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Machine/organism dichotomy and free-market economics: Crisis or transformation?

Milan Zeleny

Fordham University, GBA, NY, USA; The Tomas Bata University in Zlin, Czech Republic
E-mail: mzeleny@fordham.edu; mzeleny@quick.cz

Abstract. The free-market economy is being continually challenged – by governments, monopolies, "too big to fail" enterprises, global banks and social experimentation. Crisis is still considered to be a failure of the capitalistic system rather than a failure of politicized state and governmental institutions unable to abstain from interfering with free-market fundamentals. Crisis represents a necessary catharsis which periodically renews and regenerates prevailing business ecology. At the same time, especially with the current crisis, the system is undergoing fundamental transformation, change of paradigm and change of dominant business models. Transformations get naturally confounded with crises. Man's failure and challenge is that we repeatedly fail to do the catharsis of crisis – without the crisis. Disentangling the phenomena of crisis from those of transformation is the main charge of this paper. We address the issues of unemployment in the post-crisis environment, especially in the U.S. We trace the difficulties to treating economy as a deterministic machine while it behaves as an adaptive organism.

Keywords: Free markets, crisis, transformation, tradeoffs, resource allocation, sustainability, invisible hand, autopoiesis, unemployment, knowledge, self-service, job creation, Austrian school, self-organization

Milan Zeleny, Professor of Management Systems at Fordham University, New York City, has been recently ranked No. 1 among Czech economists, according to Hirsch citation index.

In his new book *Human Systems Management: Integrating Knowledge, Management and Systems*, World Scientific, 2005 (reprint 2008), he summarizes knowledge as purposeful coordination of action and its implications for the global economics and management.

Currently also a Visiting Professor at the Tomas Bata University in Zlín, Czech Republic, and Academic Vice Dean and Professor at Xidian University in Xi'an, China. In 2006 also a Distinguished Visiting Professor at Fu Jen University in Taipei, in 2007 at the Indian Institute of Technology, Kanpur, and in 2009–10 at IBMEC in Rio de Janeiro.

Among recently published books are *Information Technology in Business* (Thomson International), *New Frontiers of Decision Making for the Information Technology Era* (World Scientific). Currently working on *The Biocycle of Business: Managing Enterprise as a Living Organism*.

Zeleny has served as the Editor-in-Chief of *Human Systems Management* for 30 years and is on editorial boards of *International Journal of Information Technology and Decision Making, International Journal of Mobile Learning and Organization, Prestige Journal of Management and Research, Economics and Management, Information and Operations Management Education, International Journal of Multicriteria Decision Making (IJMCDM) and International Journal of Innovation and Learning, Strategic Decision Sciences, etc*.

Earlier books include *Multiple Criteria Decision Making* (McGraw-Hill), *Linear Multiobjective Programming* (Springer-Verlag), *Autopoiesis, Dissipative Structures and Spontaneous Social Orders* (Westview Press), *MCDM-Past Decades and Future Trends* (JAI Press), *Autopoiesis: A Theory of the Living Organization* (Elsevier North Holland), *Uncertain Prospects Ranking and Portfolio Analysis* (Verlag Anton Hain), *Multiple Criteria Decision Making* (University of South Carolina Press) and *Multiple Criteria Decision Making: Kyoto 1975* (Springer-Verlag).

1. Introduction

> "The problem of comprehensibility is actually a problem of acceptability. People seem not to understand what they do not like and do not want to hear or read."
>
> Humberto R. Maturana [10]

This paper is rooted in the Central European tradition of the "Austrian School" of economics. Its basic premise is captured in the following question: *How can it be that institutions which serve the common welfare and are extremely significant for its development come into being without a common will directed toward establishing them?* (Hayek quoting Menger; see [4], p. 83). In other words: there are unanticipated consequences of purposive human action [11]. At its core can be exposed the following presupposition: Along with self-interest, which at most can be recognized as the mainspring of human economy, *also public spirit, love of one's fellow men, custom, feeling for justice, and other similar factors determine man's economic actions* [12]. Man's will is guided by innumerable motives or *multiple criteria* [27, 31] often in conflict with each other – contrasting with mechanistic determinism of a singular motive of self-interest.

What is the role of crisis in a free-market economy? What are the main tasks of the State in a free-market economy? What is the main difference between crisis and transformation? What are the main aspects of the post-crisis economy? These and similar questions are the subject of this paper. We shall also discuss the mounting persistence of unemployment in mature economies and argue for treating an economy as an organism rather than a machine.

Our main thesis is that confounding the concepts of crisis and transformation as a single phenomenon creates confusion, inconsistency, and a sense of guessing, fumbling and generally not knowing. The two ideas, crisis and transformation, are related, but still quite distinct.

Crisis, in general terms, represents a turning point or turnaround in the flow of affairs. For example, a situation in which the economy of a country experiences a sudden downturn brought on by a financial crisis. An economic crisis is characterized by a falling GDP, drying up of liquidity and rising/falling prices due to inflation/deflation. Its velocity or intensity labels the form of a recession or depression. Crisis is also that change in the course of a disease which indicates a move towards improvement and recovery or degradation and death. It could also indicate a striking change of symptoms, accompanied by outward manifestations. The prevailing notion of crisis is that it has a resolution, a point of return to standard or resume of "normalcy". We often wait for crisis to end, be over or run its course. Its progress or change is incremental, moving on the *same plane* of effectiveness or performance: a *quantitative change*. *Transformation* has the character of a *qualitative change*. It represents a process of profound and radical change that orients an organization in a new direction and takes it to a new and different level of effectiveness and functioning. Once transformation runs its course, there is a basic change of character and little or no resemblance with the past configuration or structure. There is no return and no resume of normalcy but only a new standard, new way of functioning and doing things. In a living organism transformation alters its general character and mode of life, as in the development of the germ into the embryo, the egg into the animal, the larva into the insect (metamorphosis), etc. Genetic transformation is a process by which the genetic material of an individual cell is altered by the incorporation of foreign (exogenous) DNA into its genome.

The confluence of crisis and transformation applies to all aspects of spontaneous social systems, not only to crisis as a whole. Another example is job creation, sectoral evolution and the issue of unemployment – which are addressed in this paper.

