In three hours I will be rich. In five hours I can only eat out once a month. In thirteen hours I can buy myself an apartment paying full cash. But right now, in this moment I could face foreclosure on my home. Which one of these scenarios is real?

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REINVENTING MONEY: AN ECOSYSTEMATIC APPROACH

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CRISIS OF 2008

By now, everybody knows that we are still experiencing the ramifications of the biggest global financial crisis since the 1930s. The causes of this crisis will be debated for years to come. Some are blaming unrestrained greed; others a "sorcerer's apprentice" problem in which financial engineering created products too complex even for their creators; still others condemn excessive financial deregulation, incompetence by bankers and/or regulators, or even willful manipulation. However, all policy debates focuses typically on how to limit the excesses laid bare by the last financial crisis, as if this crisis is the only systemic one that has taken place so far. While the 2007–08 crisis was the biggest, the International Monetary Fund (IMF) has identified no less than 122 systemic banking crashes preceding this one since the 1970s![1] To this, they add 208 monetary crashes and 72 sovereign debt crises. By now, such systemic crises have hit more than three-quarters of the 180 countries that are members of the IMF. If we want to ensure that "it never happens again" as all policy makers ritually claim after each crash, would it not make sense to start looking at the whole forest, rather than any specific tree?

From our perspective, what all this means is that we have now

entered the period of unprecedented convergence of four planetary problems—climate change, financial instability, high unemployment, and the financial consequences of an aging society (as predicted in 1999 in Lietaer, *The Future of Money*). The ensuing crisis is playing out (and will continue to play out) in a classic two or three steps downward for every step upward pattern. Every small step upward (i.e., any temporary improvement) is predictably hailed as the end of the crisis. The same thing happened throughout the 1930s, and it is only after World War II that the expression "Great Depression" got used to refer back to that whole decade.[2] It is quite understandable—then as now—why governments, banks, and regulators make such statements, simply because, then as now, saying otherwise would only make the situation worse.

The next logical phase in this systemic crisis keeps unfolding as if on automatic pilot. Whatever governments do, the banks and other financial institutions will want to cut back drastically on their loans portfolios wherever possible, in order to rebuild their balance sheets after huge financial losses. Thus, while cutting back on its loan portfolio is a logical reaction for each individual bank, when they all do it simultaneously, it deepens the hole that is being collectively dug for the world economy and ultimately for the financial system itself.

> The second stage [of this economic crisis] is an attempt by the banks to cut their leverage and reduce their lending, so helping to drive the economy into recession. That will then feedback via bad debts in non-subprime lending and impact the capital strength of the banks. So we will see an adverse vicious circle of weak banks creating a weak economy which creates more weak banks.
>
> —Charles Goodhart, professor emeritus, London School of Economics

> There is a super bubble that has been going on for twenty-five years or so that started in 1980 when Margaret Thatcher became prime minister and Ronald Reagan became president. That is when the belief that markets are best left to their own devices became the dominant belief. Based on that, we had a new phase of globalization of financial markets and liberalization of financial markets. The idea is false. Markets do not correct towards equilibrium. … the whole construct, this really powerful financial structure, has been built on false grounds. For the first time, the entire system has been engaged in this [economic] crisis.
>
> —George Soros, global financier and philanthropist

The Economist editorialized in its lead story on October 11, 2008, "Confidence is everything in finance … With a flawed diagnosis of the causes of the crisis, it is hardly surprising that many policymakers have failed to understand its progression."[3] This chapter will show that this is indeed the case, although in a deeper way than *The Economist* itself believes.

The last time we dealt with a crisis of this scale, the 1930s, it ended up creating widespread totalitarianism and ultimately World War II. The trillion dollar questions are:

> How can we do better this time?
> What are the strategies that will prevent us getting caught in an economic tailspin?
> What are *all* the available options for dealing with large-scale systemic banking crises?

WHY SAVE THE BANKS?

Since governments' initial response has been to bail out banks and other financial institutions, the first question must be: why should governments and taxpayers get involved in saving banks in the first

place? After all, when a private business fails, it is considered part of the "creative destructiveness" that characterizes the capitalist system.[4] But when large banks fail, somehow that doesn't seem to apply, as shown again in the 2008 scenario.

The short answer to why banks are being saved is fear. Since banks enjoy the monopoly on creating money through providing loans, bankrupt banks means reduced credit, which in turn results in a lack of money for the rest of the economy. Without access to capital, most businesses contract, which causes mass unemployment and a host of collateral social problems. Thus, when banks are in trouble, they can trigger what is known as a "second wave" crisis, through a ferocious circle making a victim of the real economy: bad balance sheets in banks => credit restrictions => recession => worse bank balance sheets => further credit restrictions and so the spiral downward goes …

It is to avoid such a tailspin that governments feel the need to prop up the banks' balance sheets. The next logical step is also formulaic. Whenever a bank or group of banks is "too big to fail" and gets in trouble, the taxpayers end up footing the bill, so that they can start all over again. In the latest banking crisis, exactly as in the previous 122 major banking crises preceding it, taxpayer bailouts have been the answer in every instance. Central banks will help by providing an interest yield curve that makes it easy for financial institutions to earn a lot of money at no risk, and in some cases by buying back bad assets.[5]

Among earlier examples, the United States government, which funded Reconstruction Finance Corporation during 1932–53 period, repeated the exercise with the Resolution Trust Corporation for the Savings and Loan crisis in the 1989–95 period, and again with the Troubled Asset Relief Program (TARP) of 2008. Other examples include the Swedish Bank Support Authority (1992–96) and the Japanese Resolution and Collection Corporation since 1996. For the 2008 international crisis, the amounts

involved are unprecedented. Usually, the costs of the U.S. bailout refer to the $700 billion of the emergency Troubled Assets Relief Program (TARP) that was spectacularly squeezed through Congress during the last months of the administration of President George Bush. In reality, the actual cost to the American taxpayer of the bailout exceeds $4.616 trillion![6] This includes the direct loans to Wall Street companies and banks, purchases of toxic assets, and support for the mortgage and mortgage-backed securities markets through federal housing agencies. This is an astonishing 32 percent of our GDP (2008), 130 percent of the 2009 federal budget.

