Theory of Counterplexity

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The Asian Conference on the Social Sciences 2014
Official Conference Proceedings
0686

Abstract

In this paper I introduce a new concept that I call Counterplexity. I define Counterplexity as the state of the social systems in which

1) The marginal returns is lower than in the previous degree of complexity;

2) No increase of complexity can determine an increase of the payoffs without a Counterplex decrease;

3) Although the best strategy for the society would be a decrease of complexity, the dominant strategy for the ruling players is keeping the degree of complexity beyond the Counterplex maximum.

The society under counterplexity is a society in which

- The improvement of the local space is smaller than the peripheral degradation,
- The increase of velocity is lower than the increase of the space to cover,
- The technics allows to save less time than the time necessary to process the degree of complexity,
- The increase of knowledge increases less than the knowledge necessary to manage the degree of complexity.

Therefore we can say that Counterplexity is the study of the social systems in which the whole is less than the sum of its parts.

Introduction

There are many definitions of the term "complexity" and different meanings in any discipline in which it is studied. The term derives from the Latin expressions "cum" and "plectere" and means "surrounding, encompassing, encircling, embracing, and comprehending several elements." (Alhadeff & Jones, 2008, p. 67).

In this work social complexity is given by the size, the quantity of energy necessary to the process of the system, the quantity of information that processes require, the size of space and time in which activities occur, the size of the causal chains, the number and distinctiveness of its parts, the number of activities and events that occur into it.

Against the silent ideology based on the idea that the more complex the better, Galilei (1632) already highlighted:

> "[…] the impossibility of increasing the size of structures to vast dimensions either in art or in nature: likewise the impossibility of building ships, palaces, or temples of enormous size in such a way that their oars, yards, beams, iron-boalds, and, in short, all their other parts will hold together; nor can nature produce trees of extraordinary size because the branches would break down under their own weight; so also it would be impossible to build up the bony structures of men, horses, or other animals so as to hold together and perform their normal functions if these animals were to be increased enormously in height; for this increase in height can be accomplished only by employing a material which is harder and stronger than usual, or by enlarging the size of the bones, thus changing their shape until the form and appearance of the animals suggest a monstrosity." (p.130)

Also in biology, although common sense suggests that the big fish eats the small one, as clearly explained by S.J. Gould (1996), "…one common mode of Darwinian success (local adaptation) does entail an apparent preference for substantial decreases in complexity - namely, the lifestyle of parasites." (p. 200) so that it is not surprising that 99.8 % of human history has been dominated by small, autonomous, self-sufficient communities. (Carneiro, 1978, p. 219)

The instruction that we have to draw is that nature seems to move from a low level of complexity quite reluctantly and complexity results an anomaly in history of organized systems.

Nevertheless, in macroeconomics, which is the science on which is based our idea of society, surprisingly, there is no concept of optimal scale. "The default rule is "grow forever." (Daly – Farley, 2004, p. 17)

The idea of complexity often underlines the aspect of the emergence, for which, with the increase of complexity new properties emerge, absent in the single elements of the system and in the previous degree of complexity, so that, as known since Aristotle "the whole is greater than the sum of its parts". (*Metaphysics*, Book H 1045a 8–10)

Edgar Morin (2008) had already noted that if it is true that the whole is more than the sum of its parts "however, the whole is also less than the sum of its parts since the organization of the whole imposes constraints and inhibitions upon the parts that constitute it and which no longer possess their total freedom." (p. 89)

In H_2O, for example, the water molecule has certain properties that hydrogen and oxygen separated do not have, and at the same time, they have some qualities absent in the water molecule. According to the same principle, in human societies, "the possibilities of liberties (delinquent or criminal in the extreme) inherent to each individual, will be inhibited by the organization of the police, the laws, and the social order." (2005, p.12)