Also the stock market, in its search of the "new normal," is exposed to the same confusion: are the old investing rules being replaced by new ones or is there going to be a sweeping reversion to historical patterns? Although we do not address the stock market here, it is instructive to point out that the so called "equity risk premium" has all but disappeared: U.S. Treasury bonds had outperformed U.S. stocks over the past 30 years and have remained equal over a 40-year period. The impacts are transformational.[1] The U.S. has never had such a six-month period as in 2009 when 2 million jobs were lost while the market gained 50%. Unprecedented phenomena are definitional for transformations. We have entered the age of unthinkable [17].

Quantitative change can climax into qualitative change, crisis and transformation can often run together or in parallel, being quite indistinguishable from each other. Yet, an effective response to one would not be the right response to the other. How do we know whether we are dealing with crisis or transformation? It is important to know the difference. When does a cyclical crisis of capitalism become a transformation towards socialism – and *vice versa*?

Triggers that induce the catharsis of a crisis are often the same triggers that launch qualitative transformation of the economy, business and society at large.

[1] "Interest rates are at zero, there's $2 trillion plus on Federal Reserve's balance sheet, and yet the economy is still losing jobs". M. El-Erian, *Business Week*, October 2009, p. 42.

A crisis is a cyclical progression, recession or slowdown within the same paradigm – most activities can resume along the same lines after its passing. Transformation represents a paradigmatic change in the "way of doing business". Once undergoing transformation, things never return to where they ended, but move towards a new standard and quality in unique and non-recursive ways.

The undetected confluence of crisis and transformation is at the core of the old tools not working, old fools making fools of themselves, new tools not being yet developed and new fools – the ones needed most – not yet being visible or consequential enough to make fools of themselves. We might have forgotten Thomas Kuhn's [9] theory of scientific revolutions[2], but mainly Joseph Schumpeter's [19] "creative destruction", and wonderfully non-mechanistic "Austrian" economics of Carl Menger [12], Friedrich von Hayek [2–6], Oskar Morgenstern [16] and Ludwig von Mises [13, 14][3].

2. At the roots of crises

The basic premise of free markets – that both sides of a business transaction must benefit – has been grossly violated in the past. The gain of one side has been extracted at the loss to the other: the economy has become a zero-sum game without added value. An unregulated market is not free because it allows one side to be cheated, deceived, misled, misinformed or lied to. While we protect the consumers against toxic food, we fail to protect them against toxic mortgages. Markets, in order to be and remain free, must be regulated, i.e. protected against predatory practices of modern exploiters of freedom.

There is a fundamental difference between *market regulation*, which protects fair and legal benefits to both sides, and *market intervention*, which increases the benefit of one side at the cost or loss to the other. Poorly regulated markets allow for excessive government and business intervention, ultimately to the detriment of all – bringing forth a crisis.

Recessions and crises are aggravated and often created by State interventionism through the Central Bank (CB) and its distortions of market signals. Free-market prices represent the best coordination system of signals guiding the economy which no planning committee, central bank or state intervention can ever replace. The less biased, distorted or manipulated are the signals, the better for the economy and ultimately the society. Keeping market signals clear, undistorted and reliable is the most important role and function of the State in the economy.

While direct prices of goods and services are not being purposefully distorted often (some lessons from centrally planned economies have been learned), indirect price-forming effects of money and interest rates are habitually underestimated. Infusing large sums of tax money or manipulating interest rates artificially (for political reasons) undoubtedly deform the prices and lower their signaling efficacy.

Let us take the example of interest rates which are just the *price of money*. Like any other price, interest rates should signal the true state of the economy, not the state of thinking and strategizing at a Central bank. Serious investment decisions are based on the true state of the economy, and the real and undistorted interest rates. Any price controls, including the price of money, lead to unsound decisions, long-term miscalculations and significant losses through erroneous investments.

Decision-making errors and misjudgments – which are a normal part of *individual* decision making in business (due to inherent risk and uncertainty in human systems) – become a *mass and massive* phenomenon under the purposeful and central distortion of prices (of money). Whole classes of business decisions are driven into error and price bubbles, financial recessions or inevitably production collapses.

In Fig. 1 we present a simplified diagram of a normally functioning economy and the crucial role of interest rates in maintaining a precarious balance between current and future production decision and action. Because we are not describing an input-output machine but a self-coordinating organism, the diagram has no beginning or end, causes and effects are not separated. We can only say that consumers either spend or delay spending (save). If they save more, the price of money (interest rates) goes down; if they spend more (consume or invest), interest rates go up.

Let us trace the cause-effect flow through the diagram:

[2] An example of a paradigmatic transformation would be the shift from the geocentric to heliocentric view of the world. Within both views there can be any number of crises, cyclical failures of old and searches for new theories and practices. But there was only one transformation (from geo- to helio-) and there was nothing cyclical about it. It was resisted with all the might of the mighty: remember Galileo Galilei and Giordano Bruno.

[3] I had a good fortune of meeting two of these five giants of economics: I met Morgenstern on VŠE and later he wrote a letter supporting my tenure at Columbia U. Von Hayek listened to my presentation of autopoiesis at Freiburg U. I have been clearly influenced by the five economists and this paper is dedicated to them.

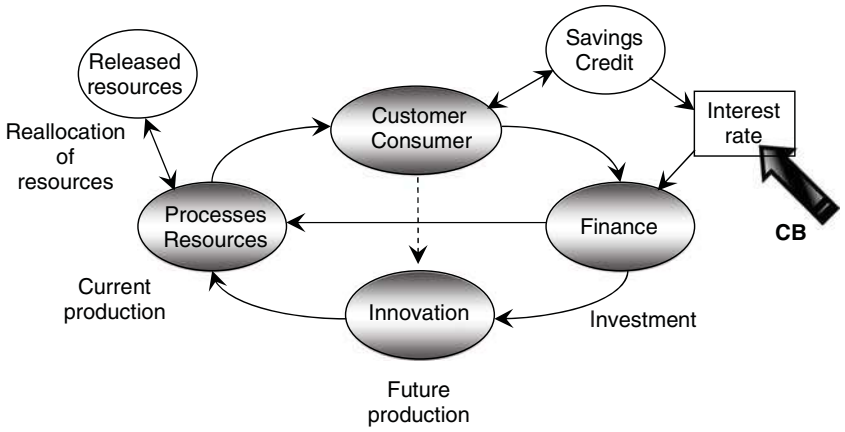

Fig. 1. How the Central Bank distorts market signals.

