monetary instruments, or, at the very least, its own way of using them. Second, the disappearance of old forms of cash creates the space required for the introduction of new forms because, as we have seen, anonymity and materiality are actually less important than the social significance of the use of cash. Finally, this dematerialisation must be seriously qualified: is anyone willing to believe that a virtual euro, whose existence requires hundreds of engineers, thousands of kilometres of fibre-optic or coaxial cables and billions of euros of technical equipment, is any less "material" than a coin of low-quality bronze struck by two individuals equipped with a small crucible, a hammer and tongs? Surely not the shopkeepers who curse when their terminals malfunction.

(1) Bruce Bartlett, "America's Most Profitable Export Is Cash", *The New York Times*, 9 April 2013.
(2) See in particular, André Mater, *Traité juridique de la monnaie et du change*, Dalloz, 1925.
(3) "Trésor de la langue française informatisé". Notice consulted on 28 December 2015.
(4) François-Michel Chrétien-Descamps, *Lettres sur le Visa des dettes de l'État ordonné en 1721*, edition prepared by François Velde, Classiques Garnier, 2015, p. 14. The author dated these letters at 1732, but François Velde shows they were taken from an earlier text, circa 1725, by the same author.
(5) Adam Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations*, Book II, Chapter 2, Londron, Methuen & Co, 1776, electronic version on econlib.org consulted on 29 December 2015. See especially paragraphs 24 and 26: "The substitution of paper in the room of gold and silver money, replaces a very expensive instrument of commerce with one much less costly, and sometimes equally convenient."
(6) John Hicks, "Automatists, Hawtreyans, and Keynesians", *Journal of Money, Credit and Banking*, Vol. 1, no. 3, August 1969, pp. 307-317.
(7) The term "hard money" stems of course from the nature of 19th century monetary standards which were both metallic (hard) and precious, but it also refers to the monetary discipline they presuppose, which was replaced in the 20th century (putting aside the many previous episodes) by the coinage rules imposed on second-tier banks by the central banks, the only institutions allowed to create money *ad libitum*.
(8) Viviana Zelizer, *The Social Meaning of Money*, New York, BasicBooks, 1994.
(9) Monetary authorities long believed that "fiduciary" money was more inflationist than "scriptural" money.

*Bernard Lietaer**

COMPLEMENTARY CURRENCIES TO THE RESCUE OF AN UNSTABLE SYSTEM

Anecdotal, marginal, even romantic are some of the terms commonly used to describe complementary currencies. However, should they become too successful, they are immediately accused of interfering with monetary policy, upsetting price formation mechanisms and reducing economic productivity.

Within current legal frameworks, a monetary monopoly is the rule in each economic zone — most frequently the nation state — be it in a capitalist or Marxist-Leninist context. The most significant difference is that in the communist case banks are permanently state-owned, while in capitalist economies they are publicly owned only during transitional periods in the wake of spectacular serial banking failures. But the system is fundamentally the same: a monopoly of a single currency created by debts with the banking system.

Recent research is starting to question this way of seeing things (1). This research tells us that measuring the viability in quantitative terms of any complex flow network (be it a natural ecosystem or an economic and financial system) reveals that a monoculture is universally harmful. Just as a plant-based monoculture upsets the balance of naturally resilient environments, so a monetary monoculture destabilises our economies. This claim is in no way the reflection of a personal preference or opinion. It is the result of a law as universal as the law of gravity!

It shows that in *any* complex flow network system, far from being a disruptive element, a minimum of diversity is

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a necessary (though insufficient) condition for guaranteeing *structural stability*. In other words, guaranteeing economic and financial viability requires a diversification of the types of currency in circulation and the types of agents that issue them. This is exactly the result that would be achieved by the multiplication of complementary currencies currently being witnessed around the world. This process is going to be further facilitated by technology with decentralised mobile payment systems capable of managing several currencies simultaneously.

Still more importantly, the applications of the blockchain — the computer technology used by bitcoin to permit direct user-to-user exchanges without a trusted third party — make it possible to convert many assets into digital cryptocurrencies. Cryptocurrency transactions exhibit higher levels of security than those seen to date in conventional payment systems, so there will be no surprise if some of the assets converted into cryptocurrencies become over time de facto significant complementary currencies. The conventional banking and financial system, which is now investing massively in blockchain applications, could thereby play its part in the emergence of a digital monetary ecosystem.

Productivity: an inadequate metric

Three indicators are essential to the analysis of the proper operation of any complex flow system, whatever it may be.

Viability is the capacity of a complex flow system to endure over time whilst maintaining its integrity. It is a quantitative measure expressed as a percentage (%) of sustainability.