In line with these considerations and in the framework that followed the works of Georgescu-Roegen (1971, 1976), the application of the second law of thermodynamics to social contexts (Rifkin, 1980, 1989), the application of the law of declining marginal returns to *The collapse of complex societies* by Tainter (1988), the concept of efficiency and the game theory, I define Counterplexity as the study of the systems in which:

1. The whole is less than the sum of its parts.
2. Due to the configuration of the strategies of the ruling players in the struggle for the payoffs there is a tendency to increase the level of complexity of the system.
3. The increase is subject to decreasing marginal returns.
4. The system reaches a point in which the payoffs are lower than in the previous degree of complexity.
5. Beyond counterplex optimum the system can increase its complexity just through counterplex decreases.
6. The system fails to go back to the previous degree of complexity because the dominant strategy of the ruling players is located beyond the counterplex optimum.

In counterplexity, the payoffs of a system are lower than in the previous degree of complexity.

I assume that increasing complexity entails a general increase of payoffs. Such increase is subject to declining marginal returns. When the system reaches the point at the intersection of B2 and C2 (fig. 1), starting from which at any level of complexity the payoffs are lower than in the previous degree of complexity, it falls in counterplexity.

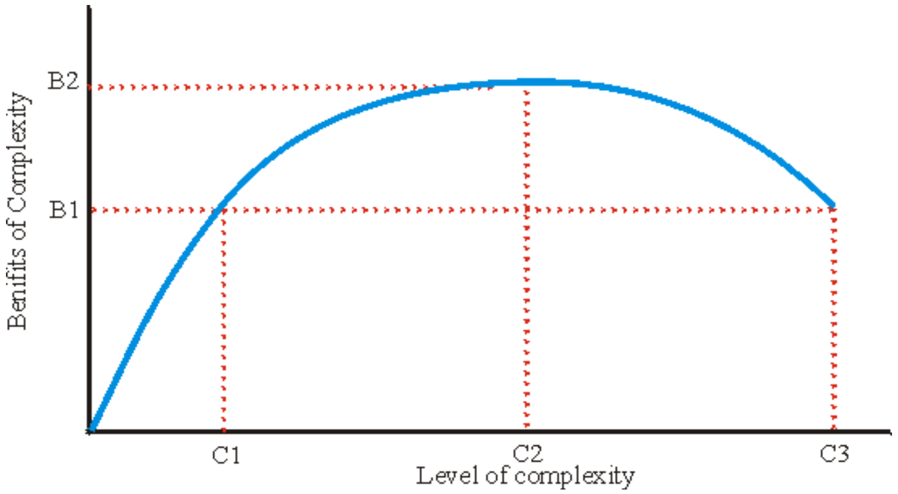

Fig. 1 The marginal productivity of increasing complexity. (Tainter, 1988, p. 119)

At first the cost-benefit curve of “investments in agricultural and other resource production, in hierarchy, in information processing, in education and specialized training, in defence and so forth, increases favourably, for the easiest, most general, most accessible, and least expensive solutions are attempted first. As these solutions are exhausted, however, continued stresses require further investments in complexity. The least costly solutions having been used, evolution now proceeds in a more expensive direction.” (Tainter 1988, p. 120)

According to the law of diminishing returns “we will get less and less extra output when we add additional doses of an input while holding other inputs fixed. In other words, the marginal product of each unit of input will decline as the amount of that input increases holding all other inputs constant." (Samuelson & Nordhaus, 2001, p. 110)

According to Tainter (1988) “[...] more complex societies are costly to maintain than simpler ones, requiring greater support levels per capita [...so that] after a certain point, increased investments in complexity failed to yield proportionately increasing returns.” (pp. 91-3)

When a society reaches the point in which the payoffs are lower than in the previous degree of complexity the system falls in counterplexity.

Beyond the counterplex optimum the system cannot increase its complexity without a counterplex decrease.

