentric financial system and the current monocentric system governed by top-down regulations. In the case of the present system, financial institutions are regulated by an outsider. This does not mean that the financial institutions affected by regulations are not involved. They are involved through lobbying, rent-seeking, and regulatory capture. However, as far as the entire system is concerned, these are zero-sum or even negative-sum interactions. By contrast, a polycentric financial system is a self-governing system in which banks and other financial institutions form voluntary clubs. Their interactions are hence turned into positive-sum games. Rent-seeking and regulatory capture are eliminated because the system is not under political control.

4) *Monitors and enforcers of rules are accountable for their actions*. Clearinghouse activities, such as penalizing members for reckless behavior, need to be themselves contestable by those within the system. If the clearinghouse had the final say, perhaps due to a well-intentioned but misguided law, we would be dealing merely with a peculiar

form of monocentricity, not polycentricity. Salter and Tarko (2017, forthcoming) note that "monitoring is undertaken by a combination of bank shareholders, whose incentives and information are a function of market mechanisms, and informal self-regulation within the clearinghouse. . . . There is a reciprocal checking of possible predation by the clearinghouse on banks, and banks on the clearinghouse, with no one agent in a privileged position to impose costs without recourse or fear of reprisal."

5) *Graduated sanctions are imposed for breaking the rules*. As in the case of the proportionality heuristic, graduated sanctions are provided by a combination of the price system and the rules for settling property and contract disputes under the common law. Legal redress is not the first step; reckless financial institutions do not immediately go bankrupt. Initially, when doubts about their activities first appear, their share price declines, increasing the likelihood of takeover, new management, and restructuring. As in the example of the Ayr Bank, even greater penalties are possible, the exact size of the penalty being decided by the rules of the legal system.
6) *Access to low-cost local arenas for conflict-resolution providing decisions is perceived as fair*. Because financial institutions acquire each other's liabilities, conflicts can occur. But, because the judicial system may be exceedingly costly, members of clearinghouses and exchanges devise internal conflict-resolution mechanisms or contract this service with existing adjudication companies (e.g., White 1989; Dowd 2015; Stringham 2015).
7) *External governmental authorities recognize, at least to some extent, the right to self-organize*. One of the biggest problems faced by a polycentric financial system is the top-

down interference of government institutions.[18] As we discussed in section 3, government institutions usually lack both the knowledge and the incentives to properly regulate the financial sector. Hence, their top-down interventions tend to be destabilizing, replacing the knowledge- and incentive-aligning features of polycentric systems with their more fragile monocentric counterparts. This design principle is particularly important to keep in mind because it implies that any transition toward a resilient financial system would necessarily be due to an explicit change in public policy.

8) *"Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises"* (Ostrom 2005, 259; italics added). The financial system provides a wide variety of services at different scales. This is one of the main reasons it is so difficult to have top-down regulation. The point of this design principle is that the wide variety of governance activities (monitoring, enforcement, and conflict resolution) need to be located at the same levels as the regulated activities. In the current system, there is a massive mismatch between the scale of the financial regulators (federal) and the scale of operation of financial institutions (going all the way to the individual level and exhibiting variety across local geographical regions). This mismatch has two important negative consequences.

On one hand, the regulator, even if we assume no corruption or capture, does not have the information to actually be an effective regulator. A regulator will tend to promote overly discrete "solutions," simply out of the practical impossibility of mapping out all the details and complexities from so high above. The information feedback to

[18] As an example in another financial context, Stringham (2002) notes that the club mechanisms for securing traders' reputations was undermined when excluded members (who had been excluded due to their untrustworthiness) appealed to the government to force their way into the London Stock Exchange.

which a top-down regulator, at whatever level of government, has access will necessarily preclude solutions best tailored to the needs of the system at any point in time.[19]

In addition, federal regulation in the post–Continental Illinois era makes the market as a whole less competitive, by favoring "Big Players," those whose success depends less on relatively predictable criteria such as making profits, and more on relatively opaque criteria such as conformity to complex regulatory standards. This in itself makes the system as a whole more fragile: the Big Players have fewer incentives to act responsibly, and whatever errors they make will have wide-ranging consequences. As Koppl (2002, 128) notes, "In asset markets, the presence of Big Players can induce 'herding' or 'bandwagon effects' and therefore 'irrational bubbles.'" Furthermore, "reducing the reliability of expectations, Big Players diminish the informational capacity of markets. Markets become less efficient mechanisms for the generation and transmission of information" (130). The most important components of modern monocentric financial systems, namely government regulators and central banks, are also examples of Big Players (Koppl 2014) whose actions render markets less predictable. The most salient example during the early years of the 2007–2008 crisis is the turbulence in financial markets caused by the Fed's ambiguity on bailout criteria during the financial crisis. That Lehman was left to fail while Bear Stearns received a bailout shows that, while ex post criteria can always be devised to rationalize a decision, the behavior of Big Players during the 2007–2008 crisis was unpredictable according to some rule or procedure known by market participants. Thus Big Players, while often intended by their

[19] Of course, this does not mean the information-feedback environment is the same for all regulators at any level of government. How this question ties into issues of federalism is an important research topic, but one we cannot elaborate on here.

proponents to be a source of stability in financial systems, in reality undermine the stability of such systems.

7. Conclusion: Implications and Paths to Financial Stability

When we apply the theory of resilience to the financial system, we arrive at a serious indictment of the current approaches to securing financial stability. These top-down regulatory attempts are not only doomed to failure, but they are likely to gradually make matters worse. Our paper only performed a comparative institutions analysis, showing that a polycentric financial system and free banking system would be more resilient. The problem of *transition* is different; it is massively complex in itself, and we cannot do it justice here.

Historical examples of free banking systems are useful for understanding which institutions worked to make financial systems stable, and they provide insight for developing a more general theory of polycentric banking and financial systems. It is probably still premature to think about how to engineer a transition to a fully polycentric banking system, as our understanding is still preliminary. We also do not claim that polycentric banking systems are the only possible way of building a more stable financial system. However, our analysis does suggest that the current focus solely on top-down regulations is overlooking important ideas, and a better system would almost certainly include a move in a more polycentric direction (although some elements of top-down management are perhaps still desirable). Scholars working in the fields of financial economics and financial regulation should pay much more attention to bottom-up institutional remedies, and place much less faith in top-down approaches that implicitly rely on an engineering mentality that is unsuited to the nature of the problem.

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