1. Consumers delay spending, start saving, banks receive more money, interest rates go down
2. Businesses can borrow money to invest in future production, through innovation
3. At the same time, consumers reduce spending on current production, production resources and capacities are released for alternative use
4. Released resources can be applied towards projects of new products and services. Resources are reallocated, new current production is implemented
5. Consumers respond to new (more desirable) products and services, spending and consumption moves upwards, rate of savings declines; at low interest rates consumers even borrow money
6. After necessary lag, demand for money increases, interest rates go up and businesses invest more in current rather than future production
7. After current products and services run their course, consumption is reduced, savings increase, interest rates go down – the new cycle of innovation and reallocation has started.

We can see that free markets are self-regulating: businesses respond to changing preferences of consumers, market supply and demand is conveyed through freely moving interest rates which signal the right focus on current or future production, while resources are being released to allow their optimal re-allocation. Entrepreneurs and managers make collectively more or less right decisions, with individual deviations of course. There is no more effective mechanism which would safely guide and coordinate separate acts of millions towards the benefit of all. The "invisible hand" of the market is quite visible, transparent and understandable.

2.1. Here comes the fed

Let us now introduce the exogenous influence of the CB (or the Fed), as with the large arrow in Fig. 1. Suppose that consumers are increasing consumption, reducing savings and using credit – interest rates would have a tendency to increase and investment would be dampened. But the government, through its CB, wants to keep a good thing going for political reason – and starts lowering interest rates *artificially* (not based on increased savings of consumers).

Lower interest rates send a signal to business that this is the time to invest in future production. There are no real savings, no released resources, consumers are spending and borrowing and businesses are investing at the same time. The demand for money is huge, yet the price of money is low. The CB lowers the interest rates further, stimulating consumption and investment even more.

The false signal of easy money leads to over-investment in new projects, but there are no released resources, re-allocation cannot take place, projects cannot be completed *en masse*. Intense competition for fully engaged resources ensues – increasing the cost of completing projects and innovation implementation. The CB further lowers the interest rate, the artificial bubble of over-consumption and over-investment expands, yet the costs of products and services keep growing due to hyper-competition for still engaged resources.

Ultimately, consumers get into debt, businesses get heavily leveraged and demand for products and services declines: the bubble bursts, the boom ends. The interest rates are still low, but the trust in market signals has been damaged. Investors are not investing and borrowing, consumers are not buying but they are starting to increase savings and reduce indebtedness. Resources and capacities are being released and ready for a new re-allocation. The economy is trying to re-establish equilibrium, to recover from the exogenous shock, to re-establish trust. Markets are getting ready to restart the interrupted natural cycle, to restore interest rates to their original signaling function. It could be a long, protracted and frustrating process.

To summarize the actions of the CB:

1. In free markets interest rates fall *because* consumers save, delay current consumption, release resources for future consumption so that businesses can invest in necessary resource allocation.
2. When the CB enters the natural cycle, it lowers the interest rates arbitrarily without the background of the real state of the market and expressed preferences of consumers.
3. Businesses respond to CB-induced cheaper credit and invest in future production even though consumers did *not* lower their consumption, increase savings and release resources. Consumers may even borrow cheap money and increase consumption where they would normally save.
4. Market self-regulation is thus distorted, *both* businesses and consumers compete for cheap credit, artificial boom ensues, while necessary resources have not been released: investments are unprofitable and cannot be successfully completed.
5. Consumers borrow for current consumption, do not save, but the interest rates – thanks to CB interventions – are still falling, enticing businesses to invest in future production.

Instead of the necessary and optimal re-allocation of resources [31], the economy faces increasing misallocation of resources. This CB-induced misallocation is then the State trying to remedy through additional Keynesian interventions, infusing additional money and resources in the wrong places and so further aggravating resource misallocation.

Artificial booms are accompanied by resource misallocation. We can compare such a boom to a *Circus Humberto* coming to town [18]. A local restaurant owner mistakenly accepts politicians' assurances that the circus presence is permanent. Circus performers and the crowds of hangers-on patronize his establishment and the hapless "entrepreneur" invests in a new chef, neon lights, new furnishings. He then builds an addition and opens a second location by borrowing the government's cheap money. One morning the circus leaves town and our restaurateur is left with an empty place, high debt, overpriced chef and no future prospects – because when the circus leaves town . . . then the circus has left town. Government to the rescue: more money available at even lower interest rates – what an opportunity to misallocate unpaid resources even more [23].

What should the government do at this stage? Exit. It should not pile up wrong signals, like raising interest rates at a wrong point in the cycle; it should accept the process of releasing the resources and not to conflate it with artificial "job creation" or "job saving" Keynesianism; only markets achieve that reliably. It should siphon off all the useless cash infusions, bailouts and "cash for clunkers" in order to prevent inflation – that is, clean up the mess caused by all these hasty political interventions.

One of the most striking failures of interventionism [21] was Zimbabwe in June 1997, when governmental food price cuts led to euphoric shopping sprees and dancing in the streets. After just one month all bread, sugar, cornmeal and meat vanished and black markets took over. Similarly, Nixon's wage and price controls of 1971 lead to a full decade of recurrent gasoline shortages with disastrous economic consequences.

Why do politicians behave this way? How can they hope to avoid artificial booms and bubbles by artificially lowering interest rates? Where are the roots of political interventionism? It is probably best to quote John Maynard Keynes, the father of all economic interventions and free-market distortions:

> "The remedy for the boom is not a higher rate of interest but a lower rate of interest! For that may enable the so called boom to last. The right remedy for the trade-cycle is not to be found in abolishing booms and thus keeping us permanently in a semi-slump, but in abolishing slumps and keeping us permanently in a quasi-boom."
>
> J.M. Keynes ([7]:322)

The revival of paleo-Keynesianism now attracts only the politicians and economists who serve politicians. Distorting market signals by infusing taxpayers' money into the unproductive parts of the economy brings forth the activism and populism needed for the votes of the masses.

