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A modest proposal towards sustainability

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The chariots of Pharaoh at the Red Sea

The crises of capitalism and of environment. A modest proposal towards sustainability

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Summary

Part I. The environmental crisis

Introduction

The present global situation recalls us the two walls in which the Red Sea had split to allow that Pharaoh follow the people beloved by God. On one wall stays the economic crisis, that is tout court the capitalist crisis, on the other wall there is the predicament of environment. Then, it is reasonable to wonder if the walls will tumble down with severe damages to all the characters, this time, of this representation; unless a "modest proposal", of the kind that we will try to formulate in this paper, be intensively pursued.

Several of the themes here gathered have already been object of reflection in some previous works ([1a), b) c) d)], [2], [3] and [4]). In this paper we collect and enrich those ideas, and put a special attention to the so called economic "cycle" and a stationary ecological-economic model in a sustainability scenario.

Some years ago, the financial "bubble", burst with its destructive and lasting economic and social consequences, the bloody geopolitics of oil of the last decades, one sixth of the humankind under the threshold of surviving, the plunder of the resources of the Earth – from the rare ores up to the great pluvial forests –, the general environment crisis, dramatic for the climate change, exemplified in an also too much persuasive way that capitalist democracies as well as totalitarian States, those which have chosen the free market economy, were not able to face the two crises of our title.

In front of the socially unacceptable disproportions between the North and the South of the world, and also inside of the "strong" Countries – the difference of wages has never been greater, up to one thousand of times between a top manager and a blue collar –, the conclusion drawn by many young people rightly motivated by the desire to rebel, and also by several not young but nostalgic, was that since the global capitalistic system and its free market are not able to give an answer to these crises *then* the capitalism has unavoidably taken the Sunset Boulevard. The task is, therefore, to accelerate its end, now in sight, in order to open a new phase after the same capitalism. A so tight consequentiality looks like ingenuous, it is.

Apart from the doubts raised by a kindly ironic title of a book authored some years ago: *Il Capitalismo ha i secoli contati* ("Capitalism has only a few centuries ahead") [5], it is not convincing why the hated capitalist system should work as a general rescuer, like it is implicit in the criticism. It's already a long time that capitalism has lost the inspiration that guided the fathers of the theory of the free market, Smith, Stuart Mill and so forth, even more in this long period of "financialization" of the economy. They

were thinking of themselves maybe more as philosophers than as economists, and were proposing the morality of action, the common good and individual happiness as objectives of the Economy. Today, nothing seems to be more anachronistic than discussing about an *ethic of capitalism*. In fact, we forwarded ourselves in the age of capitalism more antithetical to every sense of responsibility, moral and ethic: an age "*hyper-liberal*" more than "*neoliberal*" [1 d), 2].

Starting from the famous report *The Limits to growth* [6], published more than four decades ago, the environmental crisis has been initially represented as defining the physical limits of a growth based on unlimited consumption of natural resources, but already some years before of that report, the criticisms against the fundamentals of the free market economy had advanced new and interesting proposals about passing from the "*Cowboy's economy"* to the "*Spaceship Earth economy"*, as sustained by Kenneth Boulding [7]. The researches of Nicholas Georgescu-Rögen had tried to extend the laws of Thermodynamics to rule the economy of the natural resources consumption (see [8 a), b), c)]); and at the end of Seventies, the idea of pursuing a "*steady state*" of the cycle production-consumption, publicized by Herman Daly [9], looked like an interesting answer to the "*predicament of mankind*" denounced by the report of the "Club of Rome" [6].

It was going on and structuring a critique of classical economics, and environment and nature were no longer identified as pure economic factors indefinitely reproducible and available; it was beginning to shift the focus from the quantity of goods produced and producible to intangible assets, to the quality of man life.

The wealth generated by the economic systems lies not only in goods and services: there are other forms of social wealth, as the health of ecosystems, as the quality of justice, the degree of equality, the good relationships among the members of a society, the democratic character of institutions, that is, all the items listed by Robert Kennedy in his famous speech back in 1968, all items that do not enter in the GNP. In an only one word: the well-being.

It could seem not too timely to speak about the crisis of capitalism, just when there are the first signals, eight years after the "burst" of the financial bubble, of a some economic relaunch, mainly in US, not so in China; but, as we try to show in this paper, the nature of this crisis, in the globalized world, is such that requires to be faced with a new view. *A new point of view* that gives role to the environment and to the careful management of natural resources, not only to limite predictable heavy damages but also to model a new "stationary state" economy that conjugates economic variables with ecologic ones. On the other hand, the predicament of environment is worsening and the threat of climate change has become a reality with which we are dealing now and in the coming decades. The *"new" point of view* is what is echoed in the last four decades not only by the environmentalists but also from a meager patrol of economists, unheard, and that claims an ecological reconversion of economy and society.

The data of environmental crisis

A new age seemed to be opened in the early Nineties, when the Conference of Rio de Janeiro released the great themes of the environmental crisis out of the enclosure of environmentalism, strongly emphasizing the issue of climate change. The response of the facts has unfortunately followed another direction. The consumption of natural resources is carried out besides of all rationality, with a systematic looting that constantly reduces the biological diversity and the extension of the great forests – the latter at a rate of tens of thousands of square kilometers per year – while the desert areas are extending, the drought increases, the isotherm lines shift towards North in the more populous hemisphere of the world.

The systematic looting of all the materials of the underground had already led, according to the report "Opening Pandora's box" of the Gaia Foundation (2012), to an increase of 180% of the production of iron ore, 165% of cobalt, 125% of lithium, just in the decade before; the mining industry in China was increased by a third in the period 2008-2012, and in Peru the mining exports increased by one-third in 2011 alone.

Any physical entity, including the human population with its cars, its buildings, its chimneys, cannot keep growing forever. The economy and the human population depend on a continuous flow of air, water, food, raw materials and fossil fuels from the earth; and constantly send waste and pollution to the earth. The limits of growth are the limits of the capacity of the sources of the planet to provide those flows of materials and energy, and the limits of the wells of the planet are the capacity to absorb waste and pollution. At the current regimes, the flows that govern the human economy cannot be kept indefinitely, on the contrary, many sources of critical importance are being degraded and are running out.

In spite of this, the prospecting for hydrocarbons continues to grow exponentially, due to the ease for oil concessions. The hunt for rare minerals precious for technological innovation has no district, while the open-air mines transform territories in huge industrial wasteland, the tops of the mountains are removed, the land devoured. In Latin America, Asia and Africa more and more community land, river basins and entire ecosystems are plundered and the communities are displaced. It's the "*land grabbing*" [10], [11], whose data are schematically represented in Fig.1, Fig.2 and Fig.3; by this name the more critic media have indicated the phenomenon of the constant increasing of low cost transnational acquisitions of farmlands or areas convertible in agricultural uses – e.g., after a deforestation – in foreign countries, made by multinationals or States. *Land grabbing* has reached the peak in the five years 2005–2009; it has also implied the appropriation of fresh water, whose level only recently one begins to assess [11].

Fig. 1 A global map of the land-grabbing network: land-grabbed countries (green disks) are connected to their grabbers (red triangles) by a network link, considering only 24 major grabbed countries. Relations between grabbing (red triangles) and grabbed (green circles) countries are shown (green lines) only when they are associated with a land grabbing exceeding 100,000 ha [11].

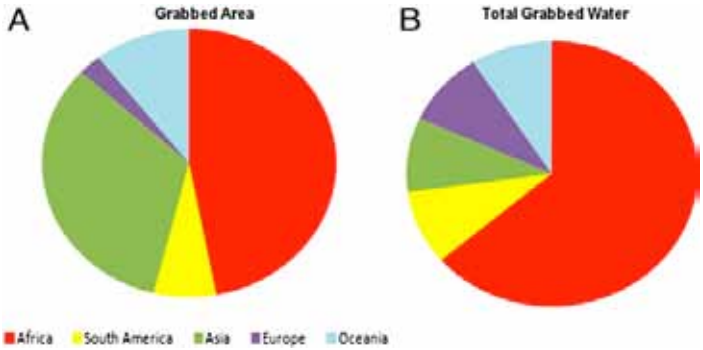


Fig. 2 Distribution of grabbed land (A) and water (B) across continents [11]

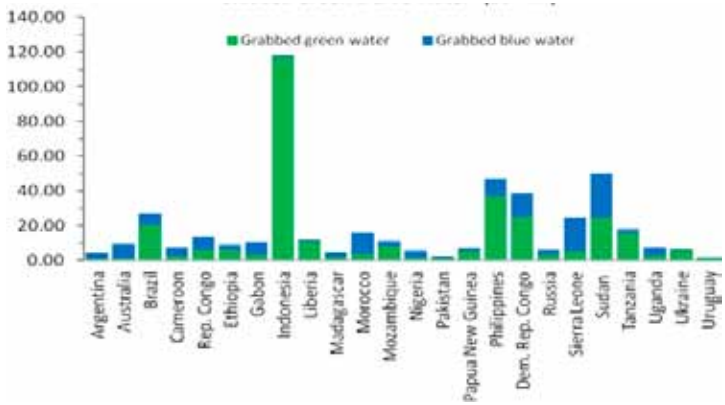


Fig. 3 Water grabbing in the 24 most land-grabbed countries. Green water (rain water) and maximum blue water (irrigation water) grabbing (2012) [11].

The *International Land Coalition Conference*, held in Tirana in 2011, has defined *land grabbing* as: "*(i)... acquisitions or concessions ...in violation of human rights, particularly the equal rights of women; (ii) not based on free, prior and informed consent of the affected land-users; (iii) not based on a thorough assessment, or are in disregard of social, economic and environmental impacts, including the way they are gendered; (iv) not based on transparent contracts that specify clear and binding commitments about activities, employment and benefits sharing, and; (v) not based on effective democratic planning, independent oversight and meaningful participation*." [12]. That is, an almost always iniquitous appropriation by the buyers and a plundering of important resources for those whom, sometimes consentient, undergo. "*...Lands and water grabbing are occurring at a dramatic rate in all continents except Antarctica...*", the water grabbing exceeds the needs of food production, as claimed by the grabbers, and "*...it would be sufficient to improve food security and to abate the malnourishment of the grabbed countries.*" [11]. It is possible to follow all land deals, current or already completed, by a dedicated "observatory" online [13].

In fact, is a new form of colonialism, whose upsetting characteristics have assumed, in the substantial ignorance of public opinion and with the complacent silence of governments, such dimensions as to make more and more actual the request made by the philosopher Hans Jonas, in name of an imperative of responsibility, an ethical commitment towards the biosphere [14]. The consequences of a such depredation, which impacts on the health of those who work there and the people so affected, are read in medical bulletins of the countries involved and in WHO statistics.

About the consumption of all natural resources, already in the press release for the presentation of the UNEP (*United Nation Environment Programme*) report 2011, it had been launched an alarm: "*By 2050, humanity could devour an estimated 140 billion tons of minerals, ores, fossil fuels and biomass per year – three times its current appetite – unless the economic growth rate is 'decoupled' from the rate of natural resource consumption. Developed countries citizens consume an average of 16 tons of those four key resources per capita (ranging up to 40 or more tons per person in some developed countries). By comparison, the average person in India today consumes four tons per year.*

With the growth of both population and prosperity, especially in developing countries, the prospect of much higher resource consumption levels is 'far beyond what is likely sustainable' if realized at all given finite world resources, warns this report by UNEP's International Resource Panel. Already the world is running out of cheap and high quality sources of some essential materials such as oil, copper and gold, the supplies of which, in turn, require ever-rising volumes of fossil fuels and freshwater to produce. Improving the rate of resource productivity ('doing more with less') faster than the economic growth rate is the notion behind 'decoupling', the panel

says. That goal, however, demands an urgent rethink of the links between resource use and economic prosperity, buttressed by a massive investment in technological, financial and social innovation, to at least freeze per capita consumption in wealthy countries and help developing nations follow a more sustainable path." [15].

Further, the unrestrained and unlimited plundering of natural resources has consequences which are not recognized, by the governments nor by the public opinion, as side effects of that depletion. Only one example, but gigantic; and, not to talk of the so many issues afflicting the agro-alimentary cycle, which have had their spotlight turned on during Expo 2015, let's look at the oceans, at the speedy and dramatic decay of the reef system, that has become an object of study in order to support its resilience [16].

The Australian great reef barrier, the biggest reef system and one of the marvels of the world with its 1,400 miles of extension, was in the Unesco agenda for the list of sites "in danger", and the Australian government claimed victory in July 2015, since the world Unesco's heritage committee decided not to list the reef in danger "*...although Australia must report back on its recovery plans by December next year.*" [17]. What is the situation? There are more than 400 types of coral and 1,500 species of fish and the tourism income, that has strongly pushed the pledge of Australian government, has been estimated 2,6 billions of pounds a year. In the last thirty years the barrier has lost about half of its coral, the causes are: rising sea temperatures, increasing ocean acidification, larger numbers of cyclones in recent years, pollution problems triggered by fertilizers and spillage of sewage from farms and cities.

Ocean acidification has become a matter of a quarrel with skeptical "environmentalists", but apart from ironies, it has undoubtedly a relevant impact, everywhere in the world, on the health of coral reefs, whose state has been the object of several global studies. The most recent one gives important data on the current conditions of these systems, that are essential for all the sea life and, just for this reason, undergo the attack of the fleets of industrial fishing [18]. More than 800 coral reefs have been examined in 64 different sites in the world, finding that more than 80% of them had lost more than half of fish, a depletion already begun starting from the Seventies. The most worrying consequence is the same survival of the coral reefs, inasmuch deprived of fishes which clean up the barrier from invertebrates and algae "coral killer". Although protection measures will be adopted to control and limit fishing from now, such as the Australian government has pledged, the recovery time is evaluated up to sixty years, but an efficient action of protection could guarantee the survival of fish and coral [18].

Meanwhile, the ice masses of the great glaciers of the Quaternary are increasingly reducing; the Arctic ice cap has split nearly a decade ago (2006), opening the fight among the countries that already seek to seize the precious booty of oil, gas and minerals, that has so become accessible. A fight that

has not yet been regulated by an international convention like the one about the Antarctica. By the way, colossal fracture lines have been revealed on the edges of that vast frozen continent , prodromal to the release of "iceberg" as large as the Valle d'Aosta. And another concern is incoming due a threatening positive feedback: the melting of permafrost, Siberian or Antarctic, that could free from ice massive quantities of Methane, one of the main greenhouse gases. The extreme meteorological events have become so repeated to make almost forgotten the hurricane Katrina and the destruction of New Orleans, that eleven years ago have illustrated the same meaning of extreme meteorological event.

Water "bombs" have by now become in Italy a media exercise, at least the word, with their tragic equipment of victims, floods and landslides, that mark the fragility of our territory and the criminal character of not observing the laws on soil protection. The "tropicalization" of climate – that is, the shift toward North of isotherms, the raising of the "thermal zero" above 4000 meters of height, the presence in the lands and in the seas of species whose original habitat is much more in South – echoes by now in our beaches through the mouths of placid householders. Less known, maybe it seems farest, is the spread of the drought in always larger areas of the world.

The *National Oceanic and Atmospheric Administration (NOAA)*, a Federal Agency of US, makes available on line an interactive portal, the *Global Drought Portal Data*, that each month records data on drought in the different geographic areas of the world [19]. Let's report here, for giving an example, the distribution of soil moisture at the upper layer of the soil, Fig. 4, in August 2015, and the vegetal health index, Fig.5, in July 2015; the different colours of the represented areas are self-explaining.