Following the traditional definition of Pareto optimum (1906, p. 261), and the modern definition of efficiency, I define counterplex optimum as the status in which, given an allocation of complexity that yields a consequent level of payoffs, an increase of complexity is impossible without a counterplex decrease.

To find the counterplex decrease we have to look at the ratio between a single performance and the systemic cost of the new degree of complexity that allows it.

We can see how the increase of complexity of space, time, velocity, breeds a counterplex decrease.

Counterplex space.

We find counterplex space looking at the ratio between the entire space of the system and the space necessary to maintain its degree of complexity. According to this criterion, in counterplexity, the increase of complexity of the physical space breeds a decrease of counterplex space. The counterplex decrease of space can take the following shapes:

Decrease of counterplex space in the future.

After a period of geographical expansion, for example, the collapse of the empires, as described by Tainter (1988) in the case of the Roman Empire, (p.129) must be considered as the cost of the expansion.

Decrease of counterplex time.

The management of the increase of the space requires more time than the time that new or more complex space allows to gain. Beyond counterplex optimum of space, an increase of complexity can decrease time available, especially through more work.

Decrease of counterplex velocity.

When the payoffs of the complexity start to diminish, there is a normal attempt to increase velocity in order to diminish space as obstacle. Capitalism, for instance, needs to increase velocity in order to reduce the obstacle of space. Space as obstacle is faced through more velocity, which is more space in the same amount of time. We can consider the increase of transportation of the last centuries as aimed at this goal. Another way in which capitalism addresses the necessity to increase velocity is increasing the speed of the turnover of capital.

Counterplex time.

We find counterplex time looking at the ratio between the entire stock of time available for the players and the time necessary to process the degree of complexity of the system. If physical time is given by $T=D/S$, we calculate counterplex time as $CT= CD/CS$ (Counterplex time equals counterplex distance divided by counterplex velocity). Given this criterion, in counterplexity, an increase of complexity of time yields a decrease of counterplex time. Therefore the time available to the elements of a system, net of the time necessary to the management of the degree of complexity of the system, decreases. A corollary is that considering the increase of complexity as a solving problem strategy, in counterplexity, the time that players invest in time is higher than time that the system allows them to save.

The increase of complexity/payoffs of time breeds the following counterplex decreases:

Decrease of counterplex time in the future.

If in counterplexity we increase the complexity of the time/payoffs we can have a decrease of counterplex time in the future. In fact since the increase of complexity requires energy, often non-renewable, in the future there will be no energy for less complex activities.

Decrease of counterplex velocity.

In counterplexity, in order to increase the payoffs of time we need to increase the velocity, but since physical velocity increases less than the physical space to cover, and allows to save less time than the time necessary to process the level of complexity that allows it (cf. 2.3), the counterplex velocity of the system decreases.

Increase of work.

Beyond the counterplex optimum, in order to have the same payoffs in the same amount of time it is necessary, net of new technology, to increase work. In the case of capitalism, for instance, the increase of productivity/time is one of the crucial elements. According to Giddens (1981), the struggle over the length of the work day is “the most direct expression of class conflict in the capitalist economy.” (p. 120)

Counterplex velocity.

We understand velocity in two main ways. 1) as the space covered in a given time. 2) as the number of things that is possible to do in a given time (time density).

Starting from these two meanings we can add the following criteria to determine the counterplex velocity:

According to the first meaning, as physical velocity is given by the space covered in a given time, we consider counterplex velocity as the ratio between counterplex time and counterplex space (C.V=C.T./C.S).

According to the second meaning, counterplex velocity is given by the ratio between time density and the time that the system needs in order to perform the increase of complexity. According to the first meaning, we find counterplex velocity looking at the ratio between the physical velocity and the velocity necessary to maintain the degree of complexity of the system. For example, if in the first state one can go at 100 Km/h and he has to cover, in order to live and work, at 10 Km/h, in the second, he can go at 120 Km/h, but the increase of complexity that allows him to gain 20 Km/h constrains him to cover 50 Km/h. In this case it is clear that velocity increases but counterplex velocity decreases.