The Fed's interest rates are now effectively zero and the Bank of England is threatening with negative interest rates[4] (you would be paid interest for taking a loan). Why is it not working? The trust in distorted market signals has plummeted; there are no real investment opportunities, only speculation remains.

After the crisis, misallocated resources have to be released; old jobs are disappearing together with the demand for products and services. Jobless rates are growing; unemployment is stubbornly persistent – waiting for the new market-based cycle of investments to take place.

The *fatal conceit of economics* is characterized by taking a mere *correlation* [lower interest/higher investment] for *causal relationship* [lower interest→higher investment] while effectively disregarding the requisite changes in the underlying composition of production and allocation of capital assets. Savings lead to genuine growth while artificial credit expansion brings forth boom and bust. In living organisms (but not in machines) the external *structure* is not identical with the internal *organization*. Acting merely on structural manifestations leaves the underlying organization intact.

Yet, Keynes [7] explicitly separated macroeconomics from resource allocation and capital assets theory, paving the road to favor surface manifestations (structure) over the underlying business processes (organization).

Because we uphold that the economy is not a machine but an organism, it is useful to introduce the basic concepts and principles of *autopoiesis*, i.e. self-production and self-regulation. The theory of autopoiesis is applicable to social, business and management systems because they are mostly natural, spontaneous, self-organizing and self-equilibrating organisms, not mechanistic contrivances.[5]

[4] The Bank of England was the latest last week to signal it was considering lowering further the rate it pays on commercial banks' reserves with the central bank, now at 0.5 percent, to encourage institutions to borrow more to business and consumers. Sweden's central bank in July made history when it introduced the world's first official negative interest rate, and analysts have generally praised its ultra-expansive policy for cutting borrowing costs in the real economy. Reuters, 21.09.09.

[5] Paul Krugman has tried to overcome the mechanistic limitations of economics in his little book [8], but remained unaware of autopoiesis and later reverted to "we are all Keynesians now" crowd of public servants.

3. Autopoiesis

> "If the economy were a mechanism, its planners would be like an inventor designing a machine. But because it is an organism, its "planners" are like Frankenstein designing a monster."
>
> J. Young [24]

We owe it to P. Senge [20] for introducing the idea of the Machine/Organism dichotomy into the language of business. Any observer of a corporate organism can adopt one or the other end of the M/O *spectrum*. Machine (M) is heteropoietically constructed by an external designer who remains separate from it. Organism (O) is autopoietically organized and directed by its own constitutive components.

From a large array of possible **M** and **O** distinctions, we list only a few examples:

- **M**: Conceived and constructed by its builders to pre-specified purposes of its users. Goals are externally imposed and "engineered" in.
  O: Self-produced, guided by their own, internal purposes, goals and objectives. External goals can be imposed (or enforced) but not "engineered" in or internalized.
- **M**: No autonomy. All actions are reactions to external commands and programmed (engineered) rules.
  O: Autonomous or semi-autonomous. Embodied purposes lead to self-generated actions.
- **M**: No learning takes place: machine structure is fixed and cannot learn as an entity.
  O: All living organisms can learn as an entity through all of its components.

In Fig. 2 is a scheme of a mechanistic contrivance. The same input or series of inputs (like a string ABABCCC) leads (and must lead repeatedly) to the same string of outputs. Treating economy as a machine, even if simple and mathematically tractable, must have specific cognitive and policy consequences (e.g. insisting on inputs A even though outputs keep returning B or C).

Machines cannot be autonomous in their environment; they require an *operator*, an inputs providing agent, like governmental interference.

Paradigmatic question is: do key social and economic systems behave as man-produced (heteropoietic) contrivances or as self-producing autopoietic organisms? If they are machines, then the mechanistic model analogy would be appropriate; if they are organisms then

Fig. 2. Linear organization of input/output machine.

such analogy would be fatally misplaced. Treating a living system as a machine would lead to mechanical interference with undesirable consequences.

What if free markets were self-producing, self-coordinating systems, capable of learning, adaptation, foresight and stratified responses? Then we should have applied a non-mechanistic model commensurable with the underlying phenomenon. Such a model would have to reflect self-renewal, adaptive behavior, self-sustainability, resilience and environmental bonding.

In Fig. 3 is a scheme of a self-producing organism. Its organization must be circular (or spiral) rather than linear, with state-dependent autonomy and external (environmental) perturbations replacing the inputs/outputs *mechanomorphism*.

The scheme of Fig. 3 is a state-dependent system that does not respond to mechanical inputs but to its own internal states only. A perturbation of such a system is *not an input* but an alteration of function, induced by external or internal mechanisms, like environmental effects, toxic infusions, false information signals, kinetic disruptions, etc. Applying external perturbations to a machine would be equally fruitless as input/output stimuli to an organism.

As perturbation disturbances propagate through the organism, adaptation, compensation and learning are taking place, reshaping the response over time. In order to maintain its balance, autonomy and identity, the system absorbs the perturbation by continually adjusting it responses (like transforming ABABCCC into BBBBBBC over time) so that the next or repeated stimuli "hit" entirely different states, contexts or circumstances. That would reveal a totally unmachinelike behavior of the system and explain the failures of repeated machinelike stimuli.

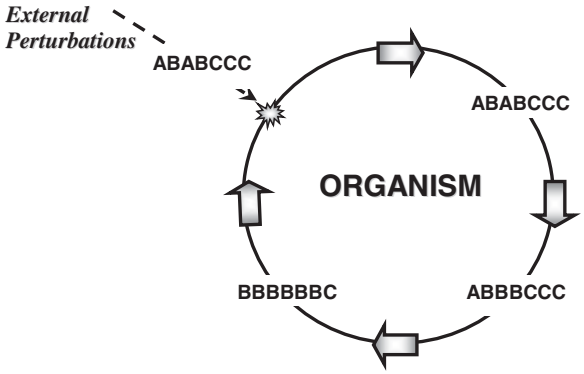

Fig. 3. Circular organization of self-producing organism.