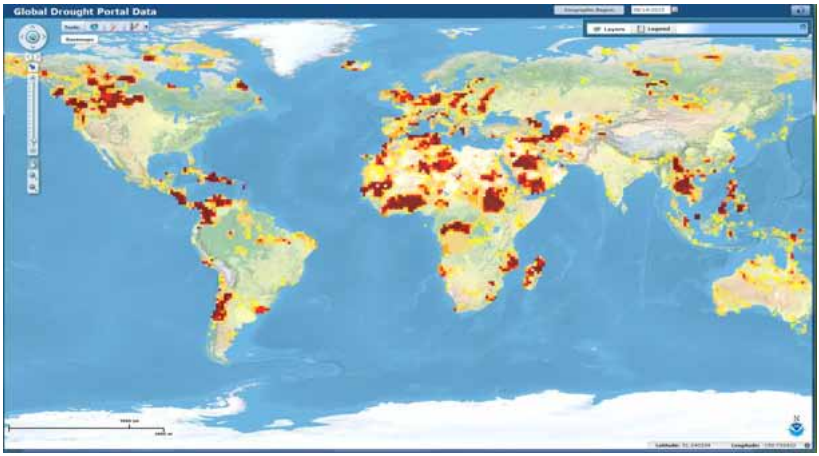


Fig. 4 Soil moisture of the upper layer of the soil [19]

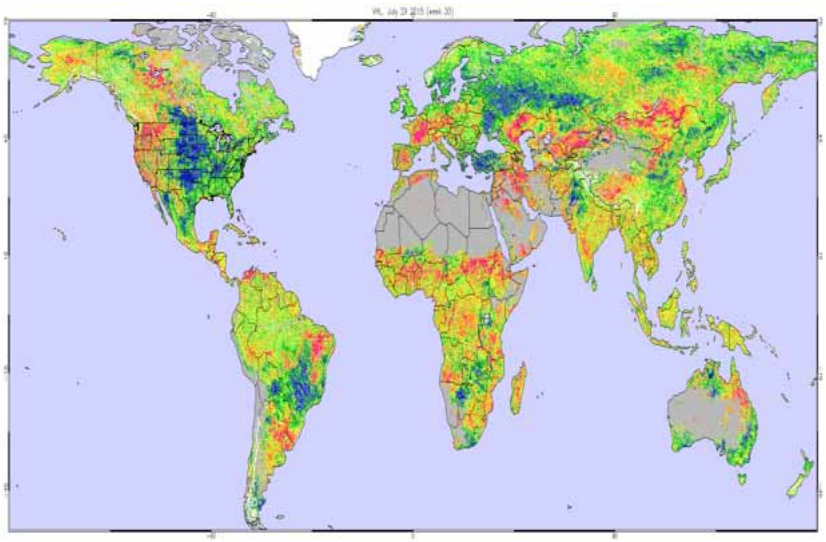


Fig. 5 VHI, Vegetal Health Index [19]

The global situation, at the end of July 2015, can be reassumed in the following points:

- in Europe, drought is increasing over the major part of the continent, at most in the Mediterranean areas; in Switzerland, due to the lack of rains, helicopter transports of water have begun to feed the cattle in the Cantons of the South
- in Asia, drought is concentrated in the South East and around the Caspian Sea
- in Africa, drought is covering ever more areas in the equatorial region and in the North, but also in South Africa is foreseen a 32% reduction of maize production
- in North America, drought is intensifying in the North-West of the continent; in the United States, it has spread like wildfire, burning about 5,5 millions of acres, much more than the mean value of 3,5 millions of acres
- in South America, drought, that is rooted in Brazil and in the South of Andes, is gaining many cities: Sao Paulo has to recur to emergency reservoirs of water and is beginning to ration the supplies of water
- in Australia, indicators show a light improvement in the North; on the contrary, drought is spreading in the South, where this condition has caused a big reduction of cattle.

A little relief has been given to many areas by the outstanding performance of El Niño, that has been supposed to last to the end of the year 2015; on the other side, it seems to be a menace to harvests in Indonesia.

It becomes increasingly clear that the alterations of the great reproduc-

tive cycles of nature, the dramatic global changes which are registered with increasing intensity and frequency are only the other side of a relationship of destruction and plunder of the resources of nature, realized in the name of profit and of a level of consumption that the "strong" countries want to maintain to the detriment of the South of the world, almost a reproduction of the inequalities that inside them continue to be deepened among the different social strata.

There really are no more hymns, sung in the name of "consumer production" and "productive consumption", as also Karl Marx did. And this becomes particularly clear in the story of the energy, making true, amid the fears that Ralf Dahrendorf expressed in his short essay "*Ecology and Democracy*" (2000), precisely that one: "*going to take energy, where it is*", that is, in the Gulf, as in fact it is happening over these forty years. Since 1973, the control of crude oil, its flows and its price is the cause always present in the three conflicts that have taken place in the Middle East; and after, conflicts and clashes have been, more or less directly, the background of fundamental strategies and projects of adduction of huge amounts of energy raw materials from the heart of Asia to the West. Nor should we forget that it is in this background, in the context of the debacles caused by the triumph of the war behind the screen of exporting democracy and by the despair of the dispossessed, that it has been fed the jihadist ideology of the war against the "American crusaders and their allies", to be fought everywhere and by any means till their retreat.

After the terrorist practice of Al Qaeda – in some way creative, "a soul without a body", in comparison with the ancient canons of the "holy" wars, which in name of the throne-altar alliance have previously characterized, in the whole Christian world, centuries of genocides and robberies in order to conquer territories and their treasures – the more traditional founding of a territorial dominion, a "caliphate", is coming back; that wants to cast the shadow of its atrocious power on areas increasingly wide; to it kneel down ethnic groups, clans or armed bands who had sworn allegiance to Osama Bin Laden.

■ Energy/Climate change

The energy has truly become a crucial and unavoidable theme; furthermore, dramatically shows a deadline to the great industrial strategies, to the policy decisions and the future of the globalized world: the final outcome of the attempts to face timely, if it's possible, the abrupt character of the climate change, that is caused by the increasingly recourse to fossil fuels, that still feed the world economies for about 80% [20].

After the alert launched in the Nineties by the reports of IPCC *(Intergovernmental Panel on Climate Change)*, that have led to the entering into force

of the Kyoto Protocol (16th February 2005), a growing attention has been given to the drastic consequences of the climate change, since when the assessments by the international scientific community were addressed to the G8's of Gleneagles (2005) and St. Petersburg (2006) [21 a), b)]. The Academies of Sciences of the Countries gathered in those summits, plus the ones of China, India, Brazil and South Africa, emphasized in their assessments that the global warming is mainly due to human activities ("anthropic cause"); strongly recommended to give a priority attention to the link energy-climate change, eventually demanding a "*prompt action*" against the global warming to the most powerful decision makers of the world.

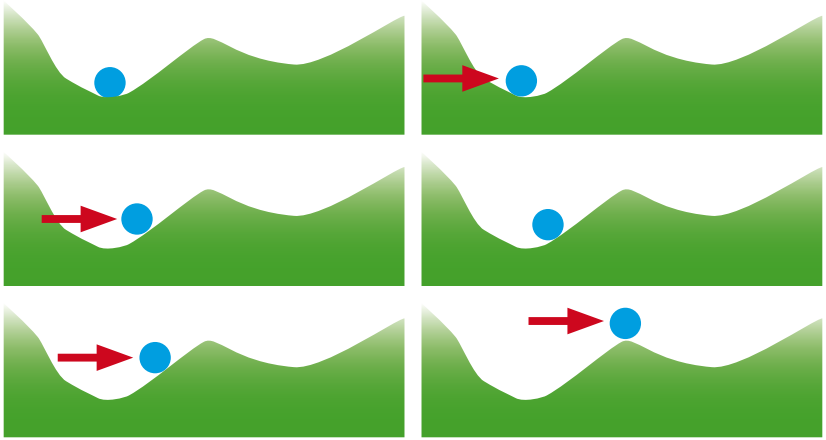
Those addresses have registered a timely answer by the Council of Europe, that, in March of 2007, launched its three "20%" as targets to be obtained within the year 2020 (-20% of emissions of carbon dioxide, CO2, with respect to the 1990 level; -20% of total energy consumptions by means of saving technologies and 20% of total energy consumptions covered by renewable energies). Some good results have been already obtained by the EU toward its three "20%"; and the EU objectives to mitigate the effects of global warming, this is by far the most important issue, have become the center of the debate and the benchmark for the policies of all governmnts.

We will take again this issue later, here remarking the very significant interaction among scientific world (Academies of Sciences, IPCC), decisions makers at global, national and local levels, great people mobilizations to urge politics in order to face global warming, that, together, have succeeded in orienting not only the market but also the preference of consumers.

Now, we have to emphasize the abrupt character of the climate change, already mentioned before, from which stem the dramatic consequences which are already taking place from time. To make the international scientific community, so determined in its appeals to the two mentioned G8, was, in fact, a fundamental change of perspective in the climate science. The report *Abrupt Climate Change*, published in 2002 by the *National Research Council* (NRC) of the *National Academy of Sciences of the United States* after a decade of study and field research, draws the climate history as made of abrupt changes and asserts that, contrary to the dominant scientific conviction, **the atmosphere is one of the factors of the modification of climate** [22]. This new paradigm explains the reason of the fierce scientific opposition against the role of greenhouse gases; they live in the atmosphere, the lowest layer, but if the mainstream assesses that the two principal factors of climate change are the balance of the ice masses and the salinity of the oceanic currents while no effect can be produced by the atmosphere, how can greenhouse gases act, since are inside the atmosphere?

But now, the questions rising from NRC report are quite different: the atmosphere is one important factor of climate change, can it cause an "abrupt climate change"? The increase of the greenhouse gases concentration in the atmosphere acts like a "forcing action": will there be a value of the intensity

of this action, in correspondence to which a sudden change in the behavior of climate occurs? Technically, we speak of "threshold value" and "threshold effect" if a continuous variation of a control parameter of a system generates a discontinuity in the behavior of the system. Let's try to better understand this issue by means of a "simple" model, drawn from [22].



A "simple" model for better understanding the "abrupt change" from the climate stability to instability

The little sphere is the climate (the set of all climate cycles), the red arrow is the intensity of the "forcing action" (the global warming). Under a certain value the effect of the forcing action is to make the sphere oscillate in the hollow, but at a certain level of intensity the sphere will be pushed from the hollow up to the peak. Both positions are of equilibrium, what is then abruptly changed in the behavior of the climate?

The equilibrium is *stable* in the hollow, while in the peak is *unstable* because a whatever little push is able to remove the sphere from that position. To a continuous and gradual variation of the forcing action corresponds for a critical value of that action – the threshold – a discontinuity: beyond the threshold, equilibrium is "broken", **a sudden change takes place from stability to instability of all climate cycles**. This abrupt climate change, triggered by the forcing action, doesn't depends on time, as it is clear when the forcing action remains over all time under the threshold: no threshold value, no abrupt change.

Who tells us that the intensity of the forcing action has reached the threshold, upsetting the stability of the climate? Over the last 650,000 years, the CO2 concentration in the atmosphere has not exceeded the 290 parts per million (p.p.m) up to before the industrial age; in 2014 it reached the 400 p.p.m. level. But is not so much the impressive level acquired, but the fact that *the*

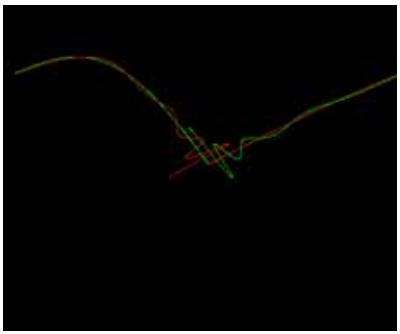
increase of CO2 concentration in atmosphere over the last 50 years has been such that had normally required in the history of the climate about 5,000 years! **This contraction in the time duration of about a hundred times is a measure certain of the forcing action, which leads from stability to climatic instability**.

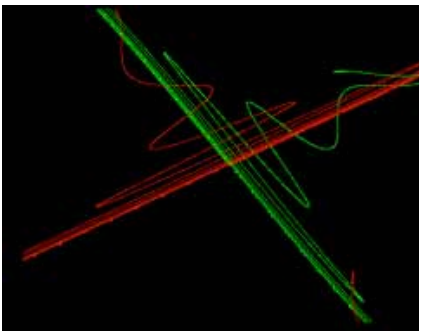
The forcing action, able to dramatically change the climate, lies in the growth of the concentration in the atmosphere of CO2, the main "greenhouse" gas. The switch from stability to climate instability is the transition that we are already living, countless the tests experimentally verified, some of which were mentioned at the beginning. Inevitable surprises, as the subtitle of the NRC report says.

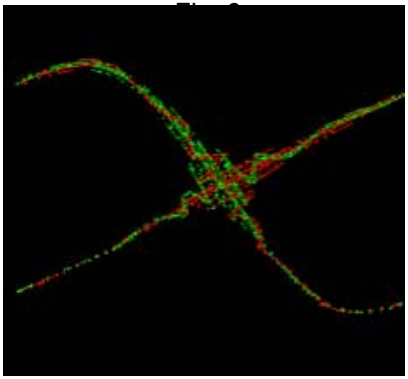
About the "simplicity" of the model. Really, it represents climate, in physical-mathematical terms, like it was a pendulum under the influence both of the gravity and of a "forcing action". The evolution of this system can be represented, as any other two-dimensional dynamical system, in an appropriate two-dimensional space called "*phase space*". In this plane it is possible to draw a *phase diagram* characteristic of each system, a "*phase portrait*"; i.e., a geometrization of the dynamics, which allows us to see "with the eyes" the evolution of the system and its quality properties like stability, instability, attractivity and other.

This way of representing dynamics, preferring the qualitative aspects of an evolution – the stability properties – than the quantitative results such as an analytical calculus could provide, is given by the theory of stability that was proposed, separately, by Henry Poincaré [23] and Aleksandr Lyapunov [24] at the turning of Nineteenth century. It is a useful tool to obtain a lot of information about a dynamical system without solving the problem of the differential equations associated to the system, often impervious due to the nonlinearity of the equations. Born in the context of Mechanics, this method – the qualitative analysis of dynamical systems – can be applied and has been very largely applied to almost any system – physical, chemical, biological, demographic, economic – in order to describe its evolution in time. The stability theory does not explicit, in general, the dependence on time of the evolution, as could do the analytical calculus, when performable. However, in many interesting cases the time law can be easily derived by the kind of trajectories followed by the system; e.g., to the closed orbits in the "phase portrait" correspond periodic motions.

In our case the phase portrait exhibits areas of stability, areas of instability and the rising of a chaotic dynamics, determined the latter by the assumption of some threshold value by the parameter that rules the intensity of the forcing action. The complexity of the dynamics of the "simple" model is well represented in the figures below (Fig. 6, 7, 8) by the behavior of the so called "*separating curves*" – the "stable manifold" (green) and the "unstable manifold" (red) in the phase portrait; and by the subdivision of the phase space in stability "islands" and chaotic regions (Fig. 9).







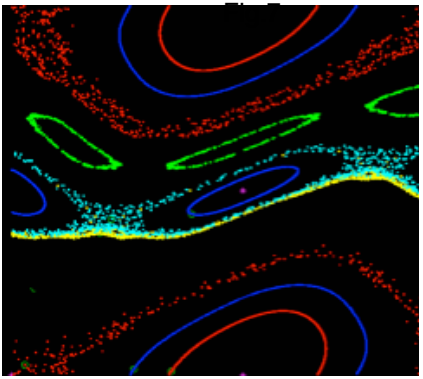


Fig. 8

Fig. 9

We have taken Fig. 6 - 9 from [25]. They refer to the so called "standard" map of pendulum, and in Fig. 9 the same phase portrait suggests what are the "islands" of stability, the ellipses closed around a fixed point, and what the chaotic regions, around the hyperbolic points.