Productivity is defined as the volume processed by a complex flow network per unit of time (e.g. grams of biomass per square metre per year for a natural ecosystem; annual GDP for an economy; billions of dollars per day in an electronic payment system; or KWh for an electricity distribution grid).

Resilience is the capacity of a complex flow system to survive an attack or a disease or adapt to a change in its operating conditions or environment whilst maintaining its integrity.

Productivity — the principal, not to say only prism of conventional economic analysis — is therefore far from satisfactory as a metric of viability of an economy. GDP, the standard metric of economic growth, is indeed unable to distinguish between healthy growth and a short-term bubble, and is therefore incapable of evaluating economic viability.

The purpose of this paper is to determine the *structural stability conditions and thus the structural viability of any complex flow network*. This requires us to focus on the third metric: resilience, i.e. the ability to cope with internal and external shocks and adapt if necessary.

To do this we need to look to information theory which tells us that the development of a complex system is based on two elements: order and the absence of order. The first quantifies everything that is regular, orderly, coherent and efficient. It encompasses almost all fields of conventional science. By contrast the second element — often overlooked — measures irregularity and incoherence, erratic behaviours adjudged to be potentially inefficient that have escaped rationalisation.

All living systems include both such elements of order and of absence of order, enabling them to adapt in homeostatic fashion to buffer performance by expending what Odum calls reserves (2). The reserve in this case is not merely a stock of a material or energy resource; it is a characteristic of the system *structure* that reflects its flexibility both to survive change and adapt to new circumstances, generally resulting in a reduction of productive performance (3). Systems that last — i.e. systems that are viable — are located in this dynamic balance somewhere between the two poles of order and disorder, of efficient performance and evolutionary resilience.

Resilience, the forgotten metric

Applied to the observation of natural ecosystems, the relationship between viability, resilience and productivity (the first being a function of the other two) takes the form of an asymmetrical bell curve. At the top is a specific area in which all sustainable natural ecosystems are located: the "viability window". Too much resilience and the ecosystem stagnates; too much productivity and it becomes structurally unstable and chaotic. In short, one way or another, excesses of resilience or of productivity leads inexorably to a collapse of viability. This curve is not completely symmetrical for in natural systems survival demands greater resilience than productivity.

The next question is inevitably whether the lessons drawn from natural ecosystems can be applied to other complex flow systems such as economic or financial systems. In other words, does the ecosystem provide a simple *metaphor* for the economy,

a metaphor in which biomass plays a role *analogue* to that of a currency? The answer is no. On the contrary, what we are dealing with is a *universal law* that applies to the *structure* of any *complex flow network* system, irrespective of the nature of the flows, of the network, or of the elements which make up that network. Just as Newton's discovery implied that the law of gravity was a universal law that applied in exactly the same way to the mass of the moon and the mass of an apple falling in his orchard.

In our particular case, the reference to Newton is even directly relevant for the driving force behind our theoretical framework is *entropy*, which contemporary thermodynamics have shown to be at the origin of gravity itself (4). We were therefore being overly cautious when, at the start of the article, we claimed that the law underlying our thesis was as fundamental as that of gravity itself. In fact, it is even more fundamental, since it is a law that has generated gravity!

The study of the structural viability conditions of complex flow networks requires only two *structural* variables: diversity and connectivity, and they are valid for any complex flow network with the same structure irrespective of the nature of the flows circulating in the network: biomass in an ecosystem, information in a biological system, electrons in an electricity distribution network or a currency in an economic system.

The current monetary system is hyper-productive and therefore hyper-fragile

By verifying the conditions of stability of financial and monetary systems as complex flow systems, we can predict that overvaluing productivity will tend to create exactly the type of economic bubbles we have observed time and again at each economic expansion and recession cycle, including the great fiasco triggered in 2007-2008.

Indeed, the global economy is a complex flow network in which national currencies circulate within each country (or group of countries as in the case of the euro) and interconnect at a global level. The monopoly position occupied by each of the currencies within a given country facilitates the price formation mechanism and the exchanges in national markets. Strict regulations have been put in place in each country to maintain these monopolies.