Bloomberg, which went to court to obtain the numbers from the administration, concludes with an amount at $7.4 trillion.[7] The most comprehensive estimate was performed by an ex–Wall Street insider. Before becoming a journalist, Nomi Prins worked on Wall Street as a managing director at Goldman Sachs, and running the international analytics group at Bear Stearns in London. Her estimate includes all the types of supports provided by both the U.S. Treasury and the Federal Reserve and comes up with a mind-boggling total of $14.4 trillion![8]

To put things into perspective, even the lowest of these estimates ($4.6 trillion) is greater than the entire inflation adjusted costs of World War II borne by the United States. Indeed, WWII cost the U.S. at the time $288 billion, which adjusted for inflation would amount to $3.6 trillion today. It is even harder to believe, but true, that $4.6 trillion is higher than the inflation adjusted costs of the Louisiana Purchase, the New Deal and the Marshall Plan, the Korean and Vietnam Wars, the S&L debacle, and the NASA race to the moon combined![9]

This begs the question: at what point do the costs for rescuing the bank system become unbearable? Governments learned in the 1930s that they can't afford to let the banking system go under, as this brings down the entire economy. What they may learn in our times is that they can't afford to save the banking system.

REREGULATION OF THE FINANCIAL SECTOR

As after every crisis, the political leitmotiv is to "ensure that it never happens again," and the solution that is invariably proposed is to tighten regulations on banks to plug the holes through which the latest problem showed up. History shows, however, that we have engaged in the same cat-and-mouse game between regulators and banks for several centuries, actually since the beginning of handing the money issuance function to the private banking system. To be precise, while such reregulation may avoid the repetition of the identical traps and abuses next time, over time, new loopholes will be discovered or created, resulting in a new variation of the same type of banking crisis.[10]

In addition, massive and very sophisticated lobbying is mobilized to reduce the scope of reregulation, or to provide useful loopholes from the beginning. Let us take the example of Washington, because it is one of the few places where we do have relatively reliable numbers on lobbying. During the debate on reregulation of the U.S. banking system, more than three full-time lobbyists were working for the banks for every elected official! Is it surprising that all the talk ended up with relatively marginal changes in the system?

CONVENTIONAL SOLUTIONS: NATIONALIZATIONS

There are two conventional ways for governments to prop up the banks' balance sheets, both involving a form of nationalization. The first is nationalizing what Ben Bernanke called in his presentation to the U.S. Congress the banking system's "toxic assets." The second is nationalizing the banks themselves. Let's briefly explore the advantages and disadvantages of both.

NATIONALIZING THE TOXIC ASSETS

This solution is invariably preferred by the banks themselves. It consists of either the government (in the initial Paulson bailout plan, for example, it is the U.S. Treasury Department) or a specially created institution funded by the government buying assets from the banks that they now want to jettison. Of course, determining the price at which these assets are purchased is a very tricky issue, particularly when a liquid market for such assets has dried up completely, as was the case in 2008.

Buying the toxic assets clearly doesn't convince everybody as an appropriate remedy.[11] It is also by far the most expensive solution, because it doesn't take advantage of the leveraging factor available in the banking system. Consequently, the injection of money by the government as capital directly to the banks is a lot more effective financially.

NATIONALIZING THE BANKS

The second way to buttress the banks is by governments providing capital directly to banks themselves, either by buying stocks or by acquiring a newly issued preferred stock. In Europe, governments have typically taken the bank nationalization road: it was the option taken for instance in Sweden in 1992; and in 2008, first for Northern Rock in the UK, and then for a wide range of banks in all countries by mid-October.

There are two advantages in this approach compared to the previous one of nationalizing the toxic assets. First, thanks to the fractional banking system by which all money is created, when banks make loans to customers, they can create new money at a multiplier of the amount of capital they actually have. Consequently, if a bank's "leveraging factor" is 10, then injecting $1 billion in the bank's capital makes it possible for it to create at least $10 billion in new money, or carry $10 billion in problem assets. In fact, the

multiplier is typically much higher. For instance, Lehman Brothers's and Goldman Sachs's ratio of assets to capital were respectively 30 and 26, before they both disappeared. Some European banks have had an even higher leverage: BNP Parisbas at 32; Dexia's and Barclays's both estimated at about 40; UBS's at 47; and Deutsche Bank's at a whopping 83.17.[12] Therefore, very conservatively put, it is ten times more financially effective for governments to bolster the balance sheets of the banks directly than to buy toxic assets.

The second advantage to buying bank shares instead of toxic assets is that there is generally a market that indicates some relative value between different banks. In contrast, when the market for toxic assets has dried up, there is no such indication, and the decisions can be quite arbitrary.