It's worth to note that a portrait analogous to that of Fig. 7 had been forecasted by Henry Poincaré in the study of the "three body" problem in Celestial Mechanics: "*...one will be hit by how much this figure is complex, so much that I do not try to draw it* (AT)" [26, p. 389]. Surely, the "three body" problem refers to a context quite different from our one, but a kind of "universality" of the chaos, arising from the dynamics of non-integrable systems, legitimates the comparison between the phase portrait of the two problems we are talking about. Among a lot of other issues scientifically important, Poincaré has "invented" the chaos, that only in more recent times, starting from the Sixties, has raised research interest; famous, under this regard, the Lorenz model [27] and the very lucky quip on the wing beat of a butterfly, that has overflowed out of the banks of the science to encounter the

screenplays of movies[1].

This digression tries to show, on one hand, that if a "simple" model can make us meeting chaos, all the more reason one can suppose that this will be the case when more realistic and more sophisticated models are used, like it's verifiable on the basis of the more recent researches. Thus, it becomes more understandable the clear-cut assertion about the earth's climate as chaotic system, given in the NRC report: "*...in a chaotic system, such as the earth's climate, an abrupt climate change always could occur.*"

On the other hand is a first step for becoming familiar, for those who need, with two-dimensional nonlinear dynamical systems, which will come to attention also after, when we will talk of economic "cycle".

Because of the lasting of the CO2 cycle in the atmosphere, the effects of the climate change will accompany all humanity for the next decades, even if a strong general action of mitigation were undertaken immediately after the Paris Agreement, published the 12th of December 2015 at the end of COP 21. Thus, to all human activities, individual and social, it has been thrown down the gauntlet to learn to live for a long time with the consequences of the global warming, while many challenging global actions need to be undertaken to face it. *As a matter of fact, all the inconveniences associated with this condition, including those of public health, they shall no longer be considered as an emergency.*

In this context, the issue of climate change requires an appropriate size in national as well as in international policies, a general sensibility, a public awareness, and proper education and training measures. In his opening number of 2012, the journal *Nature* addressed to scientists around the world so that they would promote knowledge about climate change by all means made available by the current media network, since "*the threat has never been greater*". A sentence that recalls the dramatic picture given by the NRC report, that surely influenced the statements of the Academies [21 a), b)] and, a bit less, the Fifth Report of IPCC (*Intergovernmental Panel on Climate Change*), anyway making anticipate the "*turning point*" of twenty years, i.e. from year 2050 to year 2030 [28].

It is time that an extensive program of education take the place of the appeals.

[1] *"Does the flap of butterfly's wings in Brazil set off a tornado in Texas?", this question is successfully aimed to emphasize the strong sensitivity of the Lorenz model to small perturbations on the initial state. Really, the model deals with meteorology (high-frequency phenomena, i.e., few days), not with climatology (low-frequency phenomena, more than seven days), but it is able to exhibit a complex dynamic – a chaotic one with its "strange attractor", well known to the scholars – despite that the sensitivity to small perturbations is only one of the requests for setting up chaos, whose rigorous characterization goes beyond this note.*

An instance of global rationality

Already in 2009, at the meeting held in September in New York among the heads of government, during the preparing works for COP 15 (Copenhagen), Manuel Barroso, EU Commission President, noted: "*The climate is changing faster than had been forecasted even just two years ago. Continue to behave as if nothing was is equivalent to make inevitable a transformation dangerous, perhaps catastrophic, of the climate during this century*".

But in Durban (COP 17, December 2011) a global agreement has been postponed to 2015. Of course, it is a deal that has unprecedented worldwide comparable level, and that, moreover, would require the strongest countries to expand greatly – at least 100 billion dollars a year – the low budget fixed in Cancun (COP 16).

The dramatic urgency is very clear to the politicians – see Barroso or Bolivian President Evo Morales – but has not found an echo able to activate the "*prompt action*", that the Academies of Sciences have required [21 a)]. Politics is also aware of the catastrophic consequences of the scenarios of "adaptation" – a billion and half people of the world, no longer the small state of Kiribati, to be moved within the next few decades in areas at higher altitudes – but all considerations about the inertia of the production systems, of the economic and social issues related to fossil fuels, and the difficulty of the negotiations, do not exempt from detecting a worrying gap between professed intentions and the evolution of environmental crisis.

On 12th of December 2015, is reached, as conclusion of COP 21, the Paris Agreement; an agreement that had been in some manner "written before": in the conferences held by UNFCCC (*United Nations Framework Convention on Climate Change*) during 2015; in the commitments subscribed through bilateral agreements – in the triangle U.S., Russia and China – in the last four years; in the midway good results obtained by EU with respect to the three 2020 targets and in the commitment that in 2015 U.S. administration has assumed of reducing 32% carbon emission within 2030, even though only referring to the 2005 level and not to the 1990 one. In the Paris Agreement there is not the direct objective of reducing climate-alterating emissions, but the commitment of: "*Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change*"(art.2 a))[2]. And the difficulties of path to reach the agreement, e.g. on the matter of supplies in terms of financial and technological support to developing countries, have a deep track in the final text where the

[2] The referring directly to temperature implies a large gamma of possible global emissions paths, therefore becomes more complex the monitoring of the phenomenon and of the results achieved by each Part. Mainly for this reason it has been preferred the assessment of the implementation of targets voluntarily assumed (INDC), by means of reporting.

implementation of the agreement is remitted to further and future negotiations. Not binding targets about the quantity of emissions but the *Intended National Determined Contributions* (INDC), fixed in article 3 as to mitigation, adaptation and financial fluxes; while procedures become binding, about, e.g., commitments of reporting, to be controlled, of the greenhouse gases emissions, strategies for mitigation and the level of implementation of the INDC [29].

Is not our aim or intention to draw here an analysis of an Agreement so complex, and mainly of legal character, such as the Paris one, of which surely is worth to note the very strong legitimation deriving from the large presence of leaders of State and premiers in the two days final phase. Our point of view is very similar to that expressed by Kumi Naidoo, executive director of Greenpeace International, and by Nicholas Stern, Adviser to the Prime Minister and the Chancellor of the Exchequer of UK on the economics of climate change and development, that, with our words, can be said: "Apart from assessments of single aspects, the most important effect of the Paris Agreement is to mark the *beginning of the end of the fossil fuels era*".

This forecast can be rely on the number of countries which have assumed commitments at Paris, 180 which represent the 95% of the global emissions, in front of the little more of 55% of emissions from the countries adherent to the Kyoto Protocol at the time of its entry into force (16 February 2005). EU is already discussing about the quote per each member in order to reach the goal of 40% reduction within 2030; and a covering of 100% of final electric consumptions at 2050, as recently assessed by a Mc Kinsey report[3] [30], is reasonably within the capacity.

Our last considerations do not modify the fundamentals of the framework we have so far constructed. On one hand, following "*Abrupt Climate Change"* we can state with the strength of the scientific reason that, as common people say, "the horse has already gone out of the stable": *climate instability is the scenario of the coming decades*, because the CO_2 emissions will continue to grow for next years and the cycle of this gas in atmosphere lasts many decades, with consequences that we are already experiencing and *the need of a general education aimed to overcome behaviors and actions of mere emergency.* On the other hand, there is a difficult path in front of the massive inertia and enormous consolidated interests characterizing the giant systems of the fossil energies, the need of modifying our actual way of production and consumption in order to implement the "energy revolution" and, more general, a new social economic model sustainable.

This path will take place while are continuing the two crises we are talking about. And, worse, in the presence of the terrible product of these two crises and their interactions: *the increasing fluxes of immigration for all*

[3] The report, realized by a company specialized in market polls, consisted in the analysis of the answers of many big electric utilities and other economic organizations.

coming decades. To face the capitalist crisis it will be necessary, beside of the actions needed for a real modification of the economic main-stream, a deep criticism of the theoretical bases and reasoning on which the neoliberal model is founded; further, trying to propose the way and the models for the sustainability scenarios.

Part II and Part III of this paper are aimed just to give a contribution in this direction, with the double awareness of "invading" a research field not of all of us – the economic one – and that the transition we'll describe really does not pretend to show how a society marked with the capitalist way of production and consumption can gradually change in another one, completely beyond that system.

Since we assess as realistic the position expressed by Giorgio Ruffolo [5], and think that because even those who more oppose to the capitalist system and its distortions, loaded of dramatic social effects, are able at the most to point out options and trends, but not a substitutive framework to be realized in *verifiable times*, then we retain useful to argue meanwhile about what can be theorized and practiced in the medium run, but starting from immediate first implementations. This will be not "the sun of the future", but one will have at least tried to provide the bases for a model more respectful of the man and the nature, that is a necessary condition to face the urgency of the environmental crisis and its devastating impending aspects.

Devastating aspects? It is not an exaggeration, but the economic consequences of neglecting climate change were represented at the end of 2006 to Tony Blair, much pragmatically in terms of impact on GDP, in a report that the English premier had requested to Nicholas Stern [31]: a medium fall of 5% a year of the world GDP, if actions of mitigation had not been undertaken[4], a fall such as to make a trifle our actual crisis!; and the report gave an accurate description of the different negative issues in the various sectors of production and consumption and of the probable damages, such as quantified by the models that the researchers engaged for the draft had used.

So far, there not has been an adequate answer to an instance of global rationality, of the kind that we are supporting. And the urgencies we have underlined find a very feeble, or null, echo in the globalized world of Economy and Finance.

[4] "Using the results from formal economic models, the Review estimates that if we don't act, the overall costs and risks of climate change will be equivalent to losing at least 5% of global GDP each year, now and forever… The investment that takes place in the next 10-20 years will have a profound effect on the climate in the second half of this century and in the next. Our actions now and over the coming decades could create risks of major disruption to economic and social activity, on a scale similar to those associated with the great wars and the economic depression of the first half of the 20th century. And it will be difficult or impossible to reverse these changes." [31]

Part II. The economic crisis

Economics and finance

In the global debate the attention about the crisis of the productive and economic systems has been mainly focused on the financial aspects, particularly referring to possible interventions to get out of crisis and give a new stability to those systems, but, at the same time, demanding the relaunching of the growth as a necessary condition: a condition truly difficult to be satisfied, as we can see day by day.

On the crisis of the financial instruments, the mutation from industrial capitalism to financial capitalism, we read, for years now, analysis interesting, commendable efforts of science and useful proposals on financial transactions, needed to limit the power of the rating agencies, and on the role that government should play, in particular, by competent European institutions. Proposals to be surely advanced, but that are not a stable therapy for the vulnerability of the state budget assaulted by debt and, plus, if you do not relaunch growth, as it is frequently said. Indeed, pursuing a balanced budget without a serious prospect of growth - it is claimed now by many - this leads straight into deflation or recession, as indeed happened not only in Italy. And a revival of growth is difficult in the given situation.

It should rise the suspicion that it is wrong to separate, or relegate to the "two-stroke policy", the different aspects of the crisis, that of the economic productivity from that of the natural resources, the environment and the climate change. It has become usual that even in large international conferences on the economy, on economic policies resonate some authoritative voices to emphasize this inadequacy, "After no more heard", he would have said the great bard. In the international debate has come, it is true, the theme of the *green economy*, but it soon took over, even for the most sensitive economists like Amartya Sen, not the prospect of a substantial element for radical changes to a growth model ruinous, rather only an *additional strand*, that could be considered next to the other issues in the usual assessment of the return of investments (and therefore soon challenged just by the difficulty of finding investments). Or, the green economy has been watched rather as an ideology of progress: *our common future*, Obama (of long ago), the UNESCO Decade for Education for Sustainable Development. In fact, as has been rightly pointed out ironically, "*a Sunday theme, good for the homilies*".

We believe that at the basis of this consideration of practical irrelevance of a *possible ecological conversion of the economy and society* there is a substantial lack of understanding of both the terms of the binomial "*econom-*

ic crisis - ecological crisis", due to a widespread inability to be appropriately interested in the scientific questions by the economic and political culture. Hopefully, the "spotlight" switched on over all the world by the encyclical *Laudato si'* of Pope Francesco will finally give to the subject of ecological conversion an effective resonance, and a further boost to intensifying and speeding up of the actions that need to be done. *Laudato si'* meets, half a century after, the themes raised by two articles published on *Science*; a very famous the one by Lynn White, in which the author argues that the Christian religion is responsible for environmental destruction [32]; and the other, by Garrett Hardin, which forecasted a future characterized by struggles for resources, while they will be dwindling, due to the Judeo-Christian values that restrict the principle of liability solely to the human interests [33].

The encyclical *Laudato si'*, while investigating the theme of the "two crises" and using analysis and accents of complaint that ever had risen so high in the Catholic world, draws eminently a spiritual path of great interest and does not address – nor was its task – a knot economic, and social, that is the basis of the actual impasse: the essential contradiction between technological innovation and globalization. We'll talk about that later.

The risk to which we are exposed is related to the *hybris* of venturing on the field of economic crisis, partly justified by the caution or reticence of many great economists, who have found again the enamel since when the crisis has worsened, after some luster of the domain of the "unique thought". Aware of our limitations, we will try to tell our arguments, driven by the gravity of the situation and the need to cope to it.

■ Unilateralism. From "neo-liberalism" to "fiscal compact"

We said, "hyper-liberalism" better than neo-liberalism. It 's a story whose start date you can perhaps put in mid-August of 1971 with the unilateral breaking of the Bretton Woods agreement, the statement of the not-convertibility of dollar by Nixon. An act by which the US hegemony tends to the domain. Then, with the Yom Kippur War (1973) and the subsequent explosion of the price of the barrel of crude oil, the US have been able to overthrow on their Allies, but competitors on the market, the weight of a large part of their deficit.

Milton Friedman, Nobel Prize for Economics, is famous for being the main exponent of the monetarist school and, much more significantly, because the economic theories and the preaching of his Chicago School became in the Eighties the economic policy of the Reagan administration, in United States, and of Margaret Thatcher in the United Kingdom. And those theories found another major landing point in the "Washington Consensus" (1989), with the "Decalogue" of economic policy directives that the international financial institutions based in Washington – the International Mon-

etary Fund (IMF) and the World Bank – imparted to Countries in crisis. Again, unilateral acts, real ukase often disastrous for those countries.

The recipe for "less government, more market", preached authoritatively by Friedman, has had among its most extreme applications the liberalization of capital, which would have horrified Smith and Ricardo. For the founders of the theory of the free market was in fact totally unacceptable that the capital, the historic result of a centuries-old accumulation process, materialized in a particular country, could itself become a volatile commodity, able to cross the borders of the country that had produced it.

The liberalization of capital should have led to an era of stability in the market, according to the gurus of the Chicago School; on the contrary, there have been twenty years of crises, that followed one more destabilizing than the other, and it is not arbitrary to place it among the causes of the financial bubble exploded in 2008 and the economic catastrophe that followed. What would have been the results and the degeneration of capitalism opened by the "hyper-liberalism" phase, even more in the financial sector, has been described by a fine book by Jonathan Coe [34], first and best than the economists did, confused and uncertain those ones not triumphant.

It is in this context that has matured the disengagement of the finance support, full of risks in the short to medium term, from the manufacturing industry and the production of real goods, in order to promote investments that do not depend on those risks, pursuing the road that, perhaps vulgarly but certainly effectively, was defined as "*make money with money*". A "creative wind" that has swelled enormously the finance – from the US subprime mortgages for houses to futures, derivatives, swaps etc. – up to reach a volume greater than ten times the world GDP, and which, moreover, such remains also in our days.