Viewing businesses and their economy as dead machines, contrivances or mechanisms has determined the mechanistic nature of the current economic "toolbox". It would be more useful to view natural systems for what they are: *self-producing organisms* in search of more suitable "tools" for their environment protection, optimization and sustainability – to preserve and enhance their *autopoiesis*.[6]

The process of self-production is called *autopoiesis*, contrasting with *heteropoiesis* (production of the "other"). Self-producing systems or networks are referred to as *autopoietic systems*. Autopoiesis or self-production can take place when there are autonomous individuals or agents interacting and communicating within a specific environment according to specific organizational *rules of conduct, interaction and coordination*. On a lower level, biological (living) systems are similarly autopoietic, based on the coordination and communication of their components.

The very foundations of *human knowledge* are also based on autopoietic action. They involve overt doing, the making of definite changes in the environment and in our relations to it. Such action is directed and coordinated by ideas and explicit purpose. The outcome of such purposeful action is the production of a new circumstance in which objects are differently related to one another and so the consequence of purposefully coordinated operations form new objects capable of being *known* (see [1, 30]).

3.1. Organization and structure

It is essential to differentiate between concepts of *organization* and *structure* in business corporations and the economy as a whole.

[6] We can present only the most fundamental concepts of autopoiesis here. The reader has to consult the references in order to access the larger body of literature related to biology of autopoiesis: Varela *et al.* [22], Zeleny [25, 26] etc.

A business system is defined by its key processes of production, service, transportation, transformation, communication, etc. These processes require *coordinated action* in order to produce *networks of coordinated processes.* Any network of interrelated processes is driven and recursively directed by the *rules of coordination*, including response, cooperation, competition and communication. Order-commands lead to non-recursive, externally driven one-time actions (go there, do that), while rules assure internal replication and recurrence (if this, then do that).

Identical processes (networks of processes) can be coordinated by different rules (systems or networks of rules). It is the system of rules of coordination, rather than the processes themselves, which define the nature of recurrent execution of purposeful action [15]. Recurrence is the necessary condition for learning and knowledge production.

The network of rules of coordination is what distinguishes and defines the *organization* of a business corporation. *Organization refers to the network of rules of coordination*.

Every object, every corporation and every system is organized and its identity established by its organization. Because any organization, being a network of rules, drives and replicates system action, it is at the foundation of system dynamics, execution and replication of action.

Structure is fundamentally different from the network of rules of coordination (organization). It refers to the spatio-temporal distribution of outcomes or products of the rule-coordinated processes. Structure is a specific manifestation of the underlying organization within the specific context and conditions under which the rules were applied. The same organization (rules of coordination) can be manifested in a number of different structures. Organization gives rise to structure, as action gives rise to outcome. *Structure is a static "snapshot" – spatio-temporal arrangement of components and outcomes*, a manifestation of the underlying recursively self-renewing organization of processes and their rules of coordination.

Every corporation or economic system is characterized by *both* organization and structure. While organization is long-term invariant and subject only to transformation, structure is short-term specific and subject to cyclical adaptations and crises. One has to first understand and study the organization, not merely the structure. One has to study the cause, not just the outcome. In order to change a system (corporation, economy), one has to change its organization (rules of coordination); changing its structure (the arrangement of components and outcomes) is ineffective.

Changes in organization lead to changes in structure, *not vice versa*. Changes in structure do not lead to changes in organization. *Organization drives the structure, structure follows organization. Only the observer imputes function*.

Circular concatenation of organizational processes, so called *organizational closure* is a prerequisite for self-renewal, self-replication and recursive self-regeneration of a system. Organizationally open (linear) systems are dead machines. The coordination of processes in organizational closure assures that the same network of processes and their coordination rules is produced and re-produced. Thus, not any set of rules, but only a circularly "closed" set of rules brings forth the self-perpetuation and self-sustainability of a system. An organizationally closed system produces itself – when it recursively re-creates its own network or processes and rules of coordination *that produced it*.

All autopoietic systems must be social systems. In other words, all autopoietic, and therefore all biological (living) systems, are also social systems. Also, the topological boundary, that has been necessary to describe an autopoietic system within a favorable environment of physical components (such as those within and around a cell), may not necessarily take a physical form in other domains, like for example in social systems.

In social systems, self-equilibrating networks of productions are continually renewed without changing their organization, while their components are in a flux of replacement: the birth or entry of new members replaces perishing or exiting individuals. Individual experiences are also renewed: ideas, concepts and their labels evolve, and these, in turn, serve as the most important organizing factor in human societies. This lies at the core of Schumpeter's concept of *creative destruction* [19]; it can be modeled as follows.

3.2. The model of autopoiesis

Autopoietic organization is defined as a network of interactions and processes, involving at least the processes of:

1) *Creation (poiesis)*: the rules and regulations governing the entry of new components, such as emergence, input, birth, membership, acceptance.
2) *Growth (bonding)*: the rules governing networks, associations, arrangements, functions and posi-

tions of components during their tenure within the system.

3) *Destruction (replenishment)*: the rules and processes associated with the exit or termination of membership like death, separation, bankruptcy or expulsion.

In Fig. 4, the three *poietic* processes are interconnected into a *cycle of self-production*. They form *organizational closure*, being semi-autonomous in their environment. Observe that all such circularly concatenated processes represent productions of components necessary for the subsequent processes. Although in reality hundreds of processes could be so interconnected, the three-process model represents the minimum conditions necessary for autopoiesis to emerge.

Any self-sustaining system will have the processes of creation, growth and destruction concatenated in a balanced and harmonious way, so that the creation rate does not significantly exceed the destruction rate, and *vice versa*. *Self-sustaining systems will be autopoietic in an environment of shared or common resources.*

Observe that the processes of Creation, Growth and Destruction in Fig. 4 are the minimum necessary for the sustainability of autopoiesis. If one of the three processes is missing or predominates, then organization becomes allopoietic (or heteropoietic), i.e., capable of producing only something "other" than itself. Any economy would turn unsustainable if its natural autopoiesis were disrupted by artificial or external (governmental) interventions which degrade the self-defensive compensations of the system.

Creation and Growth without the requisite Destruction would quickly deplete human, knowledge or environmental resources and come to a developmental halt, as it would with crystals and crystallization. Creation and Destruction without effective Growth would produce unstable or oscillatory patterns of behavior, etc.