In an article published in 1953, Milton Friedman (5) proposed allowing the foreign exchange markets to determine the value of

each national currency in order to improve the global effectiveness of the monetary system. This idea was actually put into practice by President Nixon in August 1971 to avoid a dollar collapse. Since then, national currencies have been interlinked by an extraordinarily efficient and sophisticated global communications network. By 2013, the volume of transactions carried out in these foreign exchange markets reached the staggering figure of 5.3 trillion dollars *per day* (a figure that should be further increased by several trillion dollars worth of foreign currency derivative transactions) (6). Over 97% of this volume is speculative; the portion involving genuine international trade in goods and services across the world represents less than 3%…

Speculation can play a positive role in any market, helping to make it more efficient by increasing market liquidity and depth. But current levels of speculation are clearly excessive. Despite dating back over half a century, the words of John Maynard Keynes remain surprisingly relevant: "Speculators may do no harm as bubbles on a steady stream of enterprise. But the position is serious when enterprise becomes the bubble on a whirlpool of speculation. When the capital development of a country becomes a by-product of the activities of a casino, the job is likely to be ill-done." (7). And that's the very least that can be said!

The current response to systemic crises: a vicious circle?

No one doubts the effectiveness of these enormous markets. The problem is their lack of resilience, which creates the chronic instability that is leading to crisis after crisis. Each time a crisis breaks out, governments invariably bail out larger banks and help them absorb smaller ones. This was indeed the major lesson learned from the Great Depression of the 1930s: if a government lets the banking system fail, everything grinds to a halt! Post 2008, governments, afraid they would be unable to cope with another banking crisis, passed "bail in" legislation (8).

As stated earlier, money — the substance that irrigates our global economic network — is created everywhere today through bank debt. History shows, however, that there are also other ways of creating money. There is gold, of course, its quantity being determined by gold field production. But it is not the only other way! Other, more modern examples are equally interesting: granting a central bank a monopoly on money creation — the solution proposed in Iceland to extract itself from its banking crisis;

Switzerland's WIR bank, a system through which sixty thousand businesses lend and borrow a currency created 80 years ago in the face of the 1929 crisis; and the thousands of complementary currencies, largely local initiatives, spawned over the last twenty years around the world. In addition, blockchain technology is currently opening up unprecedented new horizons.

The banks' monopoly on money creation through debt is currently facing substantial criticism despite the fact that it is protected in Europe by the Lisbon Treaty and elsewhere by the influence of the financial community on the political classes. However, an economy — a living system, after all — can escape neither entropy nor the laws of life. Imagine a planetary ecosystem in which one single species of plant or animal was tolerated and artificially maintained and from which all diversity was banished, the arrival of any competing species being perceived as a threat likely to reduce the productivity of the whole. Such a system, no matter how effective, is bound to come to a bad end, condemned to suffer a sudden crash and collapse regardless of the heroic efforts by experts and regulators to keep it afloat...

So what happens after a collapse of this kind? Let us consider the systemic crises — simultaneous monetary and banking crashes — that occurred in Germany in the late 1920s, in the United States at the start of the 1930s, in Russia in the 1990s and in Argentina between 1999 and 2002. In all these countries, the collapse manifested itself through the disintegration of economic circuits and a drastic fall in productivity: the financial and economic "ecosystem" ceased to be viable.

Very quickly, in such survival situations, a barter economy develops based on informal norms and agreements. In theory, a more diversified and interconnected economy could form gradually over time and bring the system back into the viability window. In practice, however, we always return to a monetary monopoly as quickly as possible.

Let us contrast this process of collapse with what happens in a natural forest in which seeds fall to the forest floor and germinate at random. Gradually, a flora and fauna appear that are adapted to the dominant natural environment and, over the course of time, form the structure of a new emerging ecosystem which finally stabilises within the viability window.

New crashes, old solutions

Fortunately, most crises are less serious that the financial and monetary cataclysms described above. Exploring these extremes does, however, give us an idea of the power and the nature of the dynamics at work. Less serious crises reveal only parts of the process, just as a partial forest fire presents only certain characteristics of flame damage rather than reducing the entire forest to ashes.

As we have already said, nature has selected the conditions that make ecosystems viable over billions of years. Were this not the case, they simply would not be here today. The conditions required to maintain viable economies, however, have yet to be elucidated. How many more crises will we have to endure before the human race grasps the structural nature of the problem? To paraphrase Albert Einstein, insanity is doing the same thing over and over again and expecting different results…

Another way: allowing complementary currency systems

The other way would be to allow the emergence and growth of complementary currency systems, even to assist the most promising of them to flourish. Today a social movement of complementary currencies is taking shape. A progressive way of bringing greater resilience and stability to the economy, it merits encouragement.

In France, a first essential step was taken with the amendment of section 16 of the French Law of 14 May 2014 (*Loi relative à l'Économie sociale et solidaire*). Indeed, France was the first country to grant legal status to local currencies. But one essential condition for the successful operation of these currencies is still missing: taxpayers need to be able to use them to pay their local taxes. Without this, the money circulation loop cannot be closed and these systems will tend to remain marginal. In the UK, the Bristol Pound is demonstrating the powerful role that a city administration can play when accepting payment of taxes in the local currency.