It's good to remember that the legislative "mother" of this colossal distortion and of the endless injustices generated, is the Gramm-Leach-Bliley Act of 1999 that, over sixty years later, has revoked, with the blessing of Bill Clinton, the Glass-Steagall act, the heart of all the financial measures that the US Congress had made available to the new Deal of Roosevelt in 1933. The Glass-Steagall Act had required a clear separation between commercial and investment activities to the banks; and, it is certainly not only our belief that the restoration of that separation is a necessary condition to reduce distortion, to reduce irresponsible and "job killing" character of current financial trends. Without this, any attempt to an "*ecological conversion*" will have to do with the dictatorship of finance without rules [35].

As for the EU, what Mario Draghi has named "*fiscal compact*" is the set of very strict rules with which it is considered to deal with the crisis and begin to build an economic government of the EU, but without that, ironically, the European Central Bank has the "dynamic" power of the US Federal Bank. And with a strong expense of national sovereignty: "*the most boring suicide note in history?*" was wondering an American economist [36].

The transfer of power from the Members would not in itself really bad, but, too pragmatically, it starts from the economy, worse, from the finance and budget laws. The exact opposite of what had dreamed the great Europeans: a federal democracy, a political union based on history and culture, on the social and economic cohesion, not indeed on a balanced budget, moreover fixed in the Constitution.

A merciless criticism was raised, in its time, from many discussants not only against neoliberal austerity but also in opposition to the whole strategy of the global economic politics. For instance, Paolo Barnard said that it had gone on for the last forty years: "*A global economic policy, neo-classic, neo-merchant, neo-liberal*" in order to keep the power to the élites: "*...élites knew that States with their own sovereign currency could have produced full employment everywhere in the world without problems, but this would have taken away power to them. We were doomed to suffer.*" [37 a)]. From here, a hard remark against the euro: "*If it had been counted in sovereign currency instead of in euro", Italian debt "would not have caused anything, even though it had been at 300% of GNP*", and a contemptuous definition of its standard bearers Angela Merkel, Nicholas Sarkozy, Mario Draghi and Mario Monti [37 b)].

That transfer of power is so great that postulates a corresponding growth of an European representative democracy and of an European political government, that is, of a political Europe. Otherwise, beyond the substantial incorrectness - Germanic style - detected in the economic field by many noble fathers of economic theory, the operation results in a historically unprecedented expropriation, in an unacceptable reduction of democracy and freedom for all. The drama experienced by Greece in the summer of 2015 is there to show it. And thinking of the delay of the building of a political Europe – again, the case of Greece *docet* [38] – it should be noted that several countries, France first, have played, with their no to the European constitution in 2002, a similar action to that conducted, on the mere financial plan, by the Greek governments of the Right with their tricks on the balance sheet, which at that time were endorsed by the inattentive censors of Brussels.

■ What's the debt?

The "fiscal compact" is however, as it is trivial, a set of measures of a mere financial nature, that bears the risks to the democracies and to citizen we have just mentioned, the premise for an usual promise of a second phase of economic recovery. Yes, but the economy and its fathers what they say? "Underdetermined" for almost two decades of hyper-liberalism, they have taken again the field, since when the crisis broke out, but with proposals that seem unmarried of effects. The therapies indicated by Joseph Stiglitz and Paul R. Krugman, for example, coincide in the fundamentals, and criticize,

even vehemently, the economic shambles operated by the finance, appealing to a revival of public spending in an "anti-cyclical" key. The austerity of German brand is untimely and exaggerated because the cuts cause recession, the recession worsens the debt, that is, the opposite of what everybody wants, claimed, in a nutshell, the two Nobel of Economics.

And in order to support that economic policies to growth and full employment can, under certain conditions, produce an increase in the debt much more bearable than how much the institutional government of economy is willing to admit, Paul Krugman has intervened as columnist of *The New York Times* many times, almost a "serial", also in recent times, starting from the maybe more known article [35]. In this column he argues against the classic example advanced by the conservative economists, who compare public debt, due to the state budget deficit, with that of a family committed to pay off periodic installments for a hard loan. An analogy false twice, first because the families have to refund their debt while governments have only to guarantee that the debt increases less than fiscal basis; second, because the debt of the family is a commitment with an outside creditor while the debt of the government is money largely due just to the citizens. To those who are accustomed to foresee a future of poverty for the citizens, as a consequence of the increase of the public debt, Krugman recalls the example of the last world war: the colossal public debt incurred in its course was never repaid, but it has become less and less important with the growth of the economy and, with it, of the tax base. The taxpayers US were hit by an unprecedented burden, but the public debt, of which they were also owners through government bonds, did not make more poor the postwar Americans, on the contrary gave them an unprecedented increase in their standard of living [39].

We may add that in Europe the "*economic miracles*" of Germany and Italy in the years after the Second World War demanded more time – inevitably, compared to the devastation of the two economies, that had the ruins of destroyed cities as an icon – but that took place always to the sound of public spending. Among the start-ups there was also the Marshall Plan that, always a public investment, the American capitalism launched with strategic foresight to reactivate the so essential European market: a great recovery program at the expense of the state (roughly, 130 billions of dollars in current value).

In fact, it is a source above suspicion like Standard & Poors, that, after having clubbed Italy at the end of 2011 by the means of a famous downgrading, assessed, a little time after, the *Italian economy at the middle of Nineties as one of the leader of UE economies, in spite of the burdensome and increasing public debt*, by virtue of an average annual growth of GNP better than 2%, a moderate inflation rate, a high rate of savings (15% of GNP) and a concentration of the debt in national or European hands [40]. And Moritz Kraemer, analytical manager of S & P, known as "Mr. Scissorhands" for having cut the credit ratings of nine EU countries, had remarked that

the agreement on fiscal compact among the 17-UE nations placed too much emphasis on deficits, and the implementation of such rules would not have averted the financial crisis had they been in effect earlier; and had outlined: "*Spain had balanced budgets for most of the first 10 years of the Euro's existence, while Germany had one of the biggest deficits*." [41]. However, the financial stability of Germany was already at that time much greater than Spain's.

The Krugman's arguments against the shortsighted outlook of economists and politicians who fiercely oppose increase of public debt are convincing but don't give a logic reason of that shortsightedness, comment Guido Carandini e Paolo Leon – in an article whose title, "*Nobody knows the debt*", echoes Krugman's one – "[a reason] *that, instead, clearly emerges from a different theory that claims, in opposition to the common opinion, that capitalist system is, by virtue of its same nature, perpetually constrained by a close connection between the private-individual dimension and the public-state dimension; but this entanglement between those two dimensions can't be caught at sight. Because (just as in the case of the two faces of a coin) the perception of one dimension hides the other one and, then, the individual vision of the economy – i.e., the point of view of the family that faces a debt – conceals the outlook of the state intervention – i.e., the view of its consequences on all the citizens.*" [42].

In a recent book, Paolo Leon goes further and the main thesis he proposes is "*the blindness of the capitalists, that is, the impossibility, deeply rooted into their essence, of becoming conscious of the effects of their actions on the whole economy*". It is the State, according to the author, the only one that can realize the capitalist transformations and their effects; in order to see and understand them the capitalists have the need of the State like a shortsighted person needs glasses [43].

The austerity throws the baby of the real economy, production and employment with the bathwater of the rise in spreads. How to get out of this perverse circuit? By rising up to a "*collective*" size, able to overcome the "*dark dichotomy*" between those two dimensions, individual-private and public-state, inherent to the capitalist system, suggest Guido Carandini and Paolo Leon. But they admit that the dominance of financial markets globally could negate the positive effects of an increased use of debt. Financial speculation in fact it is not willing to grant the necessary time because those effects can be realized and "*the economic and political culture is unable to look up at the collective level and to dominate a prolonged recession, very dangerous for our democracy.*" [42].

Is there nothing between the "deficit doves", like Krugman, Stiglitz and chums, and the "deficit hawks", the army of the austerians, those for which government deficits are too high, expenditure has to be rapidly cut and the Government should get out of the way and let the private sector do what it does best?

Restoring the old Modern Monetary Theory (MMT)[5], the "deficit owls" take the field. They throw themselves with lance in rest against austerity – not only untimely, but counter-productive (pro-cyclical) – and sink the spear against the sacred numbers, defended by the "priests" of IMF or ECB, declaring them absurd, pure ideology imposed from above. Indeed, what it is the empirical or theoretical evidence in favor of the 3% as established at Maastricht, or because the level of public debt sustainability is 60% but in some cases is 120%?

But, what is a "deficit owl"? "*A deficit owl believes that the deficit is a result, not a cause, of economic difficulty, and that it's not something policy should work on directly. In my opinion, the deficit is a symptom, not a disease in itself*", answers James Galbraith, yes, the son of John Kenneth and one of the leading figures of this economic school; and goes on: "*This position is nothing new – it's only the terminology that is new. The hawks vs. doves language has dominated the conversation for years now, but in reality it has always been a more complex, less black-and-white debate than that… The owls go back to a long tradition, starting with John Maynard Keynes.*" [44].

What is the difference between "doves" and "owls", since both are in favour of deficit spending politics? Again, Galbraith: "*There are two problems with the doves' approach. One, there's no evidence that the world is going to have a major problem caused by this question of the deficit. That's a supposition based on highly unreliable computer programs. And two, if you wanted to do something today about the future budget, the only way to do that is cut vital programs like Social Security and Medicare. You can't cut things like the defense budget, because that's decided in the future. So the doves' formula is one that leaves Social Security and similar programs at great risk.*" [44], and a final lunge against the fear of bankruptcy, mainly aimed to the U.S. government financial politics: "*The concept of bankruptcy doesn't apply to a country like us; the U.S. is going to be just fine, long-term… The U.S. is more resilient than it may look. My message is the financial position of the U.S. government is far stronger than a great many people think it is. Recently we've been seeing this notion that we're heading toward some unprecedented, apocalyptic territory. You saw that with the panic over the debt-ceiling issue last summer. But the people who were actually buying and selling treasury bonds weren't flustered in the least. In fact, bond rates went down.*" [44].

[5] Born and developed in the first decades of the twentieth century, the MMT supports, against the "orthodox" monetarism, that governments that can issue their own sovereign currency are *always solvent*; and due to its faculty to issue how much paper money it wants – from this derives "Neochartalism", the other name of MMT –, the taxation is in reality a tool to rule inflation and unemployment rather than a source to finance the government budget. This theory influenced also John Maynard Keynes, especially for what concerns the instruments of financial and economic policies proposed by Abba Lerner, one of the exponents of MMT.

In a nutshell, hawks think we should act now to reduce the deficit; doves think we should act later. The problem for the doves is that they agree with the hawks that there are medium to long term risks; the government deficit aimed to finance public investments would pay, and hardly, with the exposition of the sovereign debt to the international financial speculation, with consequences so serious that provide a rational core to the measures of restriction as those that continue to be, despite the proliferation of pronouncements for growth and employment, the rudder that steers the economic Europe. Thus it is easy to weaken their point of view with the threats of the burdening our grandchildren or a Greek-style bankruptcy.

Owls, by contrast, think the deficit isn't a problem, nor now neither later; it's only a natural part of growth. Bypassing the neo-keynesism of Krugman and Stiglitz, the owls see in the government deficit a positive cornucopia, provided that the central banks – the Fed, the ECB – finance the deficit by an unlimited buying of the bonds issued by governments. *Ça va sans dire* that this monetary lever is to be used in an innovative and daring way.

Theses very similar echoed for some time in Italy, as from owls academically stationed in Abruzzo; but, also in the case of the more famous American protagonists, we have not seen specific indications of economic strategies that realize open-mindedness and innovation in deficit spending, both from doves and owls. Above all, it is dealt with only one of the horns of dilemma – the economic crisis, the crisis of capitalism – and it is forgotten the other, the gravity of the ecological crisis. And without this awareness, if the only economic horn is faced, apart from the observation perhaps ungenerous but immediate: "yes, that the public debt of the Euro-zone countries expand also itself, meanwhile the Standard & Poor's is based in New York", comes to mind that if not for the age of "*Milan to drink*", beribboned with "*Tangentopoli*", the belief that "the State does not fail" has been one of the cornerstones of the policies led by Giulio Andreotti. But back then, frankly, the threat of the upset of climate and its disastrous consequences was the stuff for esoteric sect.

Anyway, the opportunities presented by the **need** to take urgent action against climate change are taken into account by all the aviary – hawks, doves and owls –, at most, like the provisioning convoys in traditional wars: "they will follow".

Meanwhile the global capitalist system practices a second road, "locally" so to speak.

The second road

It's a reading certainly not original, but, at least to a first approximation, quite possible: *the Second World War is related to the crisis of overproduction created, after the Great Depression of '29, in the countries that repre-*

sented the globalization of the economy at that time. There were not some giants like today are China and India, not to mention Brazil and Indonesia; the Soviet Union was behind the failure of the five-year plans of the Gosplan and the market was therefore a set barely larger than the countries that entered the war.

The war reduces the income of citizens to levels that otherwise might never bear, and increases, enormously, the extent of public investment for the war. Productions, not profits, are in fact nationalized and assume exponential growth rates, eminently aimed to a colossal destruction in the countries that become theater of war. There is not only the destruction of buildings, infrastructures and systems, but also the self-destruction of the same war products (bombs, missiles, carriers). Producing massive amounts of objects of destruction, whose fate is realized in the self-destruction, is a way to deal with overproduction; and the devastation that they bring is the condition for the growth associated with the reconstruction. A growth supported by the government deficit. This is the cycle triggered by the Second World War, which led to a dramatic minimum: hunger in Germany but also in Italy and in Russia, not to mention Japan, the heavy hardships in France and Britain, and tens of millions of deaths involved in the evolution of the cycle.

Due to its characteristics, *the war seems to be an indispensable instrument of the capitalist economy.* The tens of thousands of nuclear warheads legacy of the cold war, the hundreds of open conflicts around the world in recent decades guarantee that, at least in the industry of weapons, there will never be an overproduction crisis. *En passant*, it is worth remembering that in this industry, Italy occupies the 5th place in the world with a noiseless but resolute protagonism.

In support of weapons and conflicts the children soldiers are recruited in poor countries, but amid genocides, horrors and rapes, budgets of all states, ethically blind, are strongly determined to maintain the transfer of public resources to new weapons systems, for the "defense" of course, making frankly rhetorical the repeated appeal: "empty the arsenals and fill the granaries!". On this sector of the government deficit, all decision makers of budget policies simulate blindness, and in recent years the harsh reprimands of the European Union or the International Monetary Fund against the PIIGS have always ignored this issue. The Greeks, although reduced to misery, must ensure, in their virtuous budget, more than 3% of GDP to the weapons that they buy mostly from France and Germany.

All this is the sumptuous banquet of the "professionals of arms", however, far from responding to the magnitude and severity of the current crisis of overproduction. Therefore, it would take a new world war, and surely there are various circuits of powerful men, more or less hidden in the various countries, who are intensely thinking of it. Reasons "patriotic", ideological or political, are found as many as you want.

The deterrence of nuclear weapons has worked for over fifty years and

holds today, although the proliferation of nuclear weapons in a world of cruel inequalities raises fears of the emergence of a "Sorcerer's Apprentice". Any case, even if not exhilarating, it is somehow legitimate to suspect that many von Clausewitz of capitalism have perceived, alarmed, the risk that the atomic war of "theater", more popular the latter in the Nineties, would no longer be "*the continuation of politics by other means*", but could flow in a global war of quick outcome. After, there would not be more to expect a lot of profit, and then, to whom never would touch?