Beyond counterplex optimum, an increase of velocity is possible only by a counterplex decrease. This decrease can take the following shapes:

Decrease of counterplex space.

For the definition that we gave of counterplex space, the results of an increase of velocity may be 1) an increase of space to cover; 2) a decrease of the payoffs of space. As regards 1) we can say that in counterplexity, the increase of space to cover in order to maintain the degree of complexity of the system, increases more than the velocity that the new level of complexity allows to perform, so that the increase of velocity breeds a decrease of counterplex velocity. We call this *counterplex slowness*.

Talking about suburbanization and cost of sprawl, it was noted that ”While the population of a city like Chicago has stayed almost static, the metropolitan area has grown 55%, meaning that the city must provide services for a developed area that has grown by half. Not only do the developers pay less of the cost for land and facilities, but, by the simplest geometry, spanning ever greater distances means spending more money on more infrastructure - longer wires and pipes for water and sewage, drainage, and electricity - and more leapfrog development that shreds an acre for every built one.” (Holtz Kay, 1997, pp. 131-2)

As regards 2) an increase of velocity beyond complex optimum determines a worsement of space.

The automobile development, for example, is often considered as a factor of destruction of space. Among others, Kunstler (1993) speaks about how “the automobile, with its promise of freedom and adventure, had commenced to transform American space in a new and horrible way, to which no one was prepared.” (p. 67)

This is consistent with studies about the dynamics of urbanization and cars in the USA that shows how the increase of the car industry forced the middle class to make homes outside of town, with a consequent degradation of urban life. (p. 90)

Decrease of counterplex time.

There are two main ways in which the increase of complexity of velocity has consequences on time.

A system can even keep the level of velocity beyond counterplex optimum providing resources of the future are used. In the case of the car, for instance, it has been said that one generation gains and pollutes, leaving the next paying the debt.” (Holtz Kay, 1997, p. 127) Kunstler (1993) considers an economy based on unlimited automobile use and unrestrained land development like “Reagan's voodoo economics" a strategy to keep the game going at the expense of the future. (p. 111).

In counterplexity, an increase of velocity needs more work than the work that velocity allows to save. Even with the use of technology, conceived as a way to optimize work and resources, taking into account energy, time, space, knowledge and timework necessary to this increase, the increase of velocity requires more time than the time that technology allows to gain, so that, again, an increase of velocity breeds a decrease of counterplex velocity.

Counterplexity is an equilibrium[1] towards tend the systems in which the dominant[2] strategy of the ruling players is located beyond the counterplex optimum.

In counterplexity, the system has payoffs lower than in the previous degree of complexity and it is beyond the complex optimum, nevertheless, it keeps its degree of complexity beyond counterplex optimum. To understand the reasons of such inefficiency we need to adopt a theory of power and introduce the concept of counterplex equilibrium.

In order to understand the reasons of the increase of the complexity, Tainter examines different possibilities: managerial, internal conflict, external conflict, synthetic and in the end he reduces them to the conflict and the integration theories. (1988, pp.32-3) maintaining his own reservations over both of them. Nevertheless he asserts that "complex societies are problem-solving organizations, in which more parts, different kinds of part, more social differentiation, more inequality, and more kinds of centralization and control emerge as circumstances require". (pp.37-8)

In part III of *Le bluff technologique*, Ellul (1988) considers absurd the increase of complexity of the technology which breeds a decrease of well-being, because he does not take enough into account the dynamics of power so that the society results like a unique subject that promotes technology as a mean to improve the payoffs.