The banks themselves, of course, prefer to avoid the dilution of bank equity and control that this approach implies. Politically, nationalizing the banks also sounds like the "socialization" of the economy, since the former communist states nationalized their banks. This ideological taint may explain why this approach was not initially considered in Washington.

UNRESOLVED PROBLEMS

The first objection to nationalizing banks or their toxic assets is the well-known "moral hazard" problem. If banks know that they will be saved when in trouble, they may be tempted to take higher risks than otherwise prudent. When these risks pay off, the profits are held privately and translated into generous dividends for the banks' shareholders and extraordinary bonuses to management. But when they fail, the losses end up being absorbed by the taxpayers. The current salvage programs confirm that this problem hasn't gone away and is unavoidably further strengthened by new bailouts. Christine Lagarde, minister of economic affairs, finances, and industry in France, stated, "Moral hazard has to be dealt with later … Maintaining the functioning of our markets is the top priority."[13]

This is exactly the argument that pops up at every systemic crisis.

Secondly, even if both strategies—bailing out the banks and reregulation of the financial sector—were implemented reasonably well, neither resolves the "second wave" problem: The banking system will get caught in a vicious circle of credit contraction that invariably accompanies the massive deleveraging that will be needed. Depending on how the reregulation is implemented, it may actually inhibit banks from providing the finances needed for a reasonably fast recovery of the real economy. In any case, given the size of the losses to be recovered, it will take many years, in the order of a decade, certainly more than enough time to bring the real economy into real trouble.

In practice, this means we are only at the beginning of a long, drawn-out economic unraveling. The social and political implications for such a scenario are hard to fathom. The last time we faced a problem of this size and scope was in the 1930s, and that event resulted in social and economic problems that ended up manifesting violently in a wave of fascism and ultimately World War II. Still, there are important differences vis-à-vis the situation of the 1930s. So far, the situation is less extreme economically, in unemployment and business bankruptcies, than what happened in the 1930s. On the other hand, governments are now a lot more indebted than was the case at the beginning of the Great Depression, and today's crisis is a lot more global than was the case then.

More important still, a financial/banking issue isn't the only one we have to deal with. It happens to coincide with several major global challenges, by now generally accepted: climate change and mass species extinction, the increase of structural unemployment, and the financial consequences of unprecedented aging in our societies. In some respects, therefore, today's crisis is less dramatic, and in others far worse than what the previous generation had to face.

NATIONALIZING THE MONEY CREATION PROCESS

Nationalizing the money creation process itself is an old proposal; though a less conventional approach, it reappears periodically in the "monetary reform" literature, particularly during periods of major banking crises such as the 2008 crisis. For historical reasons, the right to create money was transferred to the banking system as a privilege, originally to finance wars during the seventeenth century. So, contrary to what some people believe, our money isn't created by the governments or the central banks: it is created as bank debt. When banks are private, as they are in most of the world, the creation of money is therefore a private business. If the banking system abuses this prerogative, this privilege could or should be withdrawn. The logic is not new: money is a public good, and the right of issuing legal tender belongs at least theoretically to governments.

So, while bailing out the banking system through nationalizing banks or nationalizing the problem assets is the classical policy choice, it can also be expected that proposals for nationalizing the money creation process itself will reemerge, as they have in previous predicaments, including the 1930s. Under a government-run monetary system, the governments would simply spend money into existence without incurring interest at its creation; banks would become only brokers of money they have on deposit, not creators of money, as is the case now.

This would definitely make systemic banking crises a problem of the past. It would also make it possible to relaunch the economy through a large-scale Keynesian stimulus at a much lower cost to the taxpayers, given that the money thus created wouldn't require interest payments to be reimbursed in the future.

One objection to a government managing the monetary system is that governments may abuse this power, issue more money than is appropriate, and thereby create inflation. That argument is

valid. However, given that the current method of creating money through bank-debt made the twentieth century one of the highest inflationary centuries on the historical record, inflation is obviously not a problem specific to the process of money issuance by governments. Furthermore, there is no reason that Milton Friedman's proposal for the issuance of money by the central banks couldn't be applied to governments as well: put in place a rule that obliges the issuing body to increase spending by no more than a fixed 2 percent per year, reflecting the improvements of productivity in the economy.

The most important reason that this solution is unlikely to be implemented is that it will be doggedly resisted by the banking system itself. The financial system has always been and remains today a powerful lobby, and losing the right to create money would hit it at the core of its current business model.[14]

Our own objection to this solution is that, even if governments were to issue the money, while that might protect us from banking crises, it would nevertheless not solve the core systemic problem of the instability of our money system. In short, it might protect us from banking crises, but not from monetary crises.

UNDERSTANDING SYSTEMIC STABILITY AND VIABILITY

The solution we propose below is new, and relates to the identification of the fundamental systemic reason for our monetary and financial instability. Understanding this solution, however, requires that we review some evidence as to why a systemic problem is likely, that we develop a scientifically sound understanding of its nature, and, finally, that we identify effective ways to address the trouble.

The good news now is that we know a lot more than in the 1930s, and that we have many more tools available than even a decade ago. Consequently, it is now possible to identify the deeper underlying systemic causes as well as a new way to deal with them.

Furthermore, this new way is one that governments can afford, and that actually addresses a number of other social and economic issues that exist even when there is no financial crisis.

At first sight, it may not be the bankers' preferred solution, but it would actually stabilize their own portfolios while structurally stabilizing the economies of the world. It would also give them a whole new line of business, in activities that would be particularly attractive for local and regional banks. Introducing such a systemic solution is the only way to avoid periodically repeating the banking crisis exercise, which all conventional approaches are condemned to do because they deal only with some of the symptoms, and not the cause.