We shall now turn to the self-evolving system of sectoral differentiation and employment, its crises and its impending transformation.

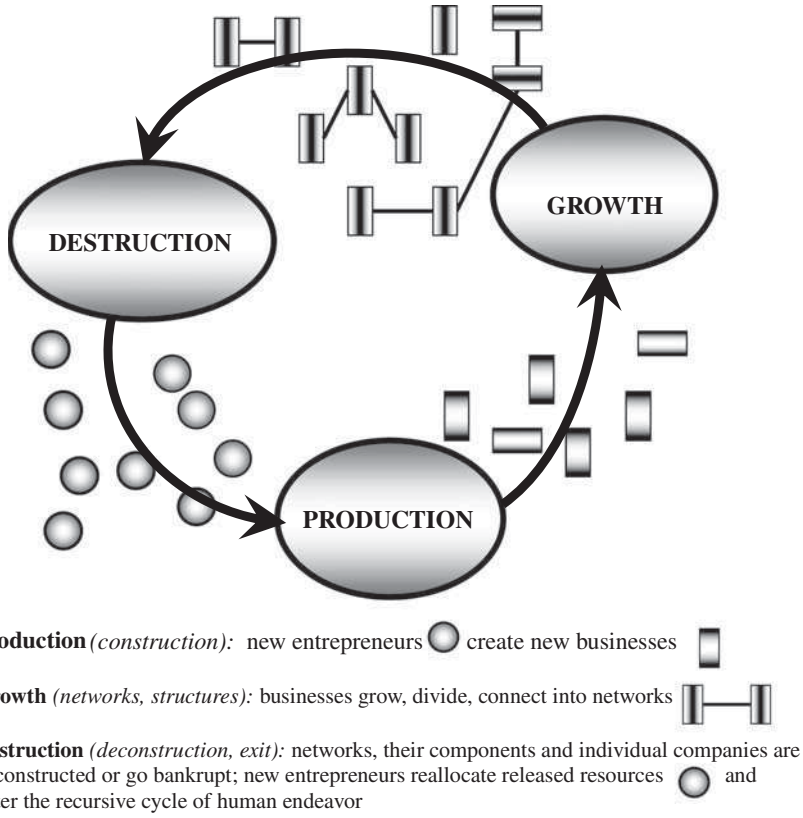

Fig. 4. Minimum organization of autopoiesis.

4. Employment transformation

With the development of employment patterns the difference between crisis and transformation becomes essential. How does the process of *releasing the resources* (see Fig. 1) really work? Can all resources be re-engaged in the same set of production processes or do some have to be re-allocated into different activities, i.e., different sectors of the economy? For example, can all the resources released from agriculture be redeployed in agriculture? U.S. agriculture now employs only 0.5% of the total work force – where have all the lost jobs gone? Is the low rate of agricultural employment a result of a sequence of short-term crises or of a long-term transformation?

The answer lies in exploring the sectoral differentiation of the U.S. economy. Economic sectors evolve, albeit through fluctuations, in one general pattern (so called S-curve): they emerge, expand, plateau, contract and vanish – just like any other self-organizing system or living organism.

Mature economies, like the U.S.A., are characterized by a large percentage of people working in the service sector. Some 80 percent of the total U.S. workforce is now in services. However, the service sector is no different from any other economic sector. The accelerating *productivity growth rates* in agriculture and manufacturing have caused a steady decline in their job-generating capacity. The service sector is following the same pattern: increasing automation, increasing productivity, global competitive pressures, high relative costs and overgrown hierarchies are annihilating its employment generating potential. In Fig. 5 we display the general sector dynamics that all economies, slowly or rapidly, sooner or later, are bound to follow.

A sector's percentage share of employment changes in concert with the sector's productivity growth rate. Agriculture has emerged and disappeared as a source of new employment. Then industry had emerged, peaked and contracted. Services have emerged and started contracting after the crisis of 2008 – all due to increasing productivity growth rates.

Now a new sector is emerging: government, welfare and unemployment (GWU); based on tax-financed consumption rather than added-value production: it is sheltered from market forces, producing very little. Can new jobs be created in the GWU sector? Of course they can, but only politically and artificially, at the expense of productive sectors. Creating Keynesian employment bubbles is not a stimulus but a temporary patchwork – until hyperinflation bursts them.

Due to their productivity growth rates, each sector has to emerge, grow, persist, stagnate, decline and dissipate in terms of its employment-generating capacity. The high-productivity growth sectors are emerging and

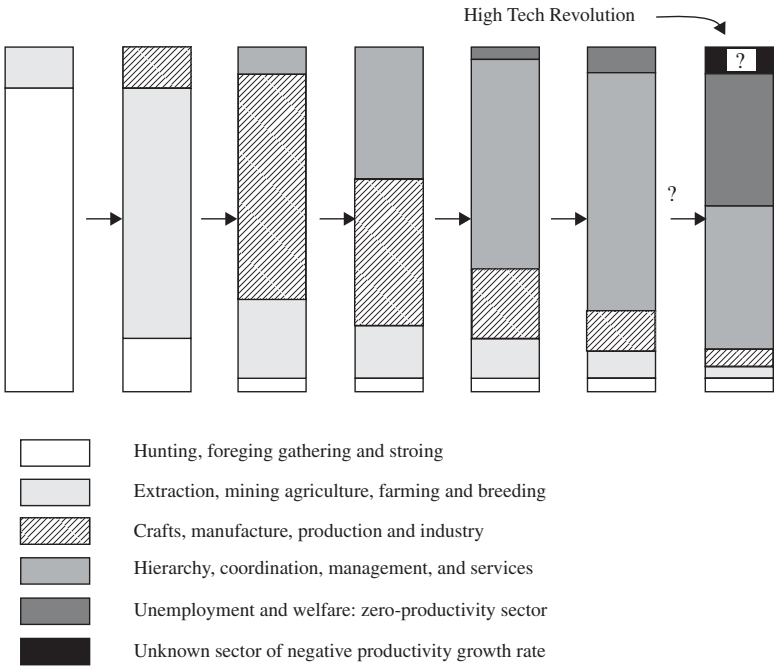

Fig. 5. Productivity-growth evolution and sectoral differentiation.

declining first, the low-productivity growth sectors (like services) are completing their cycle only now. Different productivity growth rates in different sectors are accompanied by virtually *uniform* growth rates in wages and salaries across all sectors (Fig. 6).