Lafargue (1880) quotes Antiparos, the Greek poet in Cicero's time, who sang of the invention of the water mill, seeing it as the opportunity for the millers to stop working so hard as it was no longer necessary. However, he was disappointed in the result that was so far from the one he expected, because if it is true that a worker can do five stitches a minute, while a loom can do thirty thousand in the same time, instead of resting for the equivalent of two thousand nine hundred and ninety-five stitches, the worker tries to work as much as before and even more than before. (p. 20)

These examples lead to paradoxical conclusions as far as they consider the efficiency and collective well-being the true aim of innovation and the correspondent increase of complexity.

In *The Arrival and Conquests of the Water Mill*, Bloch (1935) maintains that the reason for the establishment of water mills does not lie in their technological superiority, but in the fact that they allowed the feudal lord to exact taxes that he would not have been able to demand in a milling system based on manual labour (p.156).

For Marglin (1974) the origin and success of the factory were not due to technological superiority, but to the substitution of the capitalist for the worker in the control of the work process and the extent of production: instead of choosing how much to work and

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[1] "An outcome is an equilibrium if it is brought about by strategies that agent have good reason to follow." (Hargraves Heap & Varoufakis 1995, p. 45)

[2] In Game theory a strategy is dominant "(…) if it is a best strategy (i.e. it maximises a player's utility pay-off) regardless of the opposition's choice of strategy". (Hargraves Heap & Varoufakis, 1995, p. 44)

produce according to a personal assessment of the relative relationship between free time and the acquisition of goods, the worker has to choose whether to work or not, an alternative that is not very appealing (p. 62).

In this article, within the framework of game theory, I assume that the main reason of the increase of the complexity of a system is the advantage of the ruling players in the struggle for payoffs.

I define ruling players as those who can modify the rules of the game and ruled players those who, in order to increase, maintain or contain the decrease, have to accept the new rules of the game. They are of course fluid concepts and different players can be ruling or ruled in different contexts and at different levels.

As demonstrated by Dresher and Flood "a non-zero sum game could have an equilibrium outcome which is unique but fails to be Pareto optimal" (cf. Straffin, 1993, p. 73). Similarly, in counterplexity we have an equilibrium which fails to be complex optimal. Consistent with the conceptual frame of game theory, I define counterplex equlibrium as the condition of a game in which, although marginal returns are lower than in the previous degree of complexity and the system is beyond the complex optimum, no ruling player has anything to gain by adopting a strategy of decreasing complexity unilaterally.

The counterplex equilibrium is as much stable as far as the strategy of increasing complexity is dominant for both ruling and ruled players. In the case of space, for instance, Harvey (1985) displays how the ruling class modified "the mobilization of effective demand through the total restructuring of space so as to make the consumption of the products of the auto, oil, rubber, and construction industries a necessity rather than a luxury." (p. 207)

According to Diamond (2005), kings and nobles in societies like Maya, focused on short-term concerns like "enriching themselves, waging wars, erecting monuments, competing with each other in a short-term perspective and extracting enough food from the peasants to support all those activities" (p. 94) and without a long-term perception of themselves, failed to recognize and solve their apparently obvious problems. According to the theory of counterplexity, it is not a matter of short-long terms strategies, their behaviour was not irrational. Just the result of the dominant individual strategy conducted to the collapse of the system.

Counterplex equilibrium of space.

The system continues to increase its degree of complexity of space although it is beyond complex optimum, because increasing complexity is the dominant strategy.

We can see how in the case of geographical expansion, or the modern urbanization or the intensive use of the space, generals in the past, big companies or contractors in modern times are able to obtain the best payoffs in the struggle for payoffs at the expense of ruling players.

Diamond (2005) shows how the logic of oil and mining companies as well as seafood industry is based on the rational logic of business. (pp. 441-85)

As regards to modern urbanization, according to Harvey (1985), each of the global crises of capitalism was preceded by massive movements of capital into long-term investment in the built environment as a kind of "last-ditch hope for finding productive uses for rapidly over accumulating capital." (p. 20)

Counterplex equilibrium and time.