BEYOND THE BLAME GAME

A lot of energy and ink have been spent trying to allocate the blame for this disaster. Greed in the financial sector, lack of oversight by regulators, policies that overemphasize deregulation, and incompetence at various levels have all become favorite targets. Our view is that any or all of these may indeed have played a role, but at the core we are dealing, as already stated, with a much deeper systemic issue.

Floating exchanges rates, introduced by President Nixon in 1971, were the last structural change introduced into the global monetary architecture, and are increasingly being blamed as another cause for the instabilities. However, even before this period, boom-and-bust cycles involving banking and monetary crises were, in Charles Kindleberger's words, a remarkably "hardy perennial." Kindleberger inventories no less than forty-eight massive crashes, ranging from the 1637 tulip mania in Holland to the 1929 crash on Wall Street.

Such repeated financial breakdowns, in very different countries and times, under different regulatory environments, and in economies with very different degrees of development, should

be seen as a first telltale symptom of some underlying systemic or structural problem.

If such a deeper issue is involved, it would explain why each new set of regulations achieves, at best, a reduction in the frequency of banking and monetary crises, without getting rid of them or their horrific economic and socio-political costs. If such a deeper structural problem exists, it would also explain why even some of the brightest and best-educated people on the planet have not been able to avoid major financial catastrophes, however diligently they do their work, whether on the regulatory or on the financial services side. Finally, if our money system is indeed a structural "accident waiting to happen," then even if it were possible to perfectly control greed through innovative, tight regulations, this could only defer when the next disaster would hit.

STABILITY AND SUSTAINABLE VIABILITY IN COMPLEX FLOW SYSTEMS

We now have scientific evidence that a structural issue is indeed involved. The theoretical origin of this evidence may be surprising to the economic or financial community, although it wouldn't be such a surprise for scientists familiar with natural ecosystems, thermodynamics, and complexity or information theory. The science that explains this issue rests on a thermodynamic approach with deep historical roots in economics.[15]

In this view, complex systems, such as ecosystems, living organisms, and economies, are all seen as matter-, energy-, and information-flow systems. For example, the famous food chain is actually a matter-/energy-/flow-network built of complex relationships among organisms. Plants capture the sun's energy with photosynthesis; animals eat the plants; species then eat each another in a chain to top predator; only to have all organisms die, decompose, and have their energy/matter be recycled by bacteria. Similarly, economies are circulation networks consisting of millions of businesses and bil-

lions of customers exchanging different products and services, which when taken as a whole, are supposed to meet the needs of all participants.

For the past twenty-five years, major progress has been made on understanding what makes natural ecosystems sustainable or not. This work is the natural extension of Nobel Prize–winning chemist Ilya Prigogine's and Club of Rome cofounder Erich Jantsch's work with self-organizing energy-flow systems. In fact, according to Kenneth Boulding, many early economists held energy-based views of economic processes. This changed when those who favored Newtonian mechanics during the late nineteenth century (such as Léon Walras and William Stanley Jevons) turned economics into today's familiar views on the mechanics of "rational actors" and the reliable self-restraint of general equilibrium theory, an approach which completely dominates not only practically all of today's mainstream academic economic literature, but also the boardrooms and political venues of the world.[16]

A growing body of empirical and theoretical work, published under different academic banners such as self-organization theory, universality theory or nonlinear dynamics, shows that all flow systems follow certain universal principles and patterns.[17] Consequently, as Sally Goerner says about universality: "all [flow] systems, no matter how complex, fall into one of a few classes. All members of a class share certain common patterns of behavior." Similarly, Predrag Cvitanovic explains, "The wonderful thing about this universality is that it does not matter much how close our equations are to the ones chosen by nature; as long as the model is in the same universality class … as the real system, both will undergo a period-doubling sequence. That means that we can get the right physics out of very crude models."[18]

The existence of parallel patterns and dynamics explains why similar energy-flow concepts and analysis methods apply to economic systems as well as natural ones. Decades of studying natural

ecosystems, in particular, have led to very sophisticated mathematical understandings of how a network structure affects an ecosystem's long-term viability, as judged by its balance between efficacy and resilience. Efficacy measures the ability of a system to process volumes of the relevant matter-, energy- and/or information-flow.

Resilience measures the ability of a system to recover from a disturbance. These variables have been more formally defined as follows:

1. Efficacy: a network's capacity to perform in a sufficiently organized and efficient manner as to maintain its integrity over time;[19] and
2. Resilience: a network's reserve of flexible fallback positions and diversity of actions that can be used to meet the exigencies of novel disturbances and the novelty needed for ongoing development and evolution.[20]

Two key structure-related variables—diversity (the existence of different types of agents acting as "nodes" in the network) and interconnectivity (number of pathways between agents)—play a central role in both efficacy and resilience but in the opposite direction. In general, a system's resilience is enhanced by more diversity and more connections, because there are more channels to fall back on in times of trouble or change. Efficacy, on the other hand, increases through streamlining, which usually means reducing diversity and connectivity.

The main point is that nature never selects for maximum efficacy, but for an optimal balance between the two opposing poles of efficacy and resilience. Because both are indispensable for long-term sustainability and health, the healthiest flow systems are those that maintain an optimal balance between these two opposing pulls. Conversely, an excess of either attribute leads to systemic instability. Too much efficacy leads to brittleness and too much resilience leads to stagnation: the former is caused by

too little diversity and connectivity, and the latter by too much diversity and connectivity.