Anyway, this reflection about the "second way" makes emerging another constrain to the present situation: the "*impossibility" to access the war, a global war, as an instrument of Economics. And the numerous "local" wars are not enough to resolve the capitalist crisis.*

■ The essential contradiction: technological innovation and globalization

An over production crisis

Some analyses have indicated a central role of technological innovation in the story of the globalized world, more and more the theater of a fierce competition among the economies and, of course, among companies. Technological innovation has played a key role, on the one hand, prompting the innovation of products to a demand sustained by individual needs, induced in the consumer, and, on the other, aiming to reduce, in the composition of the production costs, the most significant item: labor costs, especially with a continuous, rapid increase in productivity and consequent reduction of employees. It is reached so to an increasing gap between the speed with which increases the mass of the goods, produced and spilled on the global market, and the speed with which increases the spendability by part of the market. This role of the technological innovation in the context of globalization does not seem to us that has been included in an appropriate manner in the reflection of economists.

It is not, it should be emphasized, the saturation of the market: millions of women and men have never seen a cell phone, but too slow is the speed with which they enter in the availability of money to buy it! Crisis of overproduction, therefore: compared to the capability to purchase, compared to needs. Nothing new, surely; are well known in the capitalist market the crises of overproduction and, at least in theory, the tools to try to re-absorb them.

Today, however, we must look at *the quantitative consequences of the global nature of the market*. The market has ceased to be "punctiform" or "local" since the Middle Ages; the fairs had a prevalent character, but the nascent network of banks gave a much wider breath to the exchange of goods and introduced a significant role of finance already at the turn of the thir-

teenth and fourteenth century. Italians were at the first places, as points out the name of the *lombard* rate.

But the expansion of the market has assumed since the twentieth century the pace of a geometric progression, with the tumultuous innovation of the technologies of preservation and transport of goods, which can benefit of carriers increasingly capable and fast or even intangible via Internet. The speed with which it spreads the offer of goods increases at measureless level. The deployment of the technological innovation in the global market gives the process a quantitative character difficult to recover with the equipment that is put in place: *which gigantic income redistribution would be needed to meet the insufficiency of an effective demand, such as that which has been determined, moreover with unemployment rising*!

What has been highlighted there seems a fundamental contradiction, without addressing which all the instruments of monetary policy, or the economic and financial measures, appear to miss the target. Hard to believe, in particular, that austerity can be an effective response to a contradiction that has at its roots the inadequacy of the demand.

Just looking at that contradiction, as well as at the role of public expenditure and the occurring of financial bubbles, one can trace the economic story, for example, of the last decades of our country, Italy: *sustaining businesses in order to support consumptions, thus leaving cash to consumers, the state taking on the most of the load of the spending on health, education, welfare*. In short, the capital/labor conflict was attenuated by that implied agreement that opened space to advanced social policies. From there, the main factor of the growth of the debt: what else could they have done, in the framework of the instruments judged politically acceptable? Although, those governments have added, on their behalf and at high level, the corruption characterizing several administrations of the Eighties and Nineties in a context of institutional sloppiness, practiced as custom, and laxity on the tax evasion.

But these issues do not displace *the essential nature of the problem that lies in the compatibility ungovernable – the reality of the globalized market – between the supply size and the mechanisms that rule the demand formation*, evidently corresponding to the various levels of income distribution. Fragile then a productive plant, suspended in the uncertainty of the return on investment and therefore exposed to the bank lender and to the cost of money; in addition, to the ruthless skill of international speculators. And the imperative of the good health of the enterprise has increasingly imposed the accelerated increase in productivity and, consequently, the attack on established labor rights and the cuts to social spending: in short, *the attack on the European social model*.

Gradually, then, in a second stage, to make up for the lack of liquidity on the part of potential consumers, there has been an increasing recourse, by the financial operators, first from the United States and later in Europe, to different forms of loan, thus greatly increasing the role of the financial

dimension of the economy. In this fictitious way, by virtue of the combined effect of issuing new currency and securities, was rolled down the risk of the collapse of liquidity: demand was helped by a false growth (bubbles). After all, one could understand that was being built a risky mechanism, in its evident uncertainty and instability: why it has not been blocked or, at least, corrected by imposing standards and international deterrents? On the contrary, it has been able to grow rapidly by virtue of a systematic deregulation, an absence of control inside the financial system, stupidity, greed and a true fraudulent business in damage of the customers[6].

From the "White Book" of the EU to the Green Economy: a new model of development

The process, which links the growth of debt and the role of finance with the operation of the production, as we have tried to describe it – in particular with the role of technological innovation – is already clearly visible in the last decade of the last century and leads Jacques Delors to assess, in the "White Book" of the EU in '93, that revival of the economy (and the employment) would not come from consolidated manufacturing sectors – tangible and intangible – *but from a new sector, there where it is produced and sold a new commodity called quality of life* [45]. We are therefore at the prospect of the "Green Economy". Understood as a change in the structure of the demand, rather than as a sublime ecological instance. Already at the beginning of this century, the Green Economy seems so a "obliged" reply to the crisis of the ecological equilibrium – first, climate change – with positive consequences on the health and on the well living, but it also appears a rational response to the crisis of the economic system.

Energy efficiency and use of clean, renewable energy, urban regeneration, restructuring of industrial equipment with a more efficient use of the physical resources, pollutant reduction, waste recycling, restructuring of the transport networks of people and goods, paperless networks, soil conservation, agriculture as food security as well as control of landslides, flood safety and protection of minor water networks, preventive health care, restoration and upgrading of historical, cultural, landscape and environmental goods, excellence of craft products or niche: these items, the same on which relies

[6] The total lack of inside controls on different speculative operations, starting from the proliferation, as Chinese boxes, of bonds built on house mortgages - exemplary the placing on financial market of bonds like COD (Cancellation Of Debt) -, and the frauds in damage of customers are the screenplay of a recent movie: "The big short". The movie is almost a historic document about the explosion of the financial bubble at the end of 2007, and tells how a few finance operators, who had timely forecasted how things would have gone – at the basis of the bonds system, entirely private and no more guaranteed by government, there were titles verifiable as "shit dog" – have played against the bank system and have bet in favor of its default. And have won.

the "circular economy", represent the transition from the culture of the quantity to the culture of the quality, with productions which in prevalence can't be delocalized and for which it is difficult to trigger processes marked by an exasperate competition among companies in the context of the increase in labor productivity. With beneficial and revitalizing effects on employment, direct or indirect.

An example is a project of sustainable mobility: public transport peri-urban, local, long distance, a network pleasant to use and competitive with private means. Another example: *energy savings in buildings*. Or, more generally, urban regeneration: that is, restoration of old buildings and redevelopment of the suburbs, renewal and rehabilitation of existing housing. And all these interventions are characterized by a high-intensity of work. By contrast, the chorus of rite of a relaunch made by a recovery of mass production of cars, homes, appliances and electronic gadgets appears, in light of the contradictions described above, a bad recipe.

In Germany the "green" work has activated, since 2000, about 1 million new jobs, a number equal to ten times that of the employees of Volkswagen, the largest European car industry and among the first in the world. In Italy, *Unioncamere*[7] recorded already in 2011 about 220,000 hires in the green work sectors and announced for the following years a million of jobs. The "Energy Efficiency Plan 2010 - 2020", presented by Confindustria (the Italian entrepreneurs organization) in the fall of 2010, shown that a public investment of 16,7 billion of euro for ten years would have produced, on the same period, one million and six hundred thousand annual work units – a quarter in the field of energy savings in buildings – in addition, at the same time, of meeting the three 20% of the EU. The plan, since had become a "common notice" of Confindustria, CGIL, CISL and UIL (the latter are the acronyms of the major Italian workers' organizations), was to be presented to the government for the growth phase. Nothing has been done, mainly due to lack of employers' confidence towards their own project, but in 2015 the "Plan" has beaten back a few timid shots.

In proposing the objective of replacing in ten years almost 40% of fossil fuels with renewable energies the EU states that the challenge of sustainable energy and development can have a positive response. This change implies great problems of many kinds: engineering, financial, organizational and especially cultural. Will we have time for a changing so significant, while the climate change and the energy crisis are pressing everywhere? Even though the data that we'll report in a successive section give some hope to possible positive answers, a question stands: but is it really needed all this energy that we consume? It is in fact the question whether it is sufficient changing the flame that has to be placed under the pot or if you should also take a look at what you want to cook in the pot.

[7] National representative of the Provincial Chambers of Commerce.

Again, therefore, the reflection: *from quantity to quality*. Generally speaking, it comes to achieve a model of development radically alternative to that neoliberal, responsible, in fact, for the current situation of crisis. A rational framework, the one offered by the *economics of sustainability*, which, however, has failed, so far, to get an effective attention from the policy, nor, as we have already complained, by the side of the economic doctrine.

The economic "cycle" and dynamical systems

We have used, unwary, the current economic terminology which speaks of "cycle" and attributes the "anti-cyclical" or "pro-cyclical" character to economic policies, depending on the effects that determine. Most of the policies proposed and implemented today, around the world, look eminently at the currency and the finance, as it is now; and to us, a bit naively, seems mere common sense not to entrust a finance without rules the role of "modulating" the economic cycle.

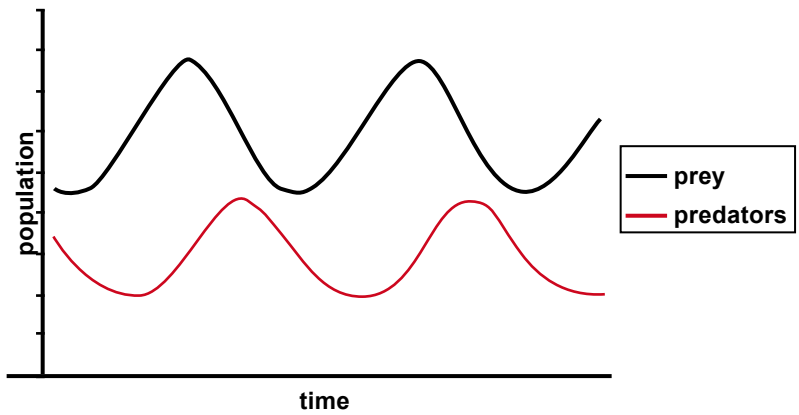
But what is a "cycle"? The language of economists about the anti-cyclical or pro-cyclical policies and also, directly, the word "cycle", attributed to the evolution over time of a variable or a whole economic system, is, generally speaking, misleading. "Cycle" has a specific definition there where it started, in Mathematics or Physics: *a closed curve that describes the trajectory over time of a system which, starting from an initial state to it returns*, while the most economists, thinking of fluctuations in time of the mathematical functions – sine or cosine – associated with a cycle, actually are referring to the variations between the maxima and minima of the variables studied by Economics. These oscillations can be described by periodic functions of the time, just as in the case of the "cycle", but *only for delimited time intervals*; therefore, far from returning the system to its initial state, as would happen if those functions were of the same period over *each* time interval, the oscillations become increasingly large, while the minima shift up; as it is evident if we would model in this way, crudely, the trend of the economic quantities from the immediate post-war years to the present day. No cycle, then, but, if anything, an open curve, a spiral, along which there is a continuous growth, loaded of social and environmental contradictions, and no return to the initial state[8].

Starting from the cycle "predator – prey" of two populations in competition, that Alfred J. Lotka [46] and Vito Volterra [47] had proposed in the

[8] After all, wasn't the same Marxian "*vulgata*" reciting that "capitalism repeats its contradictions to a higher level"? And some commentators had also found a noble cinematic metaphor in "The Exterminating Angel" by Luis Buñuel, where the failure/inability of the characters of getting out of an apartment will show itself again, when, solved their problem, the same syndrome shifts to a large mass of people, the faithful of the Sunday Mass which aren't able to leave the church at the end of the religious office.

Twenties, the Mathematics has provided to the Applied Sciences – Populations Dynamics, Biology, Health diseases, Chemistry and, in particular, Economy – a model of oscillations between a minimum and a maximum, compatible with the existence along all the cycle of both the variables defining the model, because the minima are always greater than zero: a well-known model, incredibly largely applied, of a dynamical system in two dimensions, as many as are the variables.

In the Lotka-Volterra model the two variables are the number of individuals of the two species – prey and predator – which, in ordinary conditions, vary, for the predator, from a minimum, a time after that the number of preys has reached its minimum, to a maximum, a time after that the number of preys has got its maximum; the opposite behavior holds for the number of preys. In other words, the dynamics of the two populations as function of time *is simply represented by two periodic functions, like sine or cosine, with different amplitudes and a phase displacement in time*, that accounts for the behavior just described (see the below figure).



This behavior in time is a consequence of the existence of cycles in the "phase space" of the model, such as can be determined starting from the differential equations that represent the rate of change of the two populations. As we told before, when we were speaking about the "simple" model for an abrupt change of climate stability, the problem of finding analytical solutions of the non-linear differential equations, usually not affordable, can be bypassed by means of the qualitative analysis of dynamical systems through the construction, in the phase space, of the phase portrait of the system. In the phase space every point has the role of a "physical" state, whatever be the dynamical system that one is representing; thus, the phase portrait provides a geometric vision of the trajectories – the cycles, in the Lotka-Volterra case – of the system, as succession of all states along which the system evolves.

What the phase portrait can't in general provide, except that for cycles is the dependence on time of the system evolution, that is, the time law.

Also in Economics is contemplated the existence of cycles in the proper sense of the term; for example, in the Goodwin model, that is an application, half a century ago, of the Lotka-Volterra model, where, instead of the number of "predators" and "prey", one will replace the "employment rate" and the "share of the product of the worker", the latter is a variable linked to the wage rate [48]. The employed workers have the role of predators, because the wages reduce profits and hence investments, leading to an increase of unemployment; and, by this reason, the model is also known as "Goodwin's class-struggle model". The *cycles describing the economic activity* (output, unemployment, wages) emerge *in an endogenous way*, that is, the cycles are *not generated by exogenous shocks* as is assumed by the most modern macroeconomic models. In Fig. 10, the phase portrait of the simplest version of the Goodwin model (see [48]). In Fig. 11 the graphs of economic functions are represented as depending on time, exhibiting those endogenous fluctuations which are at the basis of the cycles of Fig. 10.

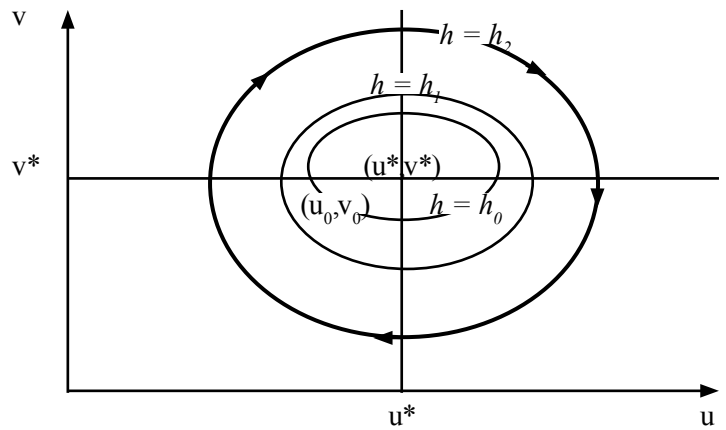


Fig. 10 Phase portrait of the Goodwin model: u is the *workers' share in product* and v is the *employment rate*. The two lines divide the positive quadrant – due to their meaning, neither u nor v can be negative – into four regions and the arrows indicate the movement of the economy in each region. For example, in the north-western region (high employment, low labor's share in output) the economy is moving to north-east (employment is rising, worker's share is increasing). Once it crosses the u* line it will begin moving to south-west. Each cycle corresponds to a determined initial state (u_0, v_0), where u_0 and v_0 are the values of the variables at a fixed (arbitrarily) time, t0; the shape of the cycles is an ellipsis centered in (u*, v*) only in a neighborhood of the point (u*, v*).