In *The Brevitate Vitae*, Seneca wrote about how we lose time who others subtract from us; Marx said that all the economy ultimately reduces itself to an economy of time (Grundrisse, book 1, chapter on money, part 2). To Rifkin the history is dominated by *Time Wars* (1987) among competing temporal visions. Different actors played the war game of the time: "Throughout history claims on people's time have come from formal and informal authorities - from the state, from the church, from the firm and corporation, and from the family." (Fuchs Epstein & Kallerberg, 2004, p. 1) We can say that in all social systems there is a constant struggle for the payoffs of time in which ruling players take advantage in increasing the complexity of time at the expense of ruled players. In Le Goff (1980), for instance, we can see how in the early capitalism, the time of the merchants won against that of the Church, and the new time of the clock towers, frequently erected opposite the church bell towers, was the time of a new social order, dominated by the bourgeoisie. (p.46)

In the early capitalism, we pass from a time measured by labor to a time that measures labor (Thompson, 1967, pp. 58-61). A time divisible into constant units was related to the development of the commodity form of social relations. (Postone, 1993, p. 211)

When ruling players succeed in making "increasing complexity of time" a dominant strategy also for ruled players, the system reaches a stable equilibrium. For instance, according to Le Goff (1980) "Curiously", it was at first the workers themselves who asked that the working day be lengthened. In fact this was a way of increasing wages, what we would today call a demand for overtime." (p. 45) but, as remarked by Postone (1993), "Very quickly, however, the merchants seized upon the issue of the length of the work day and tried to turn it to their advantage by regulating it more closely." (p. 210)

Counterplex equilibrium and velocity.

In the struggle for payoffs, often the ruling players find convenient increasing levels of complexity of the velocity. Since high velocity is difficult to produce and requires the capacity to produce a certain degree of complexity, the increase of the level of velocity excludes from control those who are unable to produce it.

Ruling players adopt many means in order to increase the complexity of velocity in spite of the general payoffs.

By 1950, General Motors had converted more than 100 electric streetcar lines to gasoline-powered buses." A federal grand jury indicted GM for criminal conspiracy in the Los Angeles case in 1949, but the eventual fine of $ 5000 was about equal to the company's net profit on the sale of five Chevrolets (p. 92).

In the case of velocity, it is clear how the ruling players made a high level of complexity of velocity the dominant strategy also for ruled players. Kunstler (1993) tells us how “The automobile, a private mode of transport, was heavily subsided with tax dollars early on, while the nation’s street car systems, a public mode of transport, had to operate as private companies, received no public funds, and were saddled with onerous regulations that made their survival economically implausible.” (pp. 86-87) After that, to do without a car was impossible. In 70’, with the suburbanization of USA and in particular the spread of malls, “People without cars were just out of luck.” (p. 119)

4.0 Exit from counterplexity

A system can exit from counterplexity in three ways:

Since everything can be conceived as a particular shape of energy, the discovery of a new source can put the system out of counterplexity. Tainter (1988) gathered evidence from the works of Harner (1970, p. 69), Martin (1969), and Jelinek (1967) about how, conceiving complexity as a response to stress conditions, including resource inequities, “when such inequities are alleviated, the need for ranking and social control may break down, leading to collapse to a lower level of complexity.” (p. 51) The stock of energy can be increased also through new technology, but “technology innovation, […] is subject to the law of diminishing returns, and this tends to reduce (but not eliminate) its long term potential for resolving economic weakness. (Tainter, p. 124)

If the distribution of payoffs makes increasing complexity no longer a dominant strategy.

Since the increase of complexity is due to the advantage of the ruling players in the struggle for payoffs, if a change of cultural paradigm is able to modify the distribution of the payoffs so that the ruling players find theory dominant strategy in a strategy located beneath the counterplex optimum, the system can escape from counterplexity.

The last option is the collapse of the system, which in non-anthropomorphic terms, considering the system as an organism, is a way of tuning its level of complexity to a new, less complex level.

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