Sustainability of a complex flow system can therefore be defined as the optimal balance between efficacy and resilience of its network. With these distinctions we are able to define and precisely quantify a complex system's sustainability in a single metric. Indeed, we now have a way of quantitatively measuring all the relevant components separately: total throughput, efficacy, and resilience. Furthermore, the underlying mathematics are well behaved enough so that there exists only one single maximum for a given network system. The generic shape of the relationships between sustainability and its constituent elements is such that there is an asymmetry: optimality requires more resilience than efficacy!

Until recently, total throughput and efficacy have been the only means for us to identify the relative success of a system, whether in nature or in economics. For example, in ecosystems, as in economies, size is generally measured as the total volume of system throughput/activity. Gross Domestic Product (GDP) measures size this way in economies, while Total System Throughput

(TST) does so in ecosystems. Many economists urge endless growth in size (GDP) because they assume growth is a sufficient measure of health. GDP and TST, however, are poor measures of sustainable viability because they ignore network structure. They cannot, for example, distinguish between a resilient economy and a bubble that is doomed to burst—or between healthy "development," as Herman Daly describes it, and explosive growth in monetary exchanges simply due to runaway speculation.

Now, however, we can distinguish whether a particular increase in throughput and efficacy is a sign of healthy growth or just a relatively short-term bubble that is doomed to collapse. Over time, nature must have solved many of the structural problems in ecosystems (otherwise, these ecosystems simply wouldn't exist today.)

APPLICATION TO OTHER COMPLEX SYSTEMS

The question will undoubtedly be raised whether what we learn from ecosystems still makes sense when applied to other systems, such as economic communities. It is critical to understand that the findings described so far arise from the very structure of a complex system, and therefore that they remain valid for any complex network with a similar structure, regardless of what is being processed in the system: it can be biomass in an ecosystem, information in a biological system, electrons in an electrical power network, or money in an economic system. This is precisely one of the strong points of using a weblike network approach instead of machine-like metaphor.

The fields of engineering, business, and economics have all been focusing almost exclusively on efficacy, and therefore constitute a wide-open field to explore the validity of the proposed metrics to improve sustainability. For example, electrical power grids have been systematically optimized for decades toward ever-greater technical and economic efficacy. It has come as a surprise to many engineers that, as they have approached higher efficiencies, suddenly large-scale blackouts have been breaking out with a vengeance "out of nowhere." For instance, large-scale blackouts have hit huge areas of the United States and Northern Germany. Among the famous ones, we should mention the 1965 blackout in New York, or the Northeastern United States blackout of 2003, and the November 2006 blackout hitting much of Western Europe. But, even excluding lightings and other catastrophic natural events, on the average every four months a power outage large enough to darken at least five million American homes occurs. The data should be available to model these systems as networks because that is what they literally are. One can then quantify their efficacy and resilience. The solution on how to rebalance such a system to make it less brittle, and to determine

its optimal sustainability, would be an obvious "hard science" test application of the metrics described here.

The point being made here is truly profound and has wide-reaching implications for all complex systems, natural or human-made, including our worldwide financial and monetary system.

Placing too much emphasis on efficacy tends to automatically increase size and consolidation at the expense of diversity, connectivity, and resilience until the entire system becomes unstable and collapses. In short, excessive focus on efficacy tends to create exactly the kind of bubble economy that we have been able to observe repeatedly in every boom-and-bust cycle in history, including the biggest bust of them all, the 2008 crisis and its aftermath.

APPLICATION TO FINANCIAL/MONETARY SYSTEMS

Viewing economies as flow systems ties directly into money's primary function as a medium of exchange. In this view, money is to the real economy like blood is to your body: it is an essential vehicle for catalyzing processes, allocating resources, and generally allowing the exchange system to work as a synergetic whole. The connection to structure is immediately apparent. In economies, as in ecosystems and living organisms, the health of the whole depends heavily on the structure by which the catalyzing medium, in this case, money, circulates among businesses and individuals. Money must continue to circulate in sufficiency to all corners of the whole because poor circulation will strangle either the supply side or the demand side of the economy, or both.

Our global monetary system is itself an obvious flow network structure, in which monopolistic national currencies flow within each country (or group of countries in the case of the euro), and interconnect on a global level. The technical justification for enforcing a monopoly of national currencies within each country was to optimize the efficacy of price formation and exchanges in national markets. Tight regulations are in place in every country

to maintain these monopolies. In his seminal 1955 paper on this topic, Milton Friedman proposed that letting markets determine the value of each national currency would further improve the overall efficacy of the global monetary system. This idea was actually implemented by President Nixon in 1971, to avoid a run on the dollar at that time. Since then, an extraordinarily efficient and sophisticated global communications infrastructure has been built to link and trade these national currencies. According to the Bank of International Settlements (BIS), the trading volume in the foreign exchange markets reached an impressive $4 trillion per day in 2007, and the derivatives are not included in that statistic! Nobody questions the efficacy of these markets, but many people are now coming to question their resilience.

The global network of our monopolistic national moneys has evolved into an overly efficient and dangerously brittle system. This system's lack of resilience, however, shows up not in the technical field of the computer networks (which all have backups), but clearly in the financial realm. This fact has been spectacularly demonstrated by the large number of monetary and banking crashes over the past thirty-five years. Such crises—particularly a combined monetary and banking crash—are, other than war, the worst thing that can happen to a country.