Let us concede one point to conventional economists: diversity of means of exchange is less efficient than a monopoly. It has also been proved, however, that the resulting drop in productivity is the unavoidable price to be paid for increasing resilience — a resilience whose necessity has been amply demonstrated. At the

other extreme, some advocates of complementary currencies wish to encourage a very high number of monetary initiatives. Here we must sound a warning: more is not necessarily better... To take this logic to a ridiculous extreme, if each individual were to issue his or her own currency, the result would undoubtedly be total stagnation.

Current experiments too timid

The risk of an overabundance of complementary currencies is clearly less imminent than that of their suppression which, in the eyes of the conventional central banking authorities, would simply be the price of their success. One central bank (that of Brazil) has officially reached the conclusion that social currencies help to build social capital and reduce poverty rather than threaten monetary policy (9).

The most mature complementary currency is Switzerland's WIR system, which we have already touched on. Thanks to WIR, we have empirical proof that the contracyclical effect of Complementary B2B currencies helps central banks in their task of stabilising the national economy in terms of jobs and GDP growth (10).

An ageing population and climate change: two new challenges that complicate the situation

Governments are currently having to face two unprecedented challenges: an aging population and climate change. According to a study by the Bank for International Settlements (BIS), between now and 2020 ageing is set to increase the public debt/GDP ratio to above 200% in the United Kingdom and more than 150% in France, Ireland, Italy, Greece, Belgium and the United States. As far as climate change is concerned, all experts agree on one fact: dealing with it would require the investment of hundreds of billions of euros in a post-carbon energy system, which includes an important role for the public purse. A continuation of the current monetary paradigm will prevent governments from acting to meet either of these challenges.

Against this backdrop, an increasing number of voices, including those of some "traditional" experts, can now be heard stressing the urgent need for unorthodox monetary initiatives. Richard Werner, for example, the inventor of quantitative easing,

is now advocating the direct issue of money by central banks through environmental investments rather than via the banks (11). Michael Kumhof, who has worked both at the IMF and at the Bank of England, goes one step further. In his view, banks should no longer be authorised to create money; he believes that nations themselves should take on this role. This solution, originally suggested by eminent US economists in the 1930s, is known as the Chicago Plan. It could resolve both the sovereign debt problem and the issue of bank instability (12). However, it remains within the paradigm of a monetary monopoly — even if, this time, it would be a public rather than private sector monopoly — and so fails to remove the risk of the third type of crisis: the structural instability of the currency itself. It would be akin to changing the driver of the monetary vehicle rather than the vehicle itself!

A genuine monetary ecosystem would be able to free up the material, emotional and even spiritual creative energies of the human species, presenting us with a larger range of possibilities for dealing with the challenges that face us at the start of the 21st century and making it possible to resolve an old paradox: why biological reasoning, so often used to explain the triumph of the capitalist economy over its communist rival, i.e. multiplicity and initiative versus bureaucratic centralisation, stopped short at the currency issue, as if one vector of information was sufficient in a living system such as the economy. There is no need to be an expert in biological or Darwinian evolution to realise that all living beings operate with a multiplicity of information vectors. Those who have tried to do anything else have been eliminated over time.

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*Anne Snick**

IS A DIFFERENT KIND OF CURRENCY POSSIBLE?

In medieval times guilds used their own currencies for local transactions. Monarchs eager to control the emerging middle class replaced these moneys with their own "royal" currency. By requiring taxes to be paid in their money, they forced local systems out of existence. Now the opposite is happening. Officially only banks have government "fiat" to create money recognized as legal tender and required for paying taxes. Yet local moneys are emerging worldwide. An important driver behind this is that citizens and social-profit organisations have access to information and communication technology (ICT) allowing them to create exchange platforms.

Complementary currencies: great range and variety

Today there is no standardized definition of complementary currencies. At one end of the spectrum are retailers' fidelity systems. A customer is "paid" a point when she or he buys things, and is incited with these points to buy again; consumer loyalty increases profits. Other systems want to bypass bank power. With Bitcoin's block-chain technology transactions can be verified without a central authority. Moneys at this end of the spectrum increase the control of economic actors over (part of) the financial system and strengthen their *competitiveness*, but don't radically question the assumption that "making money" is the aim. At the other extreme are currencies with social or ecological aims, valorising people's contribution to them. In Local Exchange and Trade

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