The U.S. economy has *matured* in terms of sectoral evolution. It has entered the stage – as the first economy ever – of declining percentage employment in the service sector. Accelerating productivity growth rates are dictated by global competition and efforts for better standards of living. The U.S. economy has become *world's laboratory* whose experiments and strivings are well worth watching: they reflect the future of world's economic transformation.

In the U.S. there are now only three areas where new jobs are still being created: education, health care and government. The first two are subject to market forces and will undergo accelerating productivity growth rates and declining employment levels in the near future. The third one, GWU, is sheltered from competition and can expand its share substantially, but it does not produce anything, relies on taxes from other sectors, and its "employment growth" is not self-sustainable.

The U.S. economy has shifted toward sectors with lower added value, leading to lower incomes and increasing reliance on debt. That is a systemic condition that no amount of fast and half-baked interventions, or Keynesian or monetarist stimuli and infusions, can successfully address.

The U.S. is at the transforming cusp as thousands of years of sectoral development come to an inevitable halt. There are *only four essential activities* humans can do economically: produce food, manufacture goods, provide services and do nothing. The U.S. economy has fully exploited all three productive sectors. There is no new sector lurking in the offing: qualitative transformation is taking place.

Other economies still have some time left, many still have to industrialize and some still have the service sector to expand into. But the U.S. economy is the harbinger of things to come, a role model the others can follow or reject, but hardly ignore. For the first time in history at least one economy has reached the end of the old paradigm and is groping for new ways of transforming its business, economy and society towards a "new standard".

It is becoming apparent that new jobs cannot be sustainably created in the UWG sector and due to the increasing productivity growth rates, not in services, manufacturing or agriculture anymore. This change represents transformation, not crisis. The things have changed. . .

It is increasingly clear that the government will be of no help with this transformation as it remains clueless even with respect to crisis. Because there is no new productive sector emerging, the self-regulating economy seeks to restore and reinstate its new plateau equilibrium through resorting to self-service and do-it-yourself modes. Producers and providers are outsourcing their production and services to customers.

Outsourcing to customers is a natural and necessary self-organizing process, including disintermediation, customer integration and mass customization – all driven by the global productivity at the cusp of transformation. Instead of the *information society* [29], we have entered a *knowledge society*. Instead of the service society, we are venturing into a self-service way of life. The shift toward self-service is a part of natural

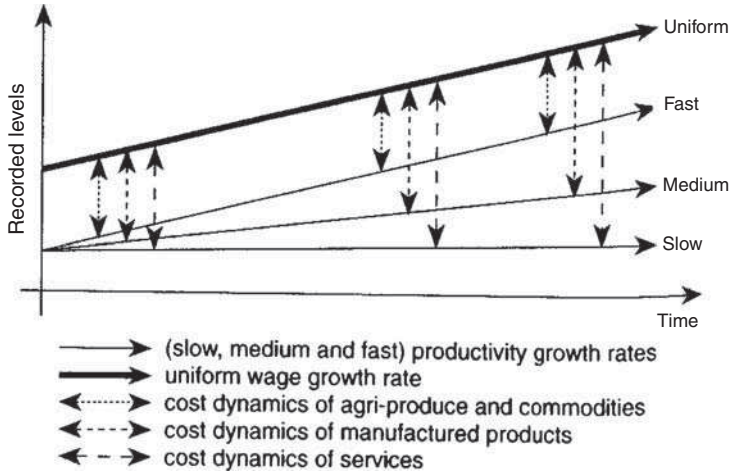

Fig. 6. Price gap: differential productivity and uniform wage growth rates cause price to grow faster in low-productivity sectors.

and spontaneous self-regulation of social and economic systems.

5. Self-service society

Rational economic agents tend toward *substituting* relatively cheap and capital-intensive manufactured goods for relatively expensive and labor-intensive services. Consumers will use goods instead of services wherever and whenever economical and possible. So we observe the emergence of automated teller machines instead of bank tellers, self-service gas stations instead of full-service stations, self-driving instead of chauffeurs, do-it-yourself pregnancy kits rather than hospital test services, self-handled optical scanners rather than cashiers, and personal computers instead of central mainframes. In other words, self-service is replacing the traditional, other-person-delivered services at an accelerating rate. Mature economies are entering the era of self-service.

5.1. Work and leisure

Human action can be loosely differentiated into *work* (creation) and *leisure* (recreation) activities. The key to useful differentiation of this kind must be the *purpose* of the activities being carried out. If the purpose is a direct or indirect economic exchange – for money, goods, time or any other reciprocity of economic value – then humans engage in work. If the purpose of such activities is not directly economic or exchange motivated, then we speak of leisure.

Much domestic, household and at-home work, as well as most forms of do-it-yourself and self-service, represents *bona fide* work because their purpose is substituting for an exchange or economic alternative. Leisure activities must be chosen as voluntary, non-contractual and unforced, seeking recreation rather than economic gain or exchange of value.

Work can be defined as an economically purposeful activity requiring requisite human coordination of task and action. "Job" designates the kind of work that is performed contractually, that is, explicitly for remuneration and *in the employ by others*.

Labor (often used as a synonym for hard work or toil) can more properly be related to performing simplified work-components or tasks without engaging in their substantial coordination towards given purposes. Work often involves labor but not *vice versa*. Work involves coordination of tasks while labor relates only to their performance.

Households are again becoming primary investment/production units. One of the fastest-growing areas in developed industrial economies, especially in the U.S., is work at home, or the SOHO (small office/home office) mode phenomenon.

Work at home relates to self-employment, part-time self-employment, work after regular office hours, work instead of regular office hours, self-service and do-it-yourself, typically relying on a home office, telecommuting, neighborhood networks, virtual office, personal computers, modem, fax, multiple and cellular telephone lines, internet, satellites and similar technologies. Work at home is the most potent job-generating "sector", moving the self-reliant population towards more productive and efficient self-service activities, reducing the pressures on energy, ecology, human stress, traffic congestion and the cost-intensive physical commuting inherited from smokestack-era factories.