Even more ironically, whenever a banking crisis unfolds, governments invariably help the larger banks to absorb the smaller ones, under the logic that the efficacy of the system is thereby further increased.

Today's global monetary ecosystem is significantly overshooting the optimal balance, because of its exclusive emphasis on efficacy. It is careening toward brittleness and collapse because a general belief prevails that all improvements need to go further in that the same exclusive direction of increasing growth and efficacy. For instance, the global monoculture of bank-debt money as legal tender is technically justified on the basis of efficacy of price formation and

exchanges within each country. Internationally, floating exchanges were also justified because they make the foreign exchange markets "more efficient." An overly efficient system is an accident waiting to happen. In observing the dynamics of an artificially enforced monoculture in a complex system where efficacy is the only criterion considered relevant, we find that the only possible outcome is systemic collapse.

As stated earlier, nature has over billions of years selected the conditions under which complex ecosystems are sustainable; otherwise they wouldn't exist today. In contrast, humanity still struggles with the issue of how to create sustainable economies. We know that the theoretical framework applies to both natural and man-made complex systems. Has the time not come to learn in this domain from nature?

THE SYSTEMIC SOLUTION

The systemic solution to our monetary crisis, therefore, is to increase the resilience of the monetary system, even if at first sight that may be less efficient. Conventional economic thinking assumes the de facto monopolies of national moneys as an unquestionable given. The logical lesson from nature is that systemic monetary sustainability requires a diversity of currency systems, so that multiple and more diverse agents and channels of monetary links and exchanges can emerge.

This is the practical lesson from nature: allow several types of currencies to circulate among people and businesses to facilitate their exchanges, through the implementation of complementary currencies. These different types of currencies are called complementary because they designed to operate in parallel with, as complements to, conventional national moneys. The problem is the monopoly of one type of currency, and replacing one monopoly with another isn't the solution.

As Edgar Cahn's work on Time Dollars demonstrates,[21] whenever complementary currencies begin flowing through the mainstream, the degree of diversity and interconnectivity in the system will increase, due to their ability to catalyze business processes and individual efforts that are too small or inefficient to compete for national currencies in a global marketplace. This approach will certainly appear unorthodox to conventional thinking, but conventional thinking is precisely what got us into this trouble to begin with. This tactic can also resolve the dilemma of what to do now about today's systemic banking crisis.

OUR PROPOSAL

Our proposal focuses here on what can and should be done most urgently to reduce the impact of the financial crisis on the "real" economy, the one where businesses produce and sell nonfinancial goods and services. It involves three components: (a) actions by the private business sector, (b) decisions by national governments, and (c) decisions by city and local governments.

THE BUSINESS SECTOR

The "real" economy is predictably becoming the biggest victim of the ongoing financial crisis. Whatever governments do for the banks, credit will be a lot harder for companies to obtain from banks for years to come. However, there is something that companies can do themselves to avoid the worst aspects of this problem. It is possible for companies to lead themselves out of this crisis.

THE WIR IN SWITZERLAND: A CASE STUDY

Once upon a time, during a crisis similar to the one in which we are now mired, sixteen businessmen got together to decide what they could do among themselves. They or their clients had each received a notice from their respective banks that their credit line

was going to be reduced or eliminated; hence bankruptcy was only a question of time. They realized that business A had needed the bank loan to buy goods from business B, which in turn needed money to buy stuff from its own suppliers. So they decided to create a mutual credit system among themselves, inviting their clients and suppliers to join. When business A bought something from B, A got a debit and B the corresponding credit. They created their own currency, whose value was identical to the national money, but with the interesting feature that it didn't bear interest.

The country's banks mounted a massive press campaign to try to squelch this revolutionary idea. Miraculously, that campaign failed, and this little system saved the businesses involved at the time. A cooperative was set up among the users to keep the accounts dealing with that currency. Soon participants could also borrow from that cooperative in that currency at the remarkably low interest rate of 1 percent. All such loans needed to be backed by inventory or other assets. Over time, the system grew to include up to one-quarter of all the businesses of the entire country.

Sixty-five years later, James Stodder from Rensselaer Polytechnic Institute performed an econometric study proving that the secret for the country's legendary economic stability was that strange little unofficial currency, circulating among businesses in parallel with the national money. That well-known economic resilience was usually credited to some mysterious and unknown national characteristic. Stodder's remarkable quantitative study used more than sixty years of high quality data to prove the points made in this story.[22]

Whenever there was a recession, the volume of activity in this unofficial currency would expand significantly, thereby reducing the recession's impact on sales and unemployment. Whenever there was a boom, business in national currency expanded, while activity in the unofficial currency proportionally dropped back again. The surprising implication of this study is that the spontaneous counter-cyclical behavior of this little "unorthodox" system

actually helped the central bank of the country in its efforts to stabilize the economy.

This is not a fairy tale, but the true story of the WIR system in Switzerland; the sixteen founders met in Zurich in the year 1934, and the system is still operating today. The annual volume of business in the WIR currency is now about $2 billion per year. The WIR system is also now accepting deposits and making loans in Swiss francs as well as in WIR. The biggest limitation of the WIR system is that WIR are not convertible into national money. Therefore, credits earned in WIR need to be spent on good and services of other members of the same network. That limitation has now been resolved thanks to another complementary currency innovation called the Commercial Credit Circuit (C3).

COMMERCIAL CREDIT CIRCUITS (C3)

It is also a well-known fact that the vast majority of private jobs (between 80 and 90 percent) are provided by small and medium sized enterprises (SMEs). And the survival of many such firms is now increasingly at risk because of cash flow problems.