The cycles, each corresponding to specific initial data (u_0,v_0), are the level lines of the three-dimensional graph of a function constructed requiring that it has to be constant along the evolution in time of the system; for any value of this constant, *h*, determined by the initial data, there is a cycle obtained as a section of the graph with the *h*-height plane. As it is stated by the theorems of the qualitative analysis of dynamical systems, this construction does not require the knowledge of the evolution law; it's enough that the second members of the equations are the part known of the problem.

The cycles of Goodwin model guarantee, we like to repeat that in view of further observations, *whatever be the state of the system from which we start in that state the system will be back within a finite and determined time. It's a typical "stationary" model*[9]*: nothing is static, but to each cycle corresponds an evolution of the system – fluctuations over time between minima and maxima for both the variables – which shows up and repeats itself with the same characteristics.*

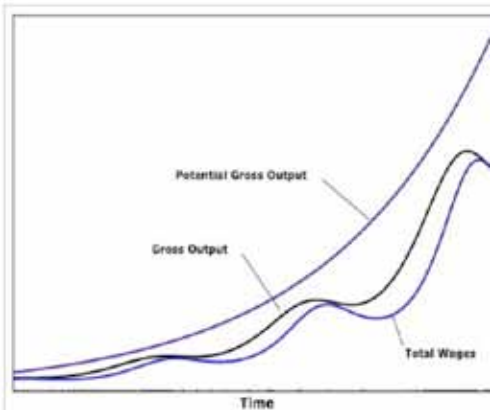


Fig. 11 The Goodwin model can generate endogenous fluctuations in economic activity without relying on extraneous assumptions of outside shocks, whether on the demand or supply side.

Then, it's of some interest to check how much the Goodwin model can be applied to represent real cases. In Fig. 12 are represented, for the U.S., the curves of the trend in time of wage share and of employment-to-population ratio. The latter has become a parameter preferred by several economists, instead of the only employment rate, because gives a better account of how

[9] Also the revolution of the Earth around the Sun is, in first but very good approximation, a **stationary** phenomenon. This is not aimed to deny, almost four centuries later, Galileo and give reason to the Cardinal Bellarmino, but simply to take note that the motion of the Earth ("yet it moves") always takes place in the same way, which generates the periodicities and fluctuations we know (day and night, seasons etc.)

many are really out of work: "*is the best measure of labor market conditions*" [49].

Fig. 12 Wage share (blue line) as Wages and Salaries as percentage of Gross domestic product and Civilian Employment Population ratio (red line) in the USA. According to the Goodwin model the wage share is to be expected to lag behind the employment rate.

Graphs of Fig. 12 represent a good performance with respect to the reliability of the Goodwin model, despite the notorious not robustness of the model; robustness, that is, the phase portrait could be strongly altered under an external solicitation up to the transformation of the cycles in open curves. This good behavior has suggested for years now many applications in Economics, some recent ones resort to Lotka-Volterra dynamics to model the uncertainty determined by the economic impacts of climate change [50].

Not as an application of the Lotka-Volterra model, but always dealing with a portrait of phase of a two-dimensional nonlinear dynamical system, some authors have proposed, in recent years, a new model, relying on the analysis of the data of different national economies, able to forecast for each country the most probable economic trend for the future and based on these two new variables: 'Fitness" and "Complexity", where Fitness is a measure of the competitiveness of countries and Complexity is the level of products sophistication. Two non-monetary and non-income based metrics, as rightly claimed by the authors; an invasion of the economic field by Physicists (see [51], [52], [53]).

The new proposal and the method of this kind of researches is well synthesized, just starting from the introduction of [51]: "*Classical economic theories prescribe specialization of countries industrial production. Inspection of the country databases of exported products shows that this is not the case: successful countries are extremely diversified, in analogy with biosystems evolving in a competitive dynamical environment. The challenge is assessing quantitatively the non-monetary competitive advantage of diversification which represents the hidden potential for development and growth. Here we develop a new statistical approach based on coupled non-linear maps, whose fixed point defines a new metrics for the country Fitness and product Complexity... We show that, given the paradigm of economic complexity, the correct and simplest approach to measure the competitiveness of countries is the one presented in this work. Furthermore our metrics appears to be economically well-grounded.*"

Nonetheless, the model can provide indications on the principal goal of the macroeconomic theories: a quantitative assessment of the time evolution of economic indicators such as GDP, competitiveness and so on. For every case? "*The answer is: it 'depends': predicting evolution of fitness and income is strongly dependent on the regime a country occupies*" [52].

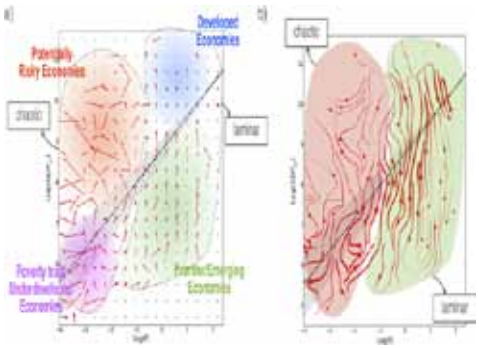


Fig. 13 a) A finer coarse graining of the dynamics highlights two regimes for the dynamics of the evolution of countries in the fitness-income plane. There exists a laminar region in which fitness is the driving force of the growth and the only relevant economic variable in order to characterize the dynamics of countries. We argue that the evolution of countries in this region is highly predictable. There is also a second regime, which appears to be chaotic and characterized by a low level of predictability. In the laminar regime we also find two different kinds of evolution patterns for the emergent countries and developed ones respectively. b) we report a continuous interpolation of the coarse grained dynamics to better illustrate the two regimes of predictability [53]

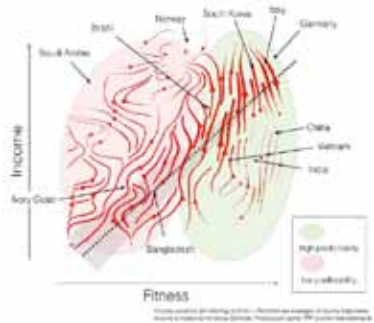
The analysis performed in the income/fitness plane (Log [GDP per capita]/ Log [F]) distinguishes between a "laminar regime", where, as in developed

economies, fitness is relevant and driving variable for economic dynamics, and a "chaotic regime", where, as for the "poverty trap" and underdeveloped economies, dynamics is ruled by other factors in competition with fitness: high predictability for the first, low for the latter (see Fig. 13 a), b)) [53].

"*The direct comparison of the Fitness with the country GDP gives an assessment of the non-expressed potential of the country. This can be used as a predictor of GDP evolution or stock index and sectors performances. These results are also useful for risk analysis, planning of industrial development and strategies to exit from the "poverty trap" ... The dynamics in the GDP-Fitness plane reveals a heterogeneous structure and certain areas behave in a laminar way (high predictability) while others appear turbulent (low predictability). This situation requires an analysis inspired to the theory of Dynamical Systems and it is not appropriate to study with the usual regressions*." claims Luciano Pietronero, a physicist, founder in 2004 and Director up to 2014 of the CNR (*National Research Council*) Institute of Complex Systems based in Rome, and co-author of the quoted papers presenting this new point of view in Economics [54].

"*In this heterogeneous scenario for the economic dynamics of countries, regressions are no more the appropriate tool to develop a predictive scheme, which instead must face issues which are very close to the problems of predictability for dynamical systems (i.e. atmosphere, climate, wind, ocean dynamics, and weather forecast, etc.)*" is the comment of the authors to Fig. 13 a) and b) [53]. And the phase portrait in Fig. 13 a) recalls a first step in the analysis by means of the dynamical systems theory: the construction of the vector field determined by the structure of the system.

It is the approach called Selective Predictability Scheme, but about predictability authors have previously observed: "*Forecasting country growth meets hurdles not dissimilar to those in weather forecasting*" [52]. The model, really, uses patches, and definitions, very similar to those describing, in the phase space, the fluid dynamics regimes ("laminar flow", "chaotic flow") with their abrupt changes, that is one of the main tool for modeling weather. "Physicists make 'weather forecasts' for economies" is the title of a news of *Nature* (23/2/2015), where is reported the figure below, the same as Fig. 13 b), but one can now appreciate the different paths as belonging to specific countries.



The new economic paradigm, advocated by physicists, is only a theoretical game? Not so theoretical, after all, if the international Institute for Economy Complexity (IEC), promoted by Pietronero, is proposed as a branch of the Institute for New Economic Thinking (INET), and the latter is willing to contribute both from a scientific perspective and through a budget sponsorship, with one third of the total IEC budget for an initial period of 5 years.

Who is INET? After the 2007 crisis it has become clear that standard economic theory is not suitable to meet the challenges of the present, strongly globalized world; and the goal of INET, a cultural non-profit economic research organization founded by George Soros in 2009, is to build a global community of new economic thinkers to engage in the crucially important task of creating new ideas to guide our economic future. To this aim INET gathers from all countries hundreds of economists, among them several Nobel Prizes like Krugman, Stiglitz, Sen and so on. In the INET plenary conference held in Hong Kong in April 2013 [55], George Soros attended to the seminar in which the "weather models" for economics have been presented by Pietronero; in a good company, because next to the Nobel Laureates Michael Spence and James Heckman there were global business leaders coming from anywhere.

Economic models like "weather forecasts" maybe meet, besides the interest of big business men, also nice environmentalist souls, since they recall the analogy between biological diversification and the growth of countries with a higher fitness; or because the economic models have the flavor of natural ones ("weather forecasts"). Mainly, we suppose, for the radical criticism against the consolidated ideas sustained by the traditional macroeconomics theory, often wrong and surely unsustainable.

But also this new and interesting theory doesn't seem to provide a proper answer to the issue of an economy sustainable with respect to the environmental crisis, that we are soliciting. Even though it's surely important the upsetting of the mainstream theories, according to which: "*there should not be any coupling between finance and economy*", and to affirm, on the contrary, just in these years witnessing the financialization of real economy: "*One of the cornerstones of the new economic thinking is to acknowledge that Finance and Economics are two highly connected aspects of the same general problem and to understand the origin and consequences of the mechanisms coupling these aspects."* [53].

The prediction of economic trends, when predictable as for a "laminar flow" (see Fig. 13 a),b)), do not tell us how much those trends will be altered by the environmental crisis, what will be the interference with climate change; and, obviously, what will be the effects on the "chaotic flow" region.

The "weather forecasts" for economics seem to fit only with the brief-medium term, just as those about the weather. It is surely important to announce, e.g., that in the next years China's GDP will increase at the rhythm about 8% instead of 4% as many monetarists say; but, recalling the dramatic

figures of the "*Stern Review on the Economics of Climate Change*" [31], it is more important to alert for possible severe and global damages on GDP – a 5% medium loss by year – due to climate change in the medium-long term, if adequate policies will not taken to face global warming.

On all this kind of issues we will surely try to attract the attention of our colleagues, but here and now it could be useful to come back again to the Lotka-Volterra model and, looking at its cycles, try to define what would be desirable happen, e.g., in the coming decade; and what would be, approximately, the corresponding portrait. In other words, **a model of a global stationary state for the "eco-economy"**, compatible with the growth of each country but with the constraint of respecting the great natural cycles: a sustainable economy.

We beg the reader's pardon if now we try to sketch, briefly, some steps towards this goal.

An immediate remark is about what is the "energy" of a cycle. Thinking of each of the cycles of Fig. 10 as a trajectory of an economic system, the "energy", i.e. the physical quantities necessary to support the cycle, is the area included inside the closed curve. For each cycle the "energy" is a constant value, but if the trajectory performs N times the same cycle the "energy" required will be N times that value. By this way it appears immediately that, also for a closed trajectory, the "energy" consumption can lead, in the time, to an unsustainable situation when the "energy" is exhausting; *a fortiori*, for a not closed curve like a spiral, that requires more and more energy for its trajectory while is enlarging itself. If we were dealing only with energy in the proper physical sense, we could overcome this hurdle recurring to the sun or other "perpetual" forms of energy.

This is not the case for some renewable energies, it's enough to think of biomasses, and is not the case for other natural resources – raw material, soil ore, metals etc. – which we have indicated, in short, with the term "energy". Precisely for this reason a rational economic model – a "stationary model" – has to think of a cycle, or of many cycles in the time, which do not exhaust in their evolution the resources required to support them. Thus, a first immediate constraint arises in the perspective of the sustainability: in any cycle the rate of consumption has to be inferior than the velocity of reproduction of each natural resource, or has to take into account the availability of that resource in order to plan its consumption and giving time to science and technology to possibly find sustainable substitutes. In this manner, in a first but good approximation, an economic evolution would be sustainable by the Nature. In terms of the model – remembering the "energy" is the area included in the cycle – all this implies to put mathematical conditions of conservation for the *total* area determined by the trajectory.

Another point. The existence of cycles in the Goodwin model depends on the fact that the model, and all other ones that have been extended and used for decades by many researchers in many Countries, is based on differential

equations, those of Lotka-Volterra type. This is not an usual practice in Economics, for well-known reasons; one for all, the impossibility of performing an experiment and of reproducing it do not allow to define a "dynamics" for the system, in the sense of the celebrated second Newton's law; therefore, in general, no differential equations are available to rule the dynamics of an economic system, so that one can describe its evolution in time.

Really, the success of Lotka-Volterra model and of its so many applications relies on the hidden *Hamiltonian character* of that nonlinear two-dimensional dynamical system[10]. Is this feature that provides the "dynamics": a generalized "energy" for the system, the Hamiltonian function H – each cycle is the intersection of a h-plane with the three-dimensional graph of the function, i.e. the solution of the equation $H(q, p) = h$[11] –, and, by this way, a very good simulation of a dynamics even though there is no force acting on the system (as the second Newton's law requires). Regarding the steps for the model we are trying to propose, one target is to assess the behavior in time of several ecological and economic variables, coupled two by two to build up a cycle, as it happens for the Goodwin model; and check this behavior on concrete cases, starting from the simpler case of only one couple of variables.

At this point the problem is to put together *couples of economic and environmental variables, not only the economic ones*. The variables of each ecological-economical couple have to be "conjugate" each other in the sense of the Hamiltonian formalism[10]; *a research that implies the analysis of the correlations between economic and environmental data*. The condition that a couple of "conjugate" variables (q, p) generates a cycle in the plane by them determined – their phase space – has to integrate the constraint on the "velocities" that we have told above.

Good candidates to be tested could be the couples: "CO_2 emissions/Fitness", in the plane (q_1,p_1), and "Energy final consumption/GDP", in the plane (q_2,p_2); with the condition that their oscillations reduce amplitude in the time – the distance between minima and maxima – and, consequently, the areas of the corresponding cycles converge to a fixed measure set: "decoupling conditions". The topological product of a cycle A in (q_1,p_1) for a cycle B in

[10] A dynamical system is such that its evolution in time is described by differential equations, like in the case of the second Newton's law of dynamics. Hamiltonian is the dynamical system for which exists a function, the Hamiltonian function H, that summarizes the information on the "energy" of the system, also when it has no more the meaning of energy as defined in Physics. In the Hamiltonian formalism each couple (q, p) of variables, on which the Hamiltonian depends, must satisfy a mathematical relationship, i.e. they have to be "conjugate" each other with respect to H.