Modern production is based primarily on the processing of information, not on hauling goods, humans and machinery over large distances. One can more effectively "haul the information", to produce goods and provide services locally. Information and knowledge travel effortlessly through electronic superhighways, through telecommunications networks and the internet. Citizens and employees working at home are in control of their time, can take care of their children and can invest in home technologies; they do not have to pay excessively for gasoline, insurance and child-care, or waste most of their precious off-work hours commuting.

5.2. Redefinition of work and leisure

The fundamental systemic disequilibrium in Fig. 6 is between *differential productivity growth* rates and the *uniform wage/salary growth* rates across sectors; it points to a self-organizing and spontaneous resolution of the tension.

Self-service activities are characterized by high efficiency: they can be delivered when, where and at whatever quality the user desires, at lower costs and in shorter time spans. They require user-friendly products with easy-to-use, reliable instructions and support, sufficient time and the high costs of alternative services. All these conditions are present in mature economies. The self-service society is characterized by an increas-

ing autonomy of workers and consumers, the growth of work-at-home, telecommuting, self-employment, community self-help, home office, part-time and seasonal work, early retirement, barter and exchanges, networking, flexible work hours, self-management, and the decline in supervisory and administrative services, decentralized self-reliance and so on. A new work/leisure division is emerging, as summarized in Fig. 7.

Human work and leisure are thus being radically redefined. The key words are empowerment, self-reliance, autonomy and self-service, replacing the more traditional notions of division of labor, specialization, manual work and the physically remote workplace of mass production, mass assembly and mass consumption. Most human activities – work, labor, jobs, leisure, recreation as well as the way and quality of life – have changed and are going to change further before the first decades of this millennium are over.

6. Economy as an organism

What is the new paradigm of post-transformation economics?

Traditionally we view the economy as a machine, based on the input→process→output model. In machines, input A is followed by output B in a predetermined and stable pattern. What if the same input A was producing B and sometimes C or D, even perhaps X? No machine could effectively function that way.

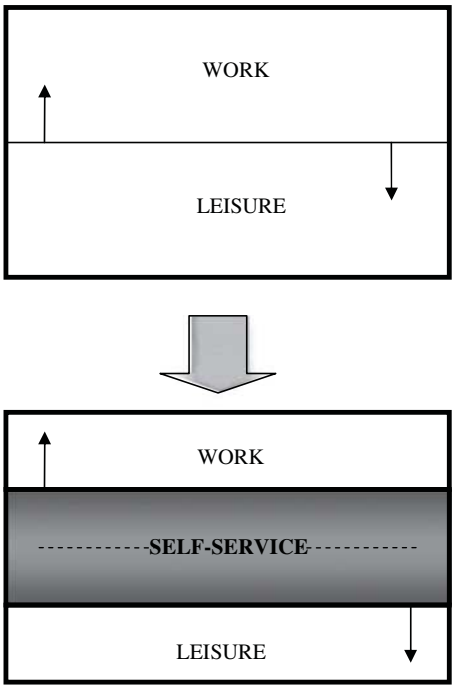

Fig. 7. Work and leisure.

But that is how living organisms behave. If you kick a dog (input A), it will cower in the corner and howl (output B). If you kick the same dog next day (A), he will stay put, bare his teeth and growl (C). When you kick him again (A), he may just sink his teeth in your flesh, quietly (D). The reason for such behavior is adaptation, accommodation, recalibration and the survival instinct of living organisms. But that is precisely how economies behave: their agents adapt, adjust, accommodate and re-calibrate *vis-à-vis* new circumstance; they also want to survive. If you lower the interest rate, people will borrow and banks will lend. If you lower it again, people become suspicious and many will not borrow because they do not trust their investments. If you lower again, say to zero, people will not borrow and banks will not lend because both do not trust such artificial infusions of their tax money. That's why governmental meddling with free markets is misplaced: traditional economics treats the economy as a machine instead of as an organism.

It is appropriate to quote Carl Menger here [12], from his *Untersuchungen* (1883), addressing the theoretical understanding of those social phenomena which are not a product of agreement or of positive legislation, but are unintended results of historical development:

> "The acknowledgment of a number of social phenomena as 'organisms' is in no way in contradiction to the aspiration for exact (atomistic!) understanding of them."
>
> C. Menger [12]

Since the Enlightenment, the economy has been viewed as being mechanistic: a series of components with linkages, transmissions, multipliers and accelerators – complete with battery jump cables; that in spite of the fact that the economy shows behavior that is clearly organic. Machines are fragile, organisms are robust. We have to build more resilient institutions and more autonomy and immunity into economic regions. We have to learn to *do the work of crisis without crisis* [17].

To return to our initiatory question of Menger: How can it be that institutions which serve the common welfare and are extremely significant for its development come into being without a common will (*Gemainwellen*) directed toward establishing them? The answers lie in the theory of autopoiesis [28].

Instead, increasingly, politicians, in their "willed" pursuit of votes often worsen, create or perpetuate economic and social crises. That is not too surprising if humans and their networks are viewed as organisms rather than machines – regardless of political and macroeconomic assumptions, axioms or multipliers.

You can jump start an internal combustion engine, but you cannot jump start the economy.

The coming transformation is truly "earth-shaking" – even more so than the historical shift from geo- to heliocentricity many centuries ago. We shall have to learn that economic and social systems are autopoietic (self-producing) organisms and not deterministic mechanisms and contrivances. We shall have to acknowledge that biology and psychology provide more appropriate tools than physics and engineering. We will have to replace calculus and differential equations by rule-based simulation and computer-scenario playing. We shall have to rely more on the wisdom of the organism than on the wisdom of governments. We will have to create new theories, write new textbooks and establish new curricula. We will have to move from macroeconomics of aggregate numbers toward microeconomics of interacting decision-making agents as the center of human economic endeavor.

A *natural* economic or social order [24] differs fundamentally from a mechanism or machine. While machines have been designed and constructed by man, genuine economic and social orders are spontaneous creations of nature. We often label and ascribe such emergent creations to God. It is therefore permissible to say that God "designed" the economy but a human inventor designed the machine. Is it not increasingly desirable (and decent) to stop improving on God's work with our manifestly ineffective and wasteful machine tools?.

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