SMEs are being pressured by suppliers for prompt payments, say within thirty days, while their larger customers pay them only in ninety or more days. This becomes a deadly cash flow trap whenever banks refuse to provide bridge financing, or do so at steep conditions. This problem has become more critical recently in developed countries under the impact of the financial crisis, but it has long been an endemic issue in developing countries.

The Social Trade Organisation (STRO), a Dutch research and development NGO, has successfully developed business models over the past decade in several Latin American countries which culminated with a financial innovation that structurally addresses this precise challenge. The process uses insured invoices or other payment claims as liquid payment instruments within a business-to-business clearing network. Each recipient of such an instrument

has the choice to either cash it in national money (at a cost), or directly pay its own suppliers with the proceeds of the insured invoice. This is achieved via the following six steps:

1. Participating businesses start by securing an invoice insurance up to a predetermined amount, based on the specific credit worthiness of their own business and of the claims they obtain on third parties.
2. The business that has obtained such an insurance (hereafter referred to as business A) opens a checking account in the clearing network, electronically exchanges the insured invoice for clearing funds, and pays its supplier (business B) immediately and fully with those clearing funds via the clearing network.
3. To receive its payment, business B only needs to open its own checking account in the network. Business B has now two options: either cashing it in for conventional national money (at the cost of paying the interest for the outstanding period, e.g., ninety days, plus banking fees); or pay its own suppliers with the corresponding clearing funds (at no cost).
4. Whatever the timing of the payment is to business A, business B is in a position to use the positive balance on its account in the network, for instance to pay its supplier, business C.
5. Business C only needs to open an account in the network. It has then the same two options as business B: cash it in for national money, or spend it in the network. And so on …
6. At maturity of the invoice, the network gets paid the amount of the invoice in national money, either by business A or by the insurance company (in case of default of business A). Whoever owns at that point the proceeds of the insured invoice can cash them in for national money without incurring any interest costs.

The implementation of a C3 a system has distinct benefits for businesses, governments, and banks.

Businesses increase their access to short-term credit as needed to improve their working capital and the use of their productive capacity. The size of this credit can be built up to a stable level between a quarter (covering therefore up to an average of ninety days of invoices) and half of annual sales, at a cost substantially lower than what is otherwise possible. Suppliers are paid immediately, regardless of the payment schedule of the original buyer, injecting substantial liquidity at very low cost in the entire SMEs network. The approach provides a viral spreading of participation to the C3 networks from clients to suppliers. The technology is a proven one, doesn't require any new legislation or government approvals, and the necessary software is available in open source.[23] Only invoices that are 100 percent guaranteed, and 100 percent computerized, are acceptable in a C3 system. C3 thereby encourages the generalization and more efficient use of IT infrastructure among SMEs, including the opening of new markets and marketing channels through e-commerce.

Governments, particularly regional governments, will also benefit. Notice that the most effective way for governments at any level to encourage the implementation of the C3 strategy is for them to accept payment of taxes and fees in the C3 currency. This encourages everybody to accept the C3 currency in payment, and provides additional income to the government from transactions that otherwise wouldn't take place. Furthermore, that additional income becomes automatically available in conventional national currency at the latest ninety days after the payment, thereby not upsetting any existing procurement policies. The first country that has followed this strategy is Uruguay.

The C3 approach is also a dependable way to systemically reduce unemployment. Governments at different levels (EU, national, regional) can contribute to a joint guarantee mechanism.

Such a guarantee mechanism is considerably cheaper to fund than subsidies or other traditional approaches to reduce unemployment. C3 helps shift economic activities from the black or grey economy into the official economy, because SMEs need to be formally incorporated to participate, and all exchanges are electronic and therefore traceable.

C3 systems are best organized at a regional level, so that each network remains at a manageable scale. Businesses with an account in the same regional network have an incentive to spend their balances with each other, and thus further stimulate the regional economy. C3 provides a win-win environment for all participants, and therefore promotes other collaborative activities among regional businesses. Each C3 network should use the same insurance standards and compatible software so that they can interconnect as a network of networks to facilitate exchanges internationally.

The win-win approach of C3 also benefits banks and the financial system. As the entire C3 process is computerized, it significantly streamlines the lending and management for the insurance and loan providers. SMEs can therefore become a more profitable sector for banks, because the credit lines are negotiated with the entire clearing network, providing the financial sector with automatic risk diversification among the participants in the network. In the upcoming surge of new competitors in the market—such as Facebook, Google, or Tesco currencies and banks—this monetary innovation provides an additional window for banks to sell their core activities. Most banks are also involved in providing insurance services. C3 opens for them a whole new market for insurances and credit, all the way down to services for microfinance enterprises. As C3 is completely computerized, even such individually small-scale entities can now be serviced at a very low cost. Finally, the C3 mechanism systemically contributes to the stability of employment and of the entire economy, which is helpful for the overall solidity of the banks' portfolios.

We propose that businesses take the initiative of creating such business-to-business (B2B) systems at whatever scale makes most sense to them.

There is one more thing that the businesses that get involved in such systems should consider doing: lobbying their respective governments to have them accept their B2B currency in payment of business taxes. This could apply only temporarily, i.e., for the period during which the banking system will not be in a position to fulfill its traditional role of financing the "real" economy to the extent that is necessary. The lobbyists have a simple but powerful argument: it doesn't cost the government any money, will actually increase tax revenue, and is the best systemic way to reduce unemployment.