[11] h is the constant value of H along the cycle, just like E, in Mechanics, is the constant value of the energy along the trajectory of a conservative motion; and is also the altitude, in the three-dimensional space of the graph of H, at which the intersection of a plane with the graph generates the cycle characterized just by h. For a different value of h, that is, for different initial values (u_0, v_0), one obtains another cycle (see Fig. 10).

(q_2,p_2) gives rise to a torus, a surface like a ring-shaped donut (see Fig. 14 a)); and the evolution of the system would be represented by a curve that winds the torus, the trajectory (see Fig.14 b)).

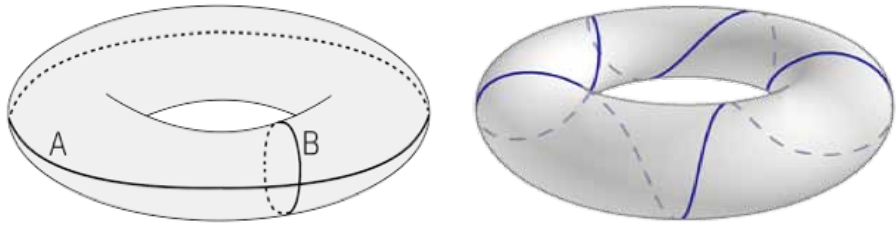


Fig.14 a) a torus as topological product of two circles; b) a trajectory on the torus

In principle, one can associate a law of evolution in time to the trajectory and, therefore, know the state of the economic system at any time, as defined by the two couples of the eco-economic variables adopted. The comparison between the values given by the model and the available data would make sense for countries of the "laminar" region of Fig. 13 b), credited with a high predictability level.

The model could be extended to a larger number of eco-economic couples of variables, if this extension resulted in a more realistic scheme. This approach could lead to a kind of "normative" model, i.e., a model that shows how the interactions between economy and environment should work in a sustainable scenario.

In order to obtain a higher degree of realism in the predictability, it would be also necessary to take account of the perturbations caused by climate change in the "phase portrait", internal to the chosen couples of variables or as an external solicitation to the system. Eventually, also for taking into account the "chaotic" region, one could resort, as a first step, to the mathematical theory of the bifurcation of a torus in another one of a higher dimension; but all this goes beyond the aim of this reflection

Here, one was aiming only to show that is possible to build a stationary model for a sustainable economy; that is, a model in which the economy is a "predator" that allows that the "prey", the nature, reproduce the assets, those the predator needs; trying to incorporate in the model strong perturbations induced by the predator himself, mainly the climate change and its social and economic consequences (e.g., immigration).

A modest proposal

At the light of all these considerations, economic theories we have summarily quoted – doves, hawks, owls and the innovative "meteorologists" – seem labile because don't pay attention to the "area" of the cycle, that is, to the availability of the natural resources; and don't conjugate variables, economic and ecological, in an only one global model, like both the economic crisis and the environmental one strongly require. Sometimes seems that resound the words of an old spell: pure water, air unpolluted, the breath of the great rainforests will have an economic value only when will be exchanged as commodities. Equally blindfolded in front of the environmental aspects, the two extreme wings of the economic discussion, both the austerity advocated by the Germanized Europe and the cornucopia offered by the "owls", take for granted, essentially, that the "cycle" of the global economy, unavoidably including the bubbles of an uncontrolled financial speculation, should be read as an evolution from one level of government deficit to a successive one, a gap to be drastically reduced, following the austere neo-liberals, to be increased as allows the cornucopia of the "owls".

The oscillations between minima and maxima suffer "casualties" (as in the "predator – prey" cycle) from the social point of view, that would probably be much less if one applied the deficit spending policies, instead of the neo-liberal austerity. Viva the "owls", then? Attention, because the two mainly opposing macroeconomic theories, and the resulting policies, do not lead to a stationary evolution; on the contrary, they postulate an external environment that feeds at increasing rates, and unlimitedly, the evolution over time of the economic system. In both cases, therefore, a growing use of physical resources of the Earth. But, if we have been clear this possibility, forty years after the alarm raised by *The Limits to Growth* [6], is now running out; further, by this way, we all would be assigned to the "*après moi le déluge*" philosophy. If we look at the urgency of the climatic instability, a disturbing echo sounds: "the time is over". Another ten, twenty years to trigger and operate a new and different economic model that gives us a future, a livable future for those who come after. No more.

The ecological reconversion of economy and society

The current situation recalls the two threatening walls of water through which the chariots of Pharaoh were running after the fugitive chosen people.

On the one hand the capitalist crisis: the irrationality of an economic model with its "cycles", that, seduced by money and finance, is not able to perceive the systematic exhaustion of physical resources made by the capitalist plundering of nature, and, as in the days of Malthus, "thinks" that na-

ture be indefinitely reproducible and therefore limitlessly exploitable by the mankind. The other hand, the ecological crisis: not only the ruinous effects on the environment and on humans of that dispossession that the economy wants to ignore, but the charging gallop of the dramatic switchover into the climatic instability.

A century and a half after Černyševskij resonates still: "*What to do*?"

The ecological reconversion of the economy, already proposed for some decades to correct the destructive irrationality of the dominant economic model, finds two new elements in favor and cogent: fifty years ago it was a day before the process that we did not hesitate to call the "bloody geopolitics of energy"; and is less than twenty years that climate change has acquired the character of peremptory urgency that we have tried to describe.

In terms of global rationality *the ecological reconversion of the economy then appears, in the light of the seriousness of climate disruption and bloody geopolitics of energy, an obvious choice, necessary and immediate: this is the new fact*.

The way to do this conversion has universal characteristics, although in what follows we will refer mainly to Europe and Italy. We have already mentioned some actions that are at the basis of the ecological conversion; their complex is what is called "***Circular Economy***", to which is proper to give here attention because is one of the fundamental requests for an ecological conversion of economy and society; to the other pillars we will give space after.

Circular Economy stems from an idea of Walter Stahel, architect and economist, of substituting the path "*from cradle to tomb*" with "*from cradle to cradle*"; no more the linear trajectory that leads in industrial societies from resource to waste, but another, circular, by which the wastes become the feeding of another processing. Stahel presented in 1976, together Genevieve Reday-Mulvey, a report to the CEE, the current EU Commission, showing an economical model that relies on closed loops and assessing the favourable impact of such a system on job creation, economic competitiveness, resource saving and waste prevention; the report was published few years after [56]. For sake of truth the idea of a circular fluxes economy is not new and can already be found in the essay of Boulding [5], but has struggled no little to establish itself. After the Stahel's one, the first report, that shows as an opportunity for economics and business the adopting a circular model, has been commissioned by the Ellen MacArthur Foundation to the McKinsey & Company and presented in 2012 [57]. At the end of the same year the EU Commission publishes a document that argues: "*In a world with growing pressures on resources and the environment, the EU has no choice but to go for the transition to a resource-efficient and ultimately regenerative circular economy*" [58], where the potential of this system is illustrated not only in terms of new employment and competitiveness but also as a true opportunity for innovation, investments and new models of work. But nowadays, the attention of EU Commission is focused on the wastes management, the

second part of the life-cycle of materials, and not on the first one, that is the ecological design of products.

One of the basic ideas of the circular economy is to draw inspiration from living processes; this view, no so original, has however created the "*Industrial Ecology*", when a positive answer has been given to the question why an industrial system should not behave like an ecosystem – in which the wastes of a species can become a resource for another one, generating in this way great trophic cycles – by Robert Frosch and Nicholas Gallopulos [59].

The industrial ecology has had echo in the scientific and technological international community, providing study cases and significant implementations of strategies able to realize circular fluxes in cascade of materials and energy. The oldest and spread example is the recycling of "wastes", also in successive steps, in order to obtain material to produce the same or other good, thus saving the matter and also the energy, when is possible, needed to a new one. Another well known example is that of tele-heating networks, in which the heat that results at the end of a process (electricity generation, high temperature industrial production) is not released to environment as uncontrolled waste but employed for home heating in a district or in a city; or the combustion of gas from waste both for manufacturing activities (e.g. agro-alimentary industry) and home heating. All actions of this kind are realized in the perspective of less unwanted by-products and a more efficient and less polluting economy.

Today the implementation of "industrial parks" is spreading, no longer limited to the historic case of the Danish town of Kalundborg, where all has started in the first Sixties from the electric power plant Asnaes. However, several criticisms have been advanced against the techno-optimism and the inadequacy of technology to forecast negative side effects. And someone, from a point of view almost "ontologic", has observed that, in the context of a continuous economic growth, technology is not able to promote sustainability, on the contrary can determine its possible collapse; and claims that sustainability requires long term visions [60].

Other researchers, wondering if sustainability is the natural context of the industrial ecology, have recognized the ecosystem metaphor proposed by Frosch and Gallopoulos as an useful tool; and some have assumed the metaphor inside the theory of complex systems, together to the old concept of *exergy*[12], trying to build by this way a framework for a general theory

[12] In thermodynamics the exergy of a system is the energy available to the use during a transformation; when the equilibrium with external environment is reached, then the exergy is zero. Therefore the exergy is usually expressed as a function of the state both of the system and the environment, even though can be theoretically defined in an intrinsic way without referring to the environment, starting from the exergy of each subsystem that composes the whole system. The exergy measures the irreversibility of a transformation: it decreases in a proportional way to the increase of the entropy of the system. Just due to this link with entropy, exergy is a quantity also in the Theory of Information.

of ecology. Exergy has however been a fundamental tool for engineers in designing the different sectors of a plant or of a productive process, thus contributing to the huge growth of chemical industry in the XX century. In the industrial ecology the exergetic analysis has been utilized in order to optimize the uses of energy with respect to its quality, in particular when there are material constraints, e.g. a limited area available for a solar plant (roof, wall etc.).

Without entering in the theoretical debate on the concept of exergy, that has engaged Chemistry, Physics, Industrial design, Ecology and the same Sustainability – the assessment of what is meant by "environment" in defining the "state of reference" of the observations is one of the critical point[12] – we limit ourselves to notice that the ratio between exergy and energy is a measure of the *quality of energy*[13] in a process; thus, not only the *quantity* like does *efficiency*, i.e. the ratio of the quantity of energy obtained as output with respect to the quantity of energy given as input to the process.

More general, exergy is suitable to compare production strategies over consumption of natural resources or assessing different methods on the basis of how much exergy they require; or, when analyzing goods, directly computing how much exergy a single good contains as well as how much exergy is necessary for its production.

Where not already for its theories, the circular economy has always been coupled with the abandon of fossil fuels and the favour of an always more extended recourse to the efficient use of energy and to renewable energies. From this view, circular economy is substantially indistinguishable from what, after, has been called *green economy*, that, at its turn, finds in the "energy revolution" a fundamental support.

Coming back to the ecological reconversion of economy and society we outline below few rapid remarks that are not explicit in the concept and in the practice of the circular economy because they are much more related to general political addresses towards sustainability.

There is not to stimulate and support an individual demand, but to allocate resources to the needs of the collective well-being rather than of the individual well-having.

Public incentives should then support the transition of the most important manufacture towards this kind of production facility. And, for some sectors, the evolution could be almost natural: for example, the passage from the electromechanical productions, from the car, from the house-building respectively to the sectors of the new energy, the intermodal mobility, the

[13] Following the point of view that characterizes industrial societies, a high quality is associated to the capacity of energy to be totally converted, at least in principle, in work useful; as it is true for *kinetic energy*, *electric energy* and *Gibbs free energy* in the chemical transformations, and in all these cases exergy and energy coincide. Also *high temperature heat* is considered, for the same reason, a high quality energy, even though the *second principle of thermodynam-ics does not allow an its complete conversion into work.*

retraining urban, the soil conservation and so on. And the above mentioned transformations, as other similar, cause effects which cut across all the economy: an evolution accompanied, in all areas, by the full involvement of the seats of scientific and technological research, inserted in the context of the restructuring of the economic and productive plant.

The perspective of an ecological reconversion is not able, however, to take the necessary priority in the public awareness, to establish itself as a desirable alternative. No one wonders whether this step should be done with urgency to avoid disasters environmental, economic, political and human caused by the devastation and the untenability of the current development model.

Also numbers are important

Here then that the three twenty percent of the EU within the year 2020 – a real *energy revolution* that has become a reference for all governments in the world – is a target and a symbol of that urgency, but at the same time, in view of a targeted technological innovation, an extraordinary opportunity for the economy and for a change in the dominant model of production and consumption: the energy revolution launches the green economy, which is the industrial context, economic and social of that revolution.

More, suggesting and encouraging the decentralization of energy consumption in favor of sources locally available, in forms of a greater control by citizens up to the self-production and the self-management, gives rise, starting from the energy, to cultures and forms of a society in a better relationship with all the natural resources and their use by all people.

This revolution is already under way, in some manner, as evidenced by the data on the growth trend, exponential, that the renewables have had worldwide since 2000, despite the economic crisis that, instead, had devastating effects in traditional manufacturing sectors and has also produced a significant slowdown in growth rates of primary energy needs.

The numbers say much more than words. Almost all the following figures, if is not specified otherwise, are taken from the annual report "Global Status Report of 2015" [61], the most comprehensive collection of data and analysis on the prospects of renewable energy sources.

In 2014 the share of total energy consumptions in the world covered by renewable sources, including hydro, exceeded 19%, with 9% of "traditional" biomasses and 10.1% of "modern" renewables; by the end of 2014, renewable sources, including hydroelectric, accounted for 23% of global electricity consumptions (nuclear power 2.6%). At the end of 2014 the total output of renewables ascended to 1,712 GW (1 billion and 712 thousand kilowatts), split up as follows: 1055 Hydraulic, 433 from biomass, wind 370, 177 pho-

tovoltaic; to which they must be added 406 thermal GW for heating water with solar panels.

The growth of the renewables in 2014 has represented 58.5% of the global power, referring only to what has been added during the year: an incredible increase that has confined the set of all fossil fuels - oil, coal and gas - to represent not even 40% of the new energy capacity made available in 2014.

That trend has been marked and made possible, over the past last decade, by the soaring increase of new investments around the world: from 40bn (40 billion) US dollars (USD) in 2004 to 279 in 2011 and, despite a subsequent decline caused by the crisis, again USD 270bn in 2014. But Bloomberg New Energy Finance (BNEF) gives more favorable figures: USD 328,9bn in 2015 including also hydropower, 4% more than the previous year [62]; and surely it has to be recalled that *in the course of 2015 the oil price has collapsed about 70%.*

In this context the European Union has played a leading role, from USD 23.6bn in 2004 to 120 in 2011; but in 2015 investment fell to the lowest figure since 2006, with USD 58.5bn, down 18 percent from 2014. UK investment bucked the trend with a 24 percent increase, while Germany and France saw their investment levels fall by 42 and 53 percent respectively [62]. The leading role now has gone to China with over USD 110bn in 2015. In 2014 Asia and Oceania, excluding China and India, have made more than the United States; but in 2015 US came second after China with USD 56 bn [62]. Impressive has been the increment of investment rates of 2015 versus 2014, realized in some emerging or developing countries: Mexico up 114%, Chile up 157 %, South Africa up 329%, Africa and Middle East regions up 54% [62].

In early 2015, are 164 the countries that have committed themselves, with determined targets, in the field of renewables and 145, compared to 15 in 2005, who have matched with the objectives the policies for achieving those objectives. "*In developing countries, distributed renewable energy systems offer an unprecedented opportunity to accelerate the transition to modern energy services and to increase energy access*", says GSR 2015.

A consequence of this trend are the approximately 8 million jobs registered in 2014 in the various sectors of renewables, just under half of them in solar energy applications. Technological innovation is traditionally "labor-saving"; this has not been the case for renewable sources, their impact on employment has no precedent of equal intensity in the history of contemporary work.

In EU - 28 the average coverage of final consumptions of energy from renewable sources in 2013 was equal to 15%, making more credible the achievement of the 20% by 2020. For Italy, renewables accounted for 17% of final consumptions, that is, already centered the target by 2020 set for the country; and 31% of electricity consumptions, that is more than 26%, the target set by 2020. But the GSR stresses, right from the start of the Executive Summary: "*Although Europe remained an important market and a centre for innovation, activity continued to shift towards other regions. China*

again led the world in new renewable power capacity installations in 2014, and Brazil, India, and South Africa accounted for a large share of the capacity added in their respective regions. An increasing number of developing countries across Asia, Africa, and Latin America became important manufacturers and installers of renewable energy technologies."

■ Notes for an economy of sustainability

"But – someone objects – this energy revolution, and the green economy ,is a secondary issue, in which capitalism can afford to show the human face. The true face remains the one, rapacious and irresponsible, of the economic crisis triggered by a murderous finance."

Capitalism is historically capable of changing skin and innovate or adapt itself; these prerogatives are the guarantee of a long life, over periods entangled with the most diverse experiences: "*Capitalism has only few centuries ahead*", we said at the beginning with Giorgio Ruffolo. Nowadays capitalism is the subject of a profound transformation, that in recent decades is leading the more "advanced" nations – including India and China – from the era of the "*industrialism*" to that of the "*informationalization*", as our epoch has been defined by various scholars: *the switch between machines and factories and informatics and web* [63]. The path of this transformation is far from clear, but it would be wrong to be misled, not recognizing this trend because of the severity of the current economic crisis.

The energy revolution is very homogeneous and interlaced with the trend we have just outlined. Hadn't been the "dematerialization" of the productions (EEC Report by Saint Geours,1979), that had intuited and anticipated, exactly from the angle of energy, one theme that is increasingly emerging as the horizon of this century? Because, just looking at the figures of the energy consumptions and the changes in demand in the sectors of utilization, one would have had to expect, in industrialized countries, a "lightening" of the productions, a gradual emerge of "networks" instead of "blocks", a technological innovation which would have even more tended to replace machines, engines and clanking industrial processes with bits of information.

From the product point of view, the *green economy* is based, anyway, on an *eminently local access to resources or their production*, and on the production and use of *sustainable durable goods*, on average sensibly less expensive than the traditional ones, for buyers who moreover are becoming increasingly more familiar with the credit system. For these reasons then, the reluctance of investors to the consumption of *traditional durable goods*, such as "brick" and car, finds an alternative; in fact, the economic crisis leaves little money and a lot of justified fear against a finance often in the hands of greedy criminals. Instead, the *sustainable durable goods*, combining usefulness with the moral – let's think just of the solar panel that, hum-

ble, replaces a fossil fuel – can motivate the consumer, increasingly sensitive to the environmental issue: a function of "teaching" to the consumer in view of a rational evolution of what the economists define "preference". And this has already started to happen [64].

A full take-off of the green economy needs and will still need *public investment policies* in some sectors, which will be reduced when those assets will be able to stand on their own on the market. Next to the green economy there is another lever to be considered for public investment: expanding the "third market", that one in which *the use value counts more than the exchange value.* This market is already populated by a host of non-profit associations and of individuals for whom social services, cultural activities, production and fair trade constitute, at the same time, employment and social cohesion [64]. And just the *social cohesion* can become an element of competitiveness for enterprises, such as it has begun to be observable in Italy, perhaps for the typical features of the market benchmarks (excellence of peculiar local productions, tourism, fruition of old and charming traditions, culture and the immense heritage of arts) [65].

It's hard to get an overall picture, but the feeling is that these levers are enabling steps with a growing footprint in the world, mainly in developing countries.

Green economy and third market: *a bottom–up economic policy that finds its protagonists able to valorize resources and local networks, in a context of a greater intelligence in using natural resources and of a demand founded on needs and behaviors more collective* (groups instead of individuals) [64].

An overall effect would be a stronger dematerialization of production and, in particular, a significant reduction in fossil fuels. The world, as we have seen from the numbers, is already more advanced on this road than previously thought. If reducing fossil fuels consumption and saving technologies will have more weight over the next decade, if the world will accord with objectives increasingly stringent, such as those that are being discussed for a lower carbon society, fossil fuels would drop from the present figure, as primary supplies of 11 Gtoe (1 Gtoe = 1 billion of tons oil equivalent) to less than 7 Gtoe, with an impact on employment, technological innovation, and on the social and cultural dynamics, difficult to quantify in their positive amplitude.

To insist on energy conservation, and implement the best technologies for the actions of this kind, it is then a significant contribution to the education for sustainability, and not only to the objectives to be achieved or in order to avoid of going to fill the colander of the world energy system with sources other than fossil energies. At the basis of any principle of sustainability is indeed the appropriate and efficient use of all kinds of resources, where "efficient" and "appropriate" benefit from strict scientific definitions, not only but especially from Physics.

The market has moved differently, according to the easiest way that favors the introduction of new technologies more than the interventions, designed to reduce resources wasting and optimize the ways of processing energy and materials, then, more complex and requesting more capabilities and more clever organizational systems. In fact the market alone, also that which is self-oriented towards solutions of minor social and environmental damage, cannot do everything. There is the need of the government intervention in individual countries, as far as possible coordinated at the same end; there is the need of a global governance to guide and address the processes[14].

This overall action can also be very "weak", such as that which the United Nations and the various COP's have in fact carried out, but that, as we have already seen, it was enough to give an orientation, a drift.

The decisions to take, we hope, as implementation of the Paris Agreement will imply a great transformation – energetic, economic, social and cultural – that has to face to the heavy inertia of giant energy systems – oil, coal and gas – with their industrial, economic and financial interests, the colossal infrastructures and hundreds of millions of workers, employees or persons involved in that network of activities. The principal steps in order to drive the requested changes have to be accomplished in a time very tight in comparison with the actual dimensions of those energy systems, and, moreover, while the upset of climate is pressing.

Of course, energy revolution and green economy are not the socialism next future, if somewhere desirable; and we repeat that is out of our intention to pretend that our "modest proposal" be a way to a gradual transfer from the capitalist society to a socialist system, as says the historical illusion of the "Reformism": the assumption that an accumulation of reforms can lead to the emergence of an *entirely different* socio-economic system with new forms of democracy. Especially, energy revolution and green economy are not an adequate response to the imbalances and the growing inequalities – between North and South of the world, within social layers of the same stronger countries – that seem to be the distressing feature of our time. But they are a *necessary condition* to deal with some hope those imbalances, to face the need of *innovative products* with low environmental impact and high "social desirability", to ensure a decent existence to next generations. To keep alive a democratic perspective of development of civilization.

It's worth to repeat that the ecological reconversion of economy and society will have to face in the coming decades the increasing fluxes of immigration, mainly due to the escape of environmental refugees. The latter is a phenomenon that nowadays is partly concealed by the immigration caused by wars or by the general concern about the jihadist terrorism, but, evalu-

[14] "Global energy sustainability and security will require many vigorous actions at national levels, and considerable international cooperation. These actions and cooperative steps will need to be based on a widespread public support, especially in exploring avenues for increased efficiency of energy use." [21 b)].

ated to have already reached about fifty of millions of people, it has intended to become within the year 2050 a matter of hundreds of millions of people: a human flood. Nonetheless, and just for this last dramatic reason, the ecological crisis remains an exceptional opportunity for an effective response to the crisis both of the production system and of the proclaimed binomial growth/stability, to be pursued in the context of an environmental and social sustainability.

Not only finance. A sustainable utopia

All this surely does not cancel, in the next days, the trend that the process of social and economic crisis has assumed, even less the power of a yet uncontrolled finance. Some specific measures, albeit if partial, are however possible: first of all the restoration of the separation, in the bank activities, between investment and commerce; and, also, the Tobin tax. About taxes, the tax burden has to shift from labor to consumption of raw materials, especially the most polluting, and of soil. The carbon tax has been a paradigmatic example of this principle, and its application in Italy it was, however short, the most effective in Europe.

As far as Europe, the Eurobonds, almost disappeared from the debate, rather than being thought of as financial engineering instruments may instead become instruments, fully guaranteed by EU, *to finance the change of the production system in favor of the model we have just outlined*.

Further, it is crucial to give public support to the settling of the economy of sustainability, in line with the choices already made in the field of climate change and energy, and giving more power to EU economic policy. The latter certainly cannot be reduced to a "fiscal compact", and requires, we repeat, an Europe that is awakening from the nightmare of the austerity to become a political Europe. Even, maybe, starting from the formulation of policies of a sustainable and wide-ranging economics.

Large European public programs have to be developed. Before of the political and social disruption that has followed the "Arab Springs" of 2011, it was possible to dream the proposal of a large production of electricity, from the solar energy coming from countries of the southern Mediterranean coast, mainly funded by European public investment. A proposal worthy of attention not only from the point of view of the energy contribution.

Enough it to say that the *5 per thousand of the surface of the Sahara* is able to cover the electricity consumption of all Africa and of all EU, foreseen in 2030, *with solar technologies available today.* Several European companies, well aware of this potential, have created "*Desertec*", a project with the aim to achieve by 2050 the covering of the needs of the countries of the MENA region (Middle-East, North Africa), and, in addition, an export capacity amounting to 100 GW of solar thermal power. It is appropriate to

mention that other immense desert areas in the world, from the Gobi desert to the Australian one or the Atacama desert (Chile), can be a ground for the implementation of global policies, aimed to mitigate climate change with a completely similar valence of transformation of the energy model and of economic and social development.

We claimed several times in the past that this potential should have suggested to the EU the sponsorship of colossal communitarian projects – funded through ECB and EIB[15] bonds to this end released – to "pick up" the sun of the Sahara, not just for Europe, but to give, through projects shared from across the Mediterranean countries, energy, water and food to alleviate the unacceptable conditions of many African peoples; also at the light of the increasing masses of people pushed to abandon their territories not only by war and massacres but also by environmental conditions, Everyone can notice the great difference between "*Desertec*" and such a commitment, that would constitute the awakening of Europe from its Schäubleian hibernation for assuming finally an economic and political dimension in place of the practice of the hegemony of only one country [2].

Should be evident the enormous political difficulties, even limiting the political dimension and focusing mainly on technical, economic and social value of such a project: from the accounts that the EU should do with the type of presence of several of its member countries in the context of Africa and the Middle East, to the problems posed by the projecting of the wing of the "Caliphate" on the oil and ethnic conflicts in the name of an only one atrocious truth. But already before Al Baghdadi, from the conflicts in Mali and in Chad, from the ephemeral but bloody attempt to impose an empire Tuareg, the militiamen of Gaddafi which had left Libya in arms, or the exterminations operated in northern Nigeria by Boko Haram, up to the jihadist claim to impose the sharia in various regions of the Sahara, Libya first of all, as well in Syria or in Iraq, all these "difficulties" have not discouraged, if not to a lesser extent, the interests of large multinationals or the industrial and financial joint ventures from going on with extractions and processing, often making "convergent" to their purpose the policies of any single country.

It's a political overview and a role of greater responsibility and listening, to be assumed, especially in the Middle East: it is exactly this kind of capability, role and synthesis among the different impulses and different national interests, which, we believe, is the sense of the size and the political presence requested to Europe.

Today all this seems utopian, when barriers are raised against immigrants and the Schengen Accord is breaking up, but so, or worse, was seventy years ago when the "Ventotene Manifesto" was issued. Here we fly inevitably lower down; but the freedom and the international unity advocated

[15] European Central Bank. The European Investment Bank is a "policy-driven" bank whose shareholders are the member states of EU. EIB is a nonprofit long-term lending institution, the largest in the world, established in 1958 by the Treaty of Rome.

by the Manifesto would find a base, solid, upon economic and social policies which, released from the constraints of austerity, could take the size and role of international public projects such as those drawn by our utopia.

Projects that integrate a dimension of sustainability not only for the planned outputs, but, more generally, because they could result in a strong correction of the current "unsustainable" distortions of the market.

In fact, commitments of this size and of this economic impact could act as a corrective of the "*new economic imbalance*", as Giorgio Ruffolo has defined, several years ago, the major distortions of the global market on the example of the "*China who buys America*" [66]. China has made huge movements of capital to buy assets of the American market, "*for an amount equivalent to 20% of the total American debt*", to the detriment of one billion of workers, peasants and miners "*who have not been invested by the wave of development*" as in Shanghai or Beijing. The fact that "*two-thirds of world savings have flown towards the most indebted country in the World*", the United States, represents a new economic imbalance, at which China contributes so heavily and with deplorable social and ethical consequences [66]. It's worth to note that China was still in 2014 the largest foreign holder of U.S. debt, even though declining, with 1260 billion dollars [67].

On the contrary, interventions of gigantic size and with a politic purpose as the ones we have outlined, should significantly straighten the distortions by directing the savings not to the unearned income and the finance, but to a production characterizing a global socio-economic model more sustainable; global, we say, not only for the economic and social consequences but also for the production of renewable energy, replacement of fossil fuels, in order to mitigate the upset of climate.

An ecological reconversion of the economy and society should be supported and accompanied by a change in our lifestyle – many small but important actions connected together – able to yield *a true cultural leap.* But all these aspects, subject by time of a vast literature, cannot be developed now in these notes.

Here, we have claimed from the beginning an instance of global rationality, that we hope can become an inescapable reference for the economic theorists and, more, devoutly considered as the highest priority in the agendas of the major decision makers. We are not able to dispense moral maxims or recipes for happiness. We have only tried to show a road along which to proceed to prevent that the two walls of water flood us like the chariots of Pharaoh.

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The chariots of Pharaoh at the Red Sea

The crises of capitalism and of environment
A modest proposal towards sustainability

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The financial "bubble" with its destructive and lasting economic and social consequences, the bloody geopolitics of oil of the last decades, one sixth of the humankind under the threshold of surviving, the plunder of the resources of the Earth, the general environment crisis, dramatic for the climate change, exemplify in a too much persuasive way that capitalist democracies - as well as totalitarian States which have chosen the free market economy - are not able to face the two crises of our title. The present global situation recalls us the two walls in which the Red Sea had split: on one wall stays the economic crisis, that is tout court the capitalist crisis, on the other wall there is the predicament of environment. Then, it is reasonable to wonder if the walls will tumble down with severe damages to all the characters, unless a "modest proposal", of the kind that we will try to formulate in this paper, be intensively pursued.

La "bolla finanziaria" esplosa alcuni anni fa con conseguenze devastanti sul piano economico e sociale, la sanguinosa geopolitica del petrolio degli ultimi decenni, un sesto dell'umanità sotto la soglia di sopravvivenza, l'esaurimento delle risorse del Pianeta, la crisi ecologica generalizzata, drammatica per quanto riguarda il cambiamento climatico, esemplificano in modo più che convincente che tanto le democrazie capitaliste, che gli stati totalitari che hanno scelto l'economia del libero mercato, non sono in grado di fronteggiare queste crisi. L'attuale situazione globale ci ricorda i due muri in cui venne diviso il Mar Rosso: un muro è la crisi economica, che è tout court crisi del capitalismo, l'altro sono le minacce all'ambiente naturale. Quindi è ragionevole chiedersi se i due muri crolleranno, con conseguenze devastanti per tutti, a meno che si decida di perseguire una "modesta proposta", come quella che formuliamo in questo saggio, in cui poniamo particolare attenzione ai cosiddetti "cicli" economici e a un modello di stato stazionario, sia ecologico che economico.

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