GOVERNMENTS

Governments will not be willing or able to force banks to lend out to the "real" economy, any more than you can push on a string. Therefore, in addition and parallel to accepting the usual bank-debt conventional money, accepting some complementary currency for payment of taxes makes a lot of sense. Which currencies should be acceptable for payment of what types of taxes is a political question that remains open for each government to decide.

They also have a built-in interest in receiving payments in a robust currency. It is obvious that the existence of such a currency facilitates exchanges that otherwise wouldn't happen, while conventional money or credit are difficult to obtain. These additional exchanges, in turn, increase the taxable income of the businesses involved, thereby starting a virtuous loop that counteracts the credit reductions by the banking system.

When people and businesses are strangled by lack of money, taxable income is automatically squeezed as well. By accepting some payments in currencies other than bank-debt money, by definition more governmental income is possible.

CITIES AND LOCAL GOVERNMENTS

There are two reasons why we recommend allowing cities and local governments to choose their own complementary currencies to implement this strategy. First, cities and local governments will be the first governmental entities to get into still deeper trouble than they are today; and second, they represent diversity and resilience at work. Given that this approach is radically new, it is simply safer to test out a new system as a pilot at a city or local level, rather than directly on a larger scale at the national level.

Indeed, cities and other local government entities will find themselves in the first line to bear the brunt of the social effects of the looming recession, while at the same time they will see their tax revenue shrink, and conventional financing through debt become much harder to obtain. This kind of problem is not going to be limited only to the United States.

The London-based *Observer* asks, "What could possibly come along in the middle of this series of economic nightmares to make things even worse? How about a total depletion of local government finances that pay for the things that make up the very fabric of American society? Imagine that rippling across the rest of the world, reducing public services to skeleton operations." Such ramifications are further explored by fiscal analyst Sujit Canagaretna:

> What is most disconcerting about the way this turmoil is panning out is that most state governments were already in a terrible state. But now things have worsened considerably and the credit markets have a real choke hold on almost all state treasuries. It is so bad that economic activity in most states has all but ground to a halt.[24]

The second argument for local currencies is that some diversity in experimenting with a new strategy can only be beneficial to all concerned. If specific issues are considered a political priority, other types of complementary currencies than the B2B ones described above could be considered. For instance, if carbon reduction is considered an important priority, a carbon reduction currency program could be launched and accepted in partial payment in taxes. Some applications of the eco-money programs in Japan are relevant precedents in this domain.

Similarly, local or regional taxes could be paid partially in conventional money, and partially in regional currencies. In short, a whole new set of tools to create incentives for specific behavior patterns, either corporate or individual, is now available, tools that in most cases have already been tested somewhere in the world.

Obviously, implementing a strategy of this nature should be done in careful steps, starting with pilot application on a limited scale. A European-wide project, for instance, should be started with a cooperative venture on a smaller scale.

ANSWERING SOME OBJECTIONS

The first objection will obviously arise from the banking system, which would prefer to keep the status quo. However, banks are going to be disintermediated by a broader use of B2B currencies only if they themselves remain aloof.

The second objection that is quite predictable will come from traditional economic thinking: using multiple currencies within a national economy reduces the efficacy of the price formation process and of the exchanges among economic agents. While this argument is valid, we know now that this overarching emphasis on efficacy is precisely what has reduced the resilience of the system, and made it so brittle.

SOME ADVANTAGES OF THE PROPOSED APPROACH

Our proposal, therefore, provides a systemic solution to the instability of the monetary system, something that the current approaches are not even trying to achieve. Systemic solutions are

the only ones that will avoid repeatedly having to go through the same type of problem in the future. For example, as the WIR example demonstrates, complementary currency systems have proven to be a key factor in fostering counter-cyclical stability.

A multiscale multistakeholder strategy has a number of advantages for the different parties involved, particularly during the transition period that we now have entered. Leadership will be required at all levels—public and private, local and national—to guide ourselves out of this crisis.

- This approach will avoid or reduce the strangulation of the real economy by the banking credit contraction that unquestionably is going to continue for a while.
- The decision that governments should reach—accepting payment of taxes in money other than exclusively bank-debt money—rests completely within their own political decision power. This strategy is also very flexible: a government can decide to accept payment of certain taxes only, only for a given percentage, for specific types of complementary currencies chosen for their robustness and have other positive effects, and/or only for specific fiscal years.
- Until now, taxes have been payable only in "legal tender," which means conventional bank-debt money. Any currency is an incentive scheme, and our current way of dealing with taxes and subsidies is limited to that single instrument, which needs to be scarcer than its usefulness to keep its value. With complementary currencies, a whole additional array of options become available, which can focus on—and fine-tune precisely—the objectives that one wants to reach. We can, therefore, tailor the complementary currencies accepted for payments of taxes to the massive challenges currently faced around the world.

- Complementary currencies have proven a useful tool for enabling the design of incentive schemes in a wide variety of domains, regardless of whether a crisis is at hand. The evidence for this can be found in a number of publications.
- Perhaps most importantly: This strategy will avoid repeating the worst part of the 1930s scenario where economic strangulation was left to play out fully, which resulted in massive bankruptcies in the productive economy, intolerably high unemployment and untold suffering, and a toxic political fallout that has proven a dangerous mess to disentangle once started. Hjalmar Schacht, Hitler's central banker, pointed out correctly that the electoral popularity of Nazism was directly due to mass "despair and